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AG. 150 - INTRODUCTION TO THE AGRICULTURAL PLANT INDUSTRY

ELEMENTARY STUDY OF SOILS

AG 150 - A

UNIT OBJECTIVE

After completion of this unit, students should be able to select from a list reasons that soils are important. Students should also be able to discuss soil formation, physical properties and label layers of a soil profile. This knowledge will be demonstrated by completion of assignments sheets, laboratory exercises and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with soils to the correct definitions.
2. Select reasons that soils are important.
3. Discuss the function of soil as related to plant growth, development and maintenance.
4. Label a drawing showing the composition of an average soil.
5. Select factors that affect soil formation.
6. Name the four physical properties of soil.
7. Identify soil particles according to size.
8. List two methods used to determine soil texture.
9. Identify six kinds of soil structure.
10. Match terms indicating soil depth to their correct descriptions.
11. Match colors of soil to their correct descriptions.
12. Label an illustration showing the layers of a soil profile.
13. Identify on a pH scale the areas of acidity and alkalinity.
14. Discuss the liming of soils to correct soil acidity.
15. Name three types of alkali soils.
16. Discuss reclamation of alkali soils.
17. Use a textural triangle.
18. Determine soil textural class by mechanical analysis.
19. Determine soil textural class by feel.

ELEMENTARY STUDY OF SOILS

AG 150 - A

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Conserving Soil*, 16-page pamphlet including spirit masters and overhead transparencies; available from U.S. Department of Agriculture, Soil Conservation Service.

b. *Experiments in Soil Science*, 259 pages; available from VEP, Cal Poly State University, San Luis Obispo, California 93407; approximate cost $10.75; order no. 1-522-820.

c. *Idaho Soils Atlas*, 148 pages of Idaho soil series with color photos; available from University Press of Idaho, University of Idaho, Moscow, Idaho 83843.

d. *Implications of Acidification of Farmland in Northern Idaho*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $.35; order no. CIS 629.

e. *Liming Materials*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $.25; order no. CIS 787.

f. *The Relationship of Soil pH and Crop Yields in Northern Idaho*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $.35; order no. CIS 811.

g. *Salt- and Sodium-affected Soils*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $1.00; order no. EXT 703.

h. *Soil Characterization Laboratory Procedures Manual*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $10; order no. MS 122.

i. *Soil and Land Judging Handbook*, available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $.50; order no. MS 52.

j. *Soils*, instructional unit; available from Agri-Farm Publications, Inc., 1019 Market Street, Gowrie, Iowa 50543; approximate cost $19.50; order no. 211. Also available--soil class activity packet, approximate cost $8.25; order no. 1108; and soil guide, approximate cost $11.30; order no. 2106.

k. *University of Idaho Soils Handbook*, includes basic soils information and soils-related Current Information Series (CIS) publications published by the College of Agriculture; available from Agricultural Communications Center, Ag Publications Building, University of Idaho, Moscow, Idaho 83843; approximate cost $27.

2. Filmstrips, slideshows, etc.

   a. *Introduction to Soils*, 27 slides and cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $36.40; order no. D14.

   b. *Soil and Its Properties*, slides and script; available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Rd., Ohio State University, Columbus, Ohio 43210; approximate cost $16.75; order no. 50085.

   c. *Soil Color*, 47-frame filmstrip; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801; approximate cost $7.05; order no. F708.

   d. *Soil Components*, 34 slides and 22-minute cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $46.80; order no. D15.

   e. *Soil Moisture*, 21 slides and 38-minute cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $41.60; order no. D18.

   f. *Soil Structure*, 22 slides and 28-minute cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $41.60; order no. D17.

   g. *Soil Texture*, 44 slides and 34-minute cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $83.20; order no. D16.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information and assignment sheets, and laboratory exercises.

E. Discuss information and assignment sheets.

F. Demonstrate and discuss procedures outlined in laboratory exercises.

G. Arrange for a field trip to land site for evaluation.

H. Review and give test.

I. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Why Soils Are Important
2. TM 2--Soil-Plant-Animal Cycle
3. TM 3--Composition of Average Soil
4. TM 4--Soil Origins
5. TM 5--Physical Breakdown of Rocks
6. TM 6--The Relative Sizes of Sand, Silt and Clay Particles
7. TM 7--Soil Texture
8. TM 8--Characteristics of the Various Soil Classes
9. TM 9--Permeability Related to Nutrient Capacity
10. TM 10--The Texture Triangle
11. TM 11--Soil Structure
12. TM 12--Hard Pans Effect on Soil Depth
13. TM 13--Soil Profile
14. TM 14--pH Scale
15. TM 15--pH Scale - Relative Strength
16. TM 16--pH Scale - Familiar Products
17. TM 17—pH Scale for Soil Reaction
18. TM 18--pH Requirements of Crops
19. TM 19--Soil pH Governs Nutrient Release...

20. TM 20--Low pH Limits Root Growth

21. TM 21--Ion Exchange of Soil Particles

E. Assignment sheet

1. AS 1--Using the Textural Triangle

F. Answers to assignment sheet

G. Laboratory exercises

1. LE 1--Determine Soil Textural Class by Mechanical Analysis

2. LE 2--Determine Soil Textural Class by Feel

H. Test

I. Answers to test

III. Unit references

A. *Agronomy Curriculum Workshop*, Iowa State University, Department of Agricultural Education, Ames, Iowa, 1980.

B. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

C. *Crops, Soils, and Fertilizers Resource Manual*, Vo-Ed No. 73, University of Idaho, Department of Agricultural Education, Moscow, Idaho, 1978.

D. Donahue, Roy L., Follett, Roy H., Tulloch, Rodney W., *Our Soils and Their Management*, 5th edition, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1983.

E. Hartmann, Hudson T., et al., *Plant Science: Growth, Development and Utilization of Cultivated Plants*, 2nd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1988.

F. Knuti, Williams and Hide, *Profitable Soil Management*, 4th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

G. Loreen, C.O., *Our Soils: Their Management and Conservation*, Northwest Vocational Curriculum Management Center, Olympia, Washington, 1975.

H. *Oklahoma Curriculum Guides*, Oklahoma State University and the Oklahoma State Board for Vocational Education, Stillwater, Oklahoma.

I. *Resource Unit on Soils for Core Curriculum*, Montana State University, Agricultural and Industrial Education, Bozeman, Montana, 1975.

J. *Resource Unit on Soils for Core Curriculum*, No. 10, University of Arizona, Department of Agricultural Education, Tucson, Arizona, 1970.

K. *Soils Handbook*, University of Idaho College of Agriculture, Moscow, Idaho 83843, 1988.

L. *Soils Unit for the Plant Science Core Curriculum*, Vol. 9, No. 7, University of Missouri - Columbia, Instructional Materials Laboratory, Columbia, Missouri.

M. *Texas Curriculum Guides*, Vocational Instruction Services, Texas State Board for Vocational Education.

N. *Western Fertilizer Handbook*, 6th edition, California Fertilizer Association, Interstate Printers and Publishers, Danville, Illinois, 1980.

ELEMENTARY STUDY OF SOILS

AG 150 - A

INFORMATION SHEET

I. Terms and definitions

A. Soil--The mineral and organic matter that supports plant growth on the earth's surface; it is a mixture of particles of rock, organic materials, living organisms, air and water

B. Mineral matter--General term for the inorganic elements in the soil, for example: nitrogen, phosphorus, potassium

C. Organic matter--General term for plant and animal material in or on the soil in all stages of decomposition

D. Parent material--The rock and other unconsolidated material from which the soil has developed

E. Soil texture--A name given a textural group based on the relative proportions of the various soil separates (sand, silt and clay)

F. Soil structure--The combination or arrangement of soil particles into aggregates

G. Aggregate--Mass or cluster of soil particles such as a clod, crumb or granule

H. Soil depth--Total thickness of a soil from the topsoil to the parent material

I. Soil color--Indication of the amount of organic matter and moisture of the soil

J. Soil profile--A vertical cross-section of the soil from the surface through all its horizons

K. Soil horizon--A layer of soil approximately parallel to the land surface, differing from other layers in color, structure, texture, pH, etc.

L. Topsoil--The "A" horizon of the soil profile; dark colored upper layer of soil that may vary from several inches to 2 or more feet thick

M. Subsoil--The "B" horizon of the soil profile; the layer of soil directly beneath the topsoil

N. Acid soil--Soil with a pH of less than 7.0; for practical purposes, a soil with a pH of less than 6.6

O. Alkaline soil--Soil having a pH value of greater than 7.0; for practical purposes, a soil having a pH above 7.3

P. Leaching--Removal of water soluble soil components from the soil by the downward action of water

Q. Reclamation--Restoration to a better or useful state, as of wasteland, desert, alkali, etc.

R. Cation--An ion that has lost an electron and has a positive (+) charge, for example: potassium, calcium and magnesium

(Note: Cations are positively (+) charged and attracted to negative (-) sites on clays and organic matter.)

S. Anion--An ion that has gained an electron and has a negative (-) charge, for example: nitrogen, phosphorus and sulphur

(Note: Anions are negatively (-) charged and attracted to positive (+) sites.)

T. Exchange capacity--The ability of a soil to absorb ions to the surface of the soil particle

(Note: Cation exchange capacity is most important in agricultural soils. Anion exchange is very low and confined to low pH soils.)

II. Importance of soils (Transparencies 1, 2)

A. Plants grow in and on soil

B. Plants support animal life

C. Plants and animals support human life

D. World population is rapidly increasing and/or has inadequate nutrition

E. Supply of productive soil is limited

F. Improved soil management could feed more people

III. Function of soil as related to plant growth, development and maintenance

A. Media for seed germination

B. Media for support of plants

C. Storehouse of plant nutrients

D. Storehouse of water for the plant

IV. Soil composition (Transparency 3)

A. Solids--Approximately 50%

1. Mineral matter

2. Organic matter

3. Living organisms

B. Pore space--Approximately 50%

1. Water

2. Air

V. Factors affecting soil formation (Transparencies 4, 5)

A. Parent materials (Transparency 4)

1. Residual

a. Igneous--Derived from molten materials in the center of the earth's crust (granitic, basaltic)

b. Metamorphic--Formed from the pre-existing rocks through the action of extreme heat and pressures (quartzite, schist)

c. Sedimentary--Formed from sediments deposited by wind, water or ice (shale, sandstone, limestone)

2. Transported

a. Wind (loess)

b. Water (alluvial)

c. Glaciers (glacial drift)

d. Gravity (colluvial)

B. Decomposition by weathering

1. Physical weathering (Transparency 5)

a. Wind

b. Plants and animals

c. Heating and cooling

d. Freezing and thawing

e. Wetting and drying

2. Chemical weathering--Chemical reactions of water, oxygen and carbon dioxide

3. Biological weathering--Micro-organisms secrete a gummy substance which aids in decomposing rocks

C. Climate

1. Temperature

2. Rainfall

D. Vegetation and organisms

1. Plant--Lichens, mosses, weeds, grasses, shrubs, trees

2. Animal--Bacteria, fungi, large animals (cattle, horses, etc.) birds, man

E. Slope and drainage

1. Hillsides

a. Thin topsoil due to soil loss by erosion

b. Reduced plant growth

c. Low organic matter

d. Less leaching (due to runoff)

2. Flat lands

a. Deeper topsoil

b. More vegetation

c. High organic matter

d. Greater leaching

VI. Physical properties of soil

A. Soil texture

B. Soil structure

C. Soil depth

D. Soil color

VII. Soil particles (Transparencies 6, 7, 8, 9)

A. Sand

1. Diameter--2.00 to 0.05 mm

2. Coarse and gritty

3. When moist, individual grains can be seen

4. Its presence decreases water-holding capacity

5. Its presence decreases nutrient holding capacity

B. Silt

1. Diameter--.05 to .002 mm

2. Its presence increases water-holding capacity

3. Its presence increases nutrient holding capacity

4. Moderate to high exchange capacity

5. Feels smooth and velvety

C. Clay

1. Diameter--less than .002 mm

2. Its presence increases water-holding capacity

3. Its presence increases nutrient holding capacity

4. High to very high exchange capacity

VIII. Methods used to determine soil texture

A. Mechanical analysis (Transparency 10)

1. A mechanical analysis of a soil reports the percentage of each of the soil particles (sand, silt and clay)

2. Percentages can be applied to the texture triangle to determine the texture of a soil

B. Feel method

1. Texture is determined by moistening the soil and rubbing between thumb and fingers

a. The wet sample is worked into a ball and placed between thumb and index finger; the thumb is pushed gradually forward in an attempt to form the soil into a ribbon (clayey soil)

b. If the wet sample will not form a ribbon, evaluate for grittiness (sandy soil)

c. Evaluate wet sample to determine if it feels velvety and slick, but will not ribbon (silty soil)

2. Descriptions of soils of different texture using the feel method (Laboratory Exercise #2)

   a. Sandy soil

      (1) Coarse and gritty

      (2) When moist, individual grains can be seen

      (3) Called a "light" soil

   b. Silty soil

      (1) Feels smooth, flowing when dry

      (2) Feels velvety or slick when wet

   c. Clayey soil

      (1) Sticky and will form a ribbon when wet

      (2) Very hard when dry

      (3) Called a "heavy" soil

IX. Types of soil structure (Transparency 11)

A. Granular (sphere shaped)--Ideal for plant growth

B. Blocky (sharp and angular faces)

   1. Water storage good

   2. Circulation of air and water is poor

C. Platy (flat, horizontal, plate-like)--Poor permeability

D. Prismatic and columnar (column-like)--Poor air-water relationship

E. Single grain

F. Massive

X. Soil depth (Transparency 12)

A. Depth refers to the total thickness of a soil from the topsoil to the parent material

B. Common measurements are

1. Very deep--over 60" deep

2. Deep--40" to 60" deep

3. Moderately deep--20" to 40" deep

4. Shallow--10" to 20" deep

5. Very shallow--less than 10" deep

(Note: The productive ability of land largely depends upon its depth of soil. Deep soils are necessary to provide the needed water and nutrients for favorable plant production. Shallow soils have a limited capacity for plant nutrients, water and root development.)

XI. Soil color

A. Color is an important characteristic used in the identification of soil conditions that affect the value of land for agricultural uses

B. Influenced mainly by organic matter content; benefits of organic matter include

1. Makes soil porous

2. Supplies nitrogen and other nutrients to the plant

3. Holds water in the soil

4. Reduces leaching

5. Improves soil structure

C. Soil colors

1. Dark brown to black--Regarded as the most productive; usually contains a higher organic matter content

2. Red or reddish brown--Usually less fertile than black or dark brown soils; may contain a high iron content

3. Yellow or gray--Usually caused by imperfect drainage

XII. Soil profile (Transparency 13)

A. Components of the soil profile

1. The "A" horizon

2. The "B" horizon

3. The "C" horizon

B. Characteristics of the soil horizons

1. The "A" horizon

a. It includes the upper part of the profile in which life is most active; generally called the topsoil

b. It is the most productive horizon because of its normally high organic matter content and is usually dark colored

c. May be from a few inches to a foot or more deep

d. Lighter in texture than the "B" or "C" horizons

e. More likely to have granular structure than the other horizons

2. The "B" horizon

a. Generally called the subsoil

b. Usually lower in organic matter and lighter in color than "A" horizon

c. Usually red or yellowish in color

d. Structure is less desirable than the "A" horizon; it may have a blocky or prismatic structure

e. Frequently heavier texture than "A" horizon

3. The "C" horizon

a. Generally called parent material

b. It is the deepest of the three major horizons

c. Usually very low in organic matter

d. Usually no structure

XIII. Acidity or alkalinity (Transparencies 14, 15, 16, 17, 18, 19, 20, 21)

A. The acidity or alkalinity of the soil solution is determined by the relative number of hydrogen (H^+) ions and hydroxyl (OH^-) ions

B. When a soil solution contains more H^+ ions than OH^- ions, it is acidic. When the OH^- ions are more abundant, the solution is alkaline. A neutral solution has an equal amount of H^+ and OH^- ions

C. The acidity or alkalinity is expressed in pH values

D. pH ranges on a scale from 1 to 14

1. 1 to 7--Acidic soil

2. 7--Neutral soil

3. 7 to 14--Alkaline soil

(Note: Acidity or alkalinity exert a great influence on the availability of plant nutrients. Plants grow best in pH range 6.0 to 7.5. Poor plant growth is the usual result at pH less than 5.2 or greater than 8.3.)

XIV. Liming soils

A. Soil acidity can be corrected by adding lime to the soil. The function of lime is to neutralize the hydrogen (H^+) ions that cause soil acidity

B. Amount of lime to apply depends on

1. The degree of acidity of the soil

2. The crops to be grown

3. The grade or purity of the lime materials

4. The frequency of application

5. Soil texture

6. Soil exchange capacity

XV. Types of alkali soils

A. Saline--Soils in which there has been an accumulation of soluble salts, for example: NaCl (table salt); these are referred to as "white alkali" soils

B. Sodic--Soils in which there has been an accumulation of sodium (Na); sodium affected soils have low permeability to water

(Note: Sodium can solubilize organic matter in the soil. In some instances this happens and the solubilized organic matter is carried to the surface. When dry, this leaves a dark crust on surface of soil. This is called "black alkali" soil.)

C. Saline-sodic--Both salty and sodic affected

(Note: The presence of either salt or sodium greatly affects the potential of a soil for crop production purposes. Their presence affects the water and nutrient uptake by the plant.)

XVI. Reclamation of alkali soils

A. Saline

1. Flood with water and leach out salts

2. Install drainage tiles to remove accumulated salts

3. Grow salt tolerant crops

B. Sodic

1. Apply gypsum ($CaSO_4$)

2. Grow sodic tolerant crops

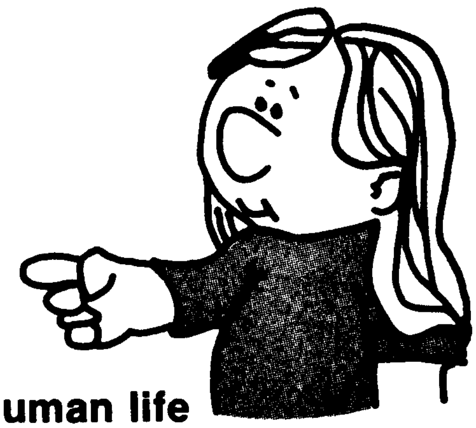
C. Saline-sodic

1. First correct sodic

(Note: This should be done first because of the poor permeability effect of sodium on the soil. This makes leaching of the salts difficult.)

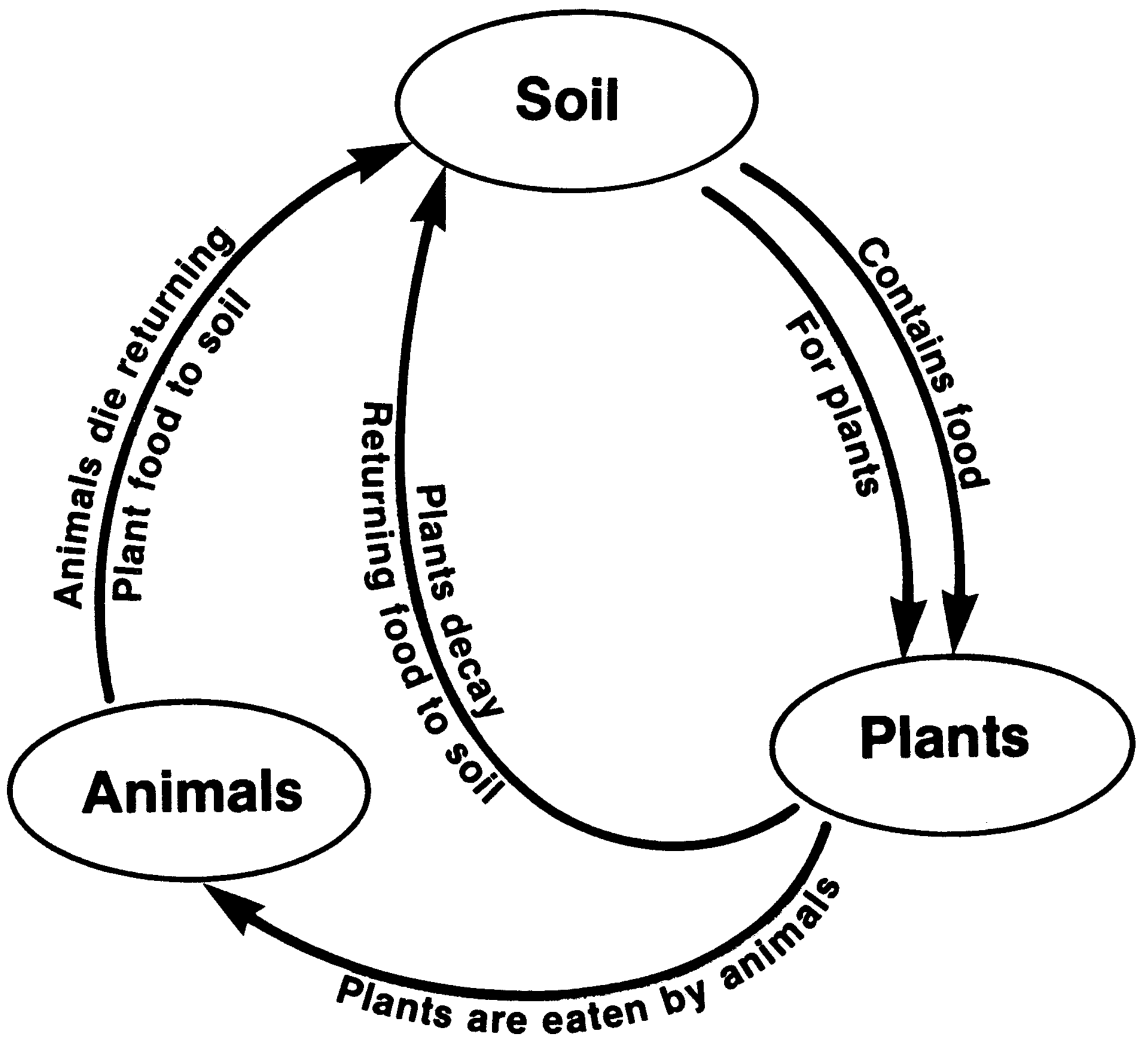
2. Then correct salt problem

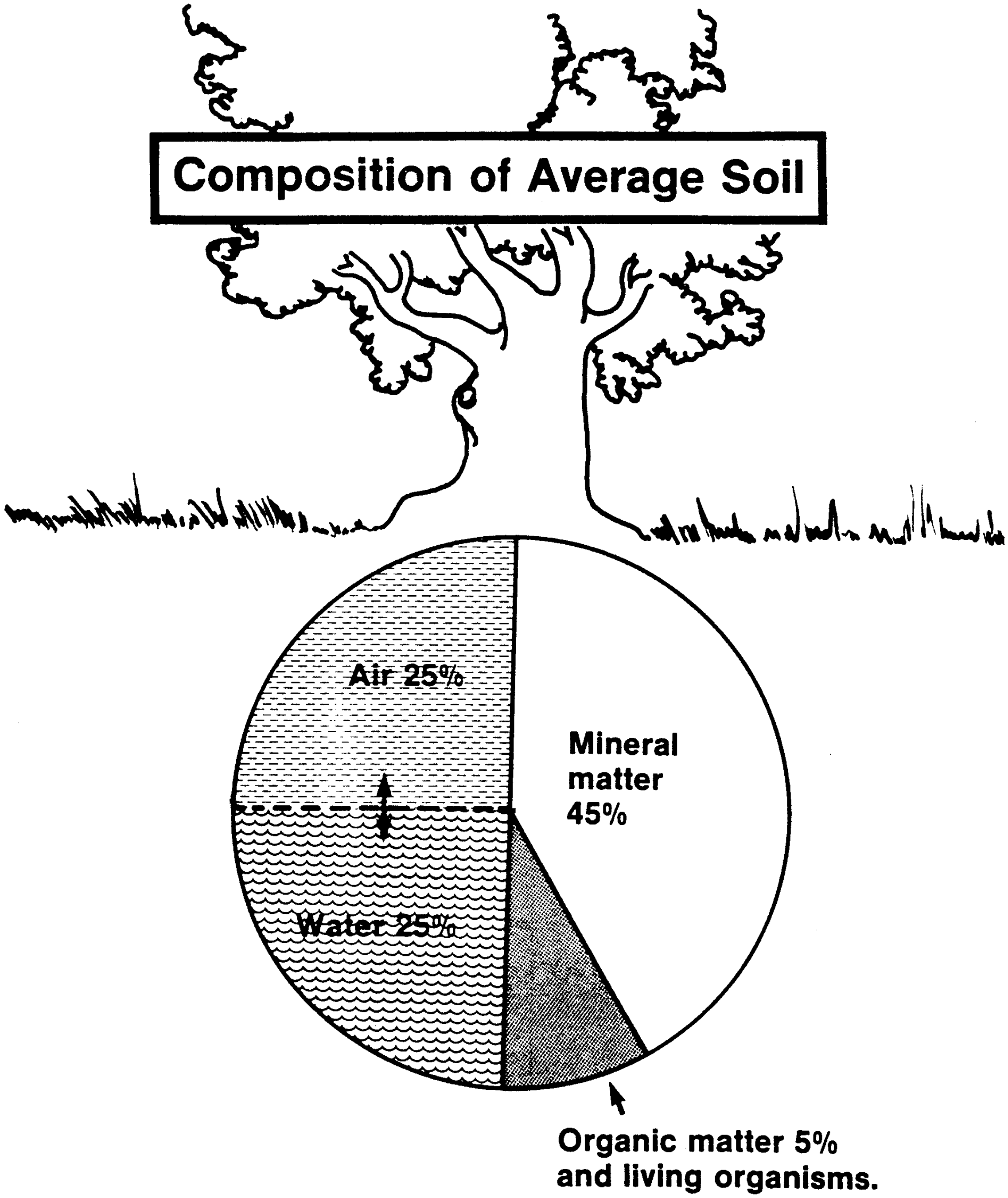
Why Soils Are Important

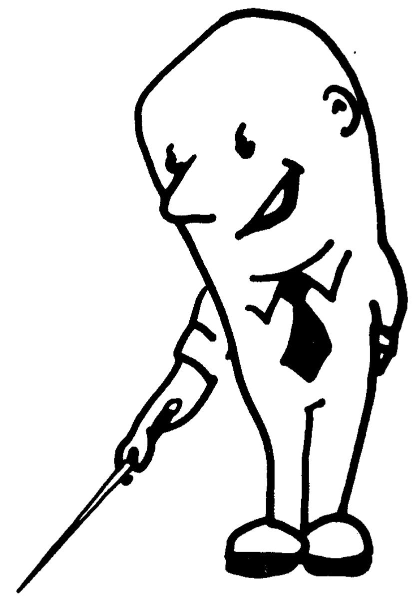


1. Plants grow in and on soil
2. Plants support animal life
3. Plants and animals support human life
4. World population is rapidly increasing and/or has inadequate nutrition
5. Supply of productive soil is limited
6. Improved soil management could feed more people

Soil-Plant-Animal-Cycle




Composition of Average Soil
Air 25%
Mineral
matter
45%
Water 25%
Organic matter 5%
and living organisms.



Soil Origins

1. Residual

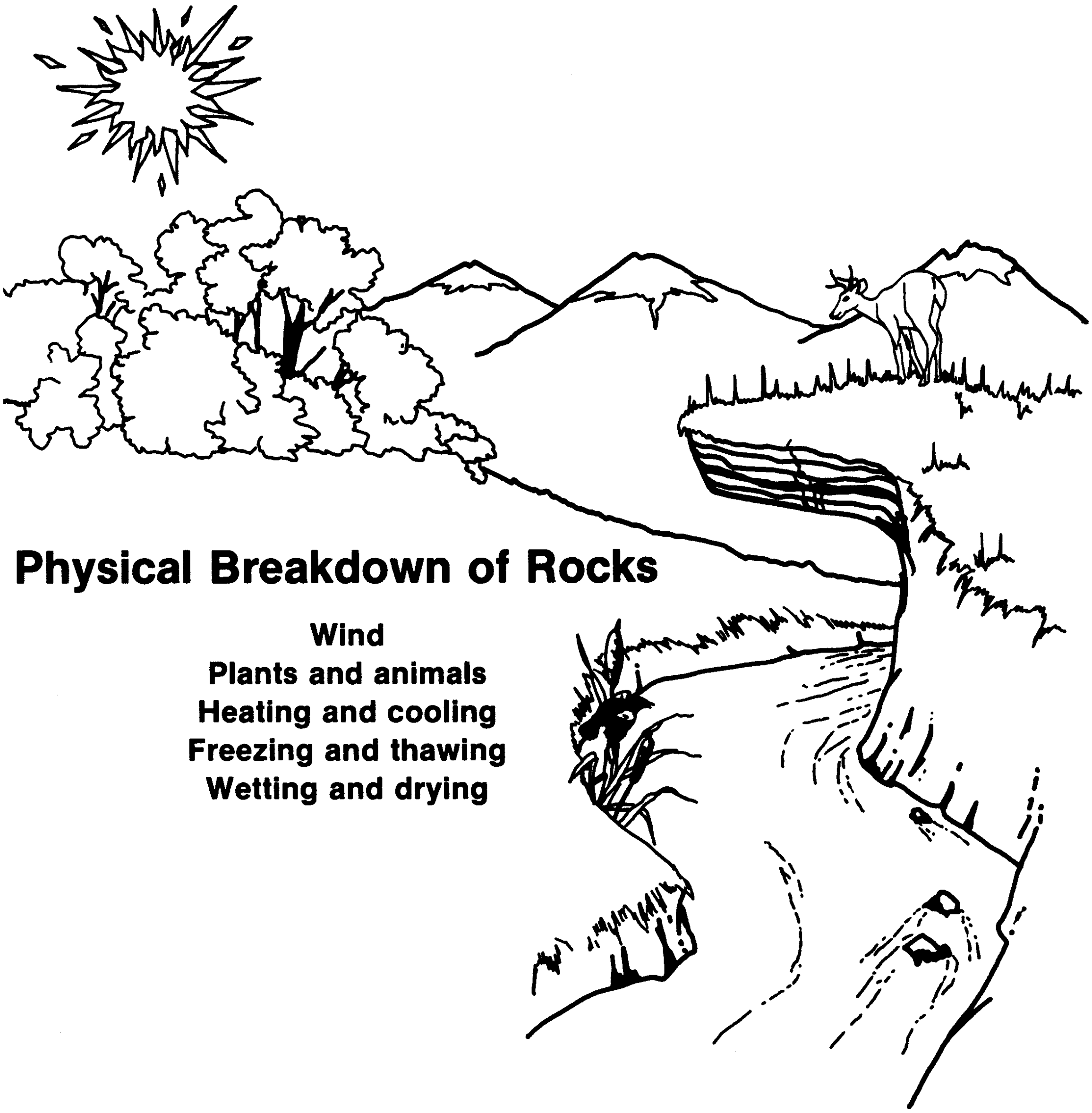
- a. Igneous
- b. Sedimentary
- c. Metamorphic

  (a–c) From rock

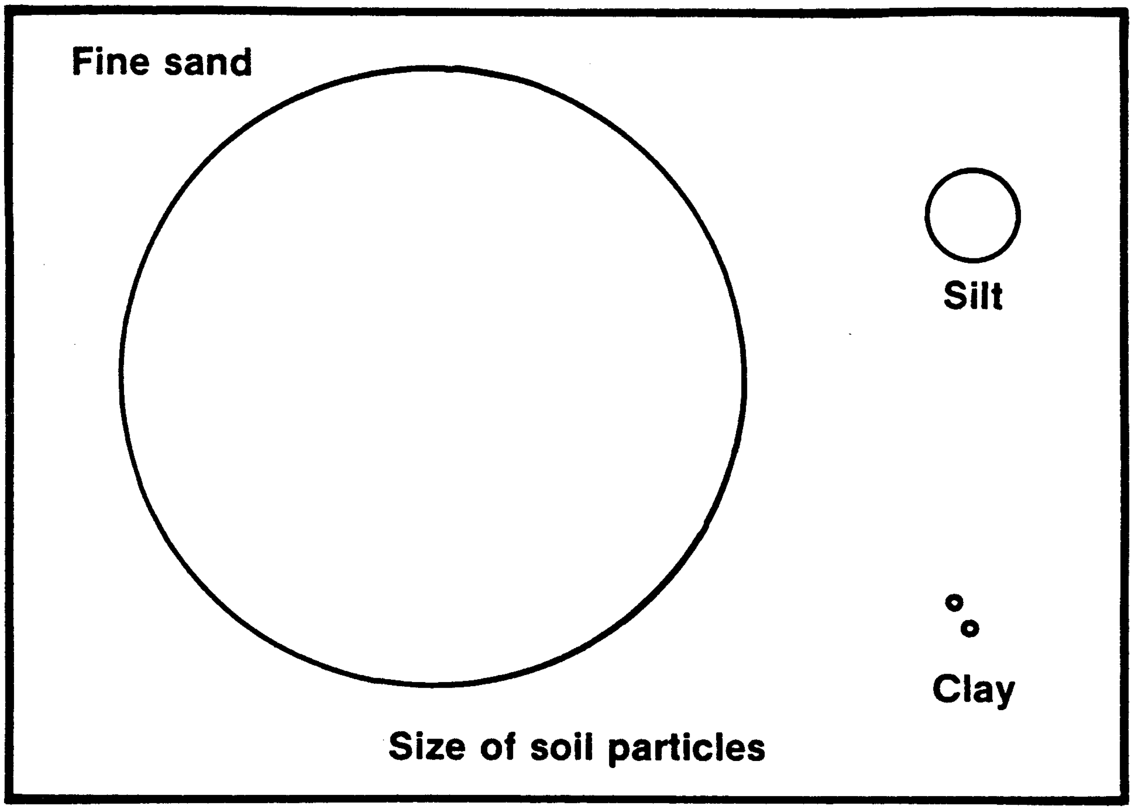
- d. Organic - peat (from plant life)

2. Transported

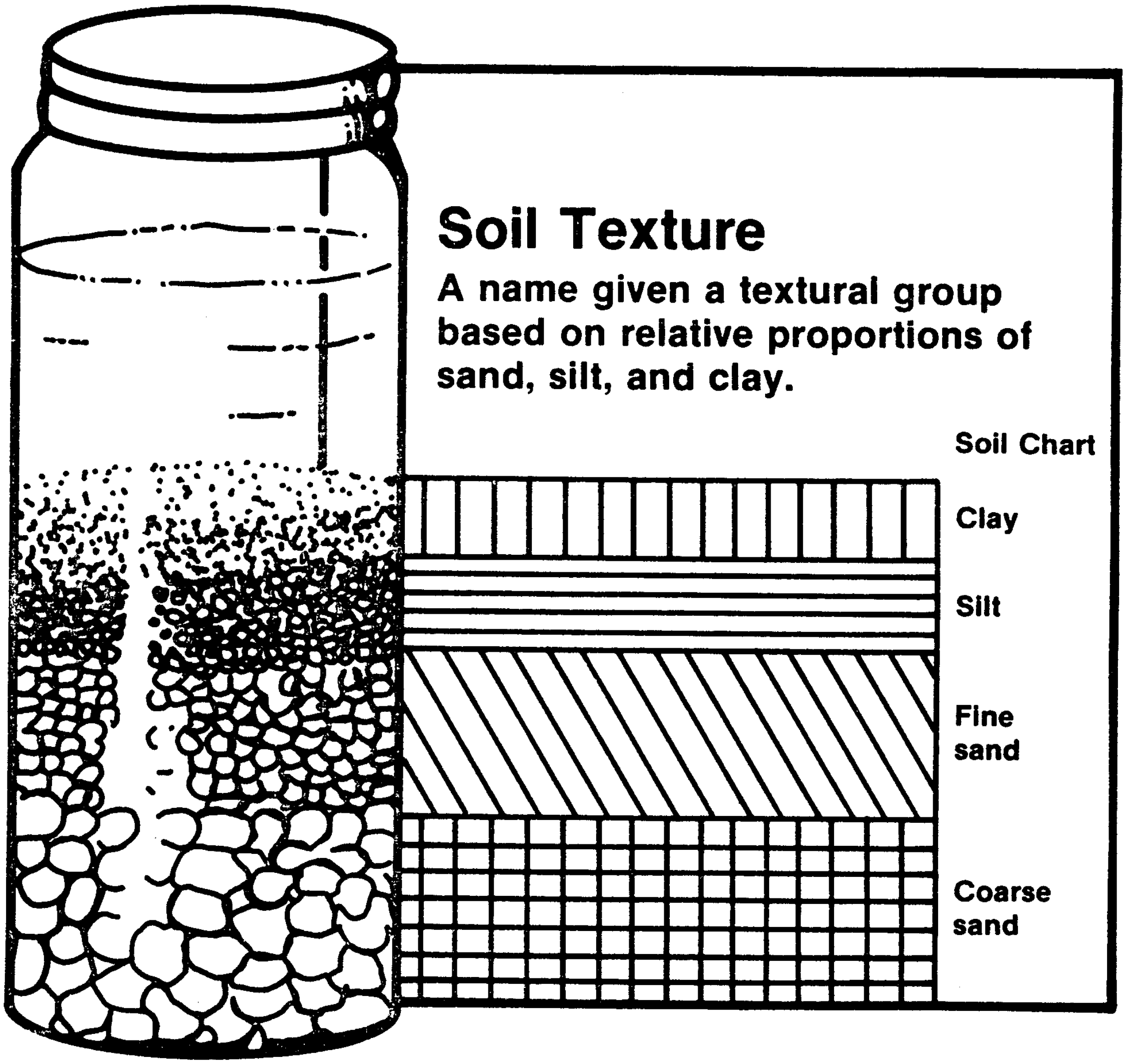
- a. Wind (loess)
- b. Water (alluvial)
- c. Ice (glacial till)


Physical Breakdown of Rocks
Wind
Plants and animals
Heating and cooling
Freezing and thawing
Wetting and drying

The Relative Sizes of Sand, Silt, and Clay Particles



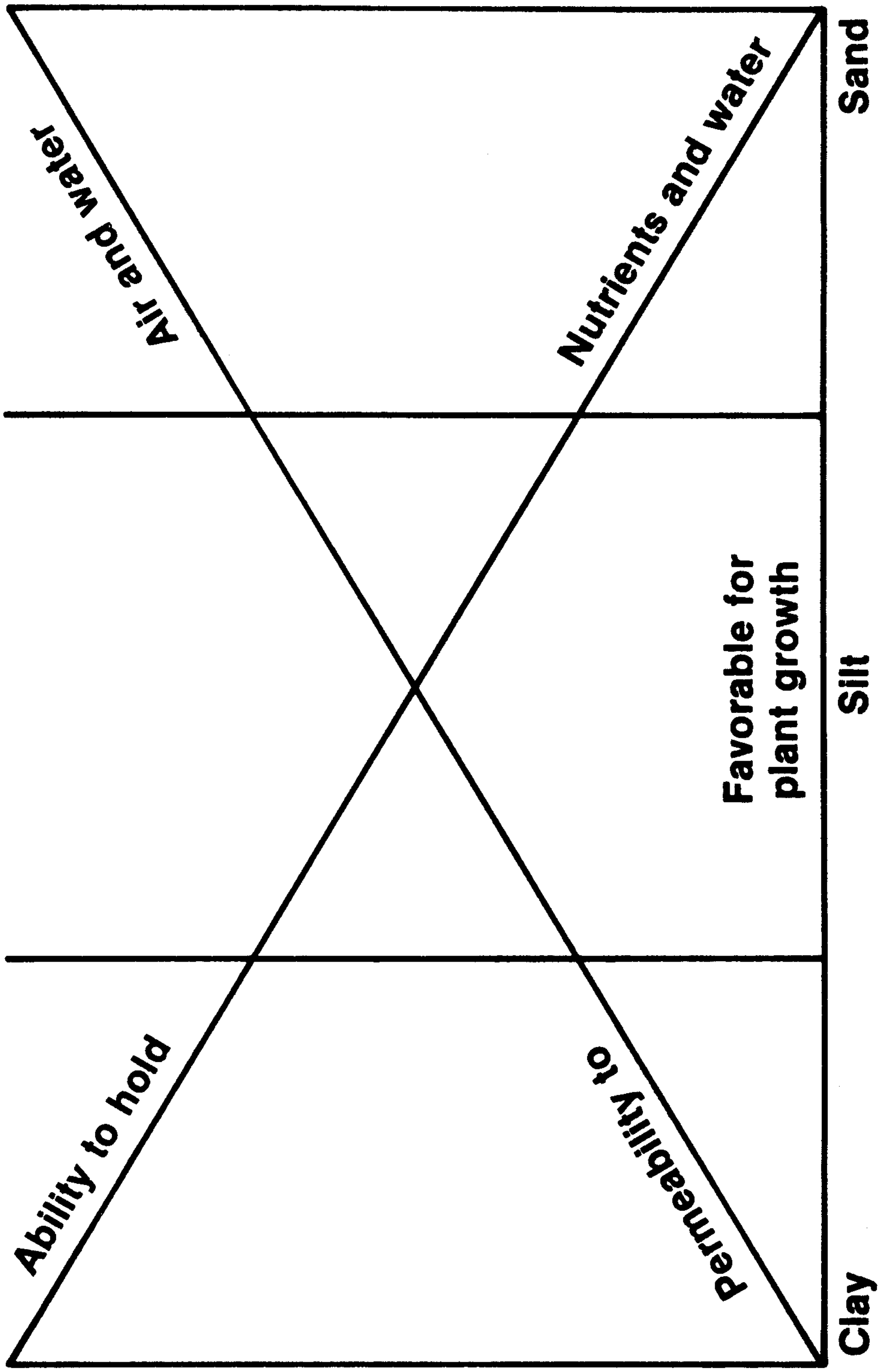
Name	Size, diameter in millimeters
Fine gravel	2 - 1
Coarse sand	1.00 - 0.50
Medium sand	0.50 - 0.25
Fine sand	0.25 - 0.10
Very fine sand	0.10 - 0.05
Silt	0.05 - 0.002
Clay	Less than 0.002


Soil Texture
A name given a textural group based on relative proportions of sand, silt, and clay.
Soil Chart
Clay
Silt
Fine sand
Coarse sand

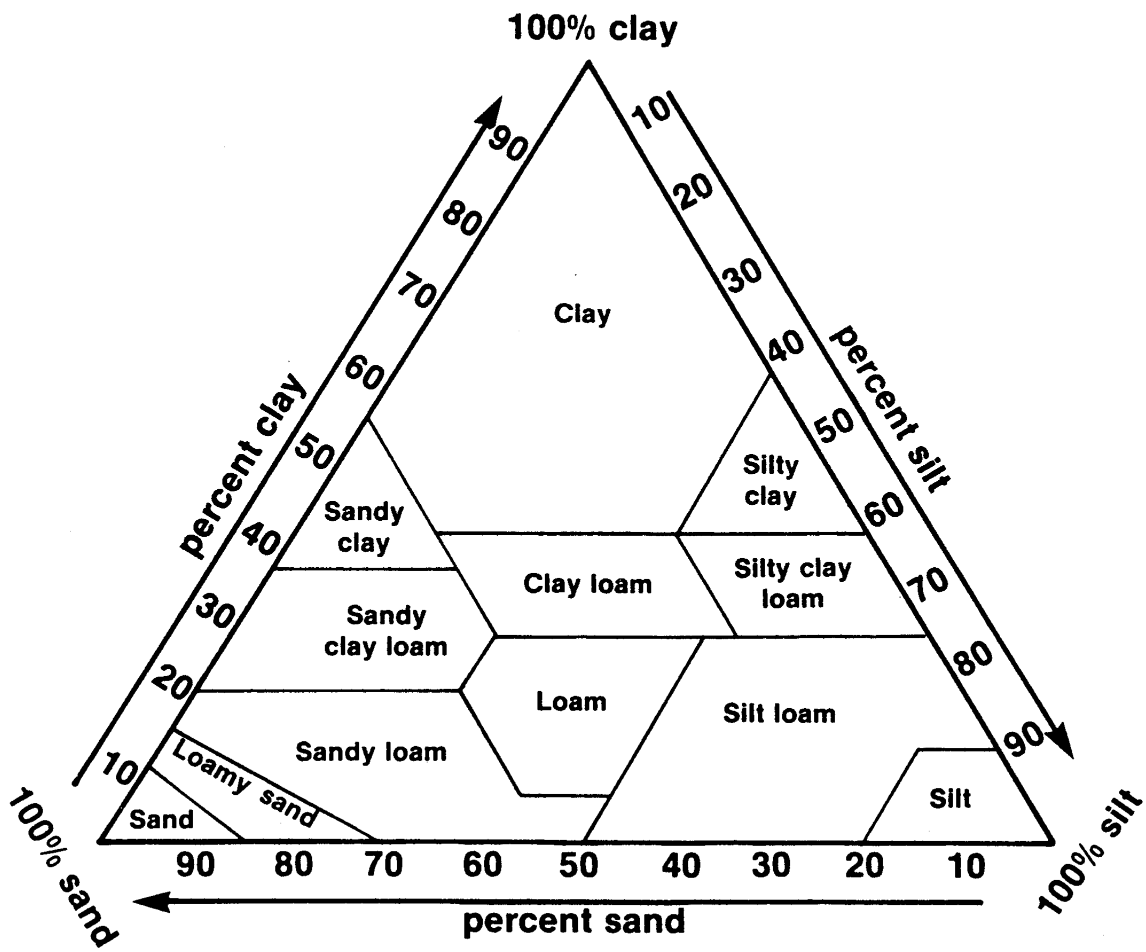
Characteristics of the Various Soil Classes

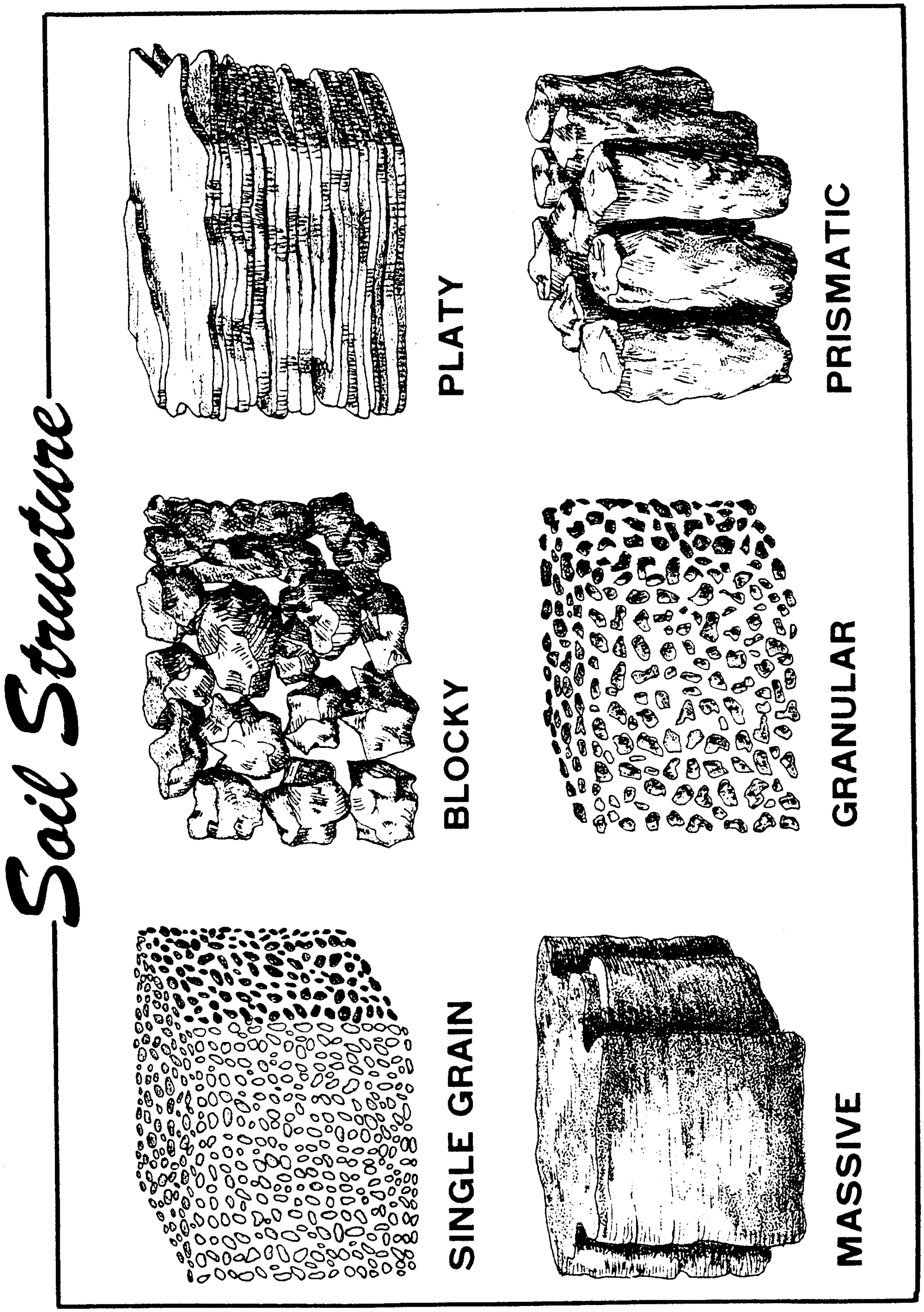
Characteristics	Sand	Silt	Clay
Looseness	Good	Fair	Poor
Air space	Good	Fair to Good	Poor
Drainage	Good	Fair to Good	Poor
Tendency to form clods	Poor	Fair	Good
Ease of working	Good	Fair to Good	Poor
Moisture holding capacity	Poor	Fair to Good	Good
Fertility	Poor	Fair to Good	Fair to Good

Permeability Related to Nutrient Capacity

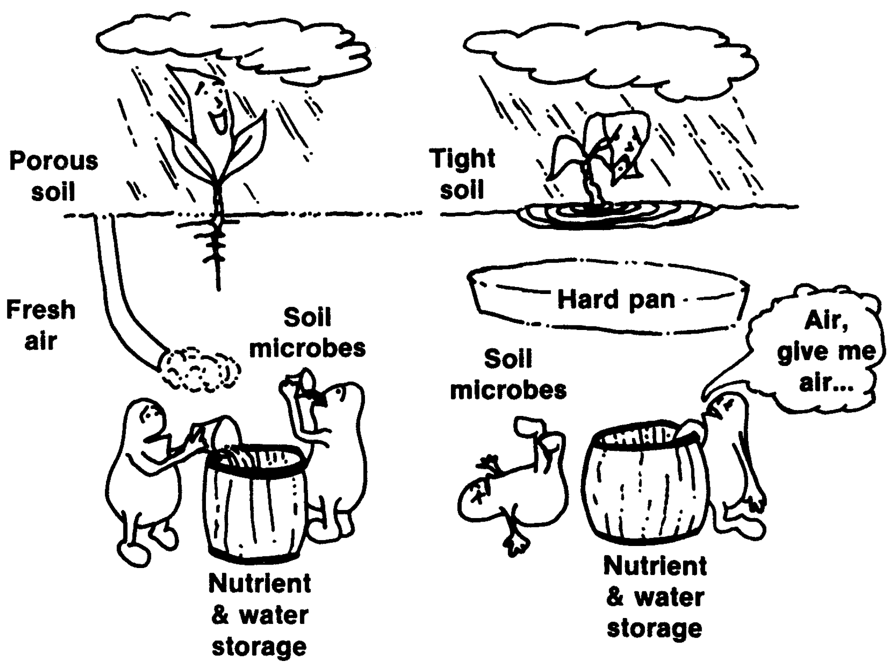


The Texture Triangle

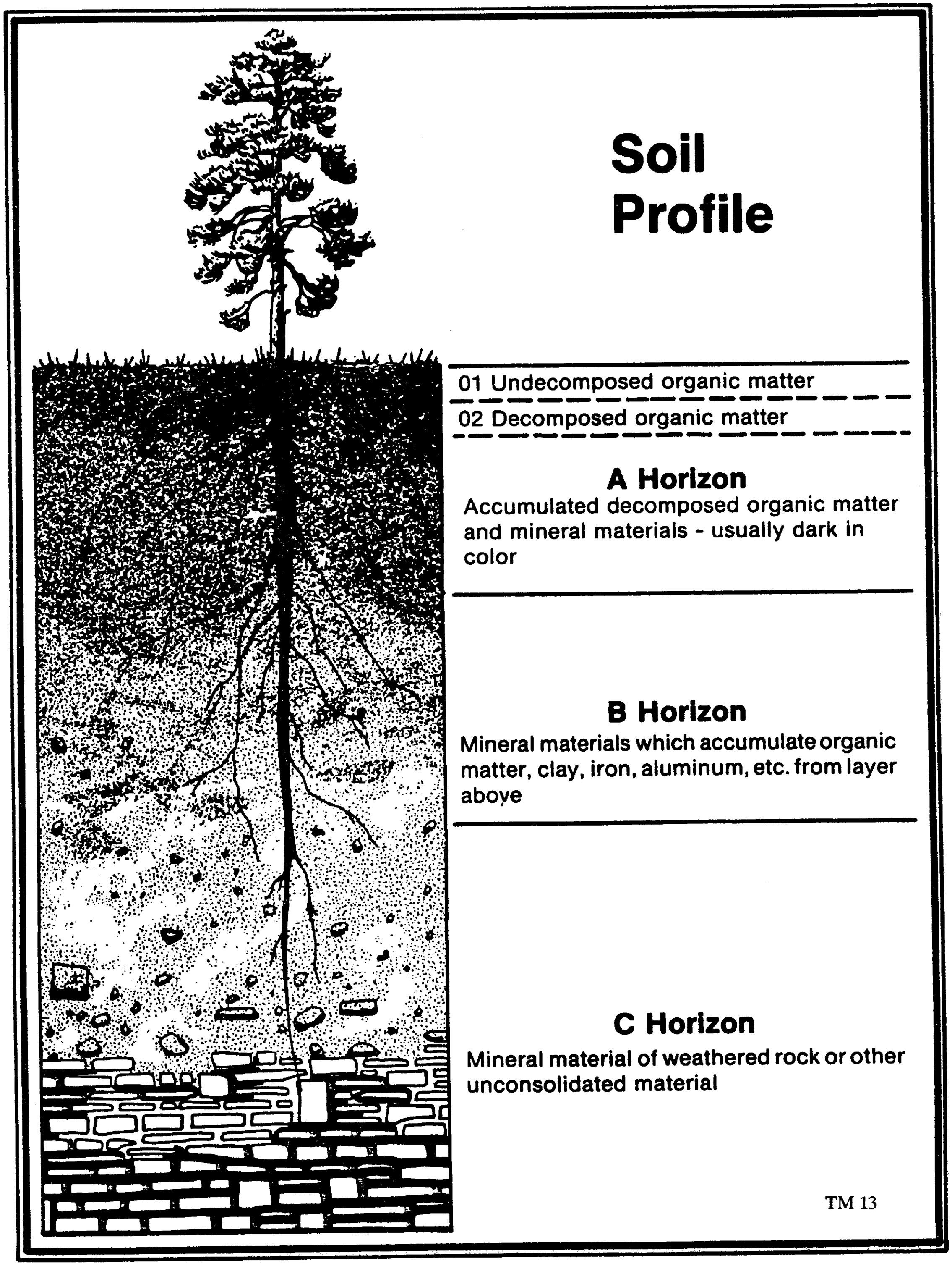


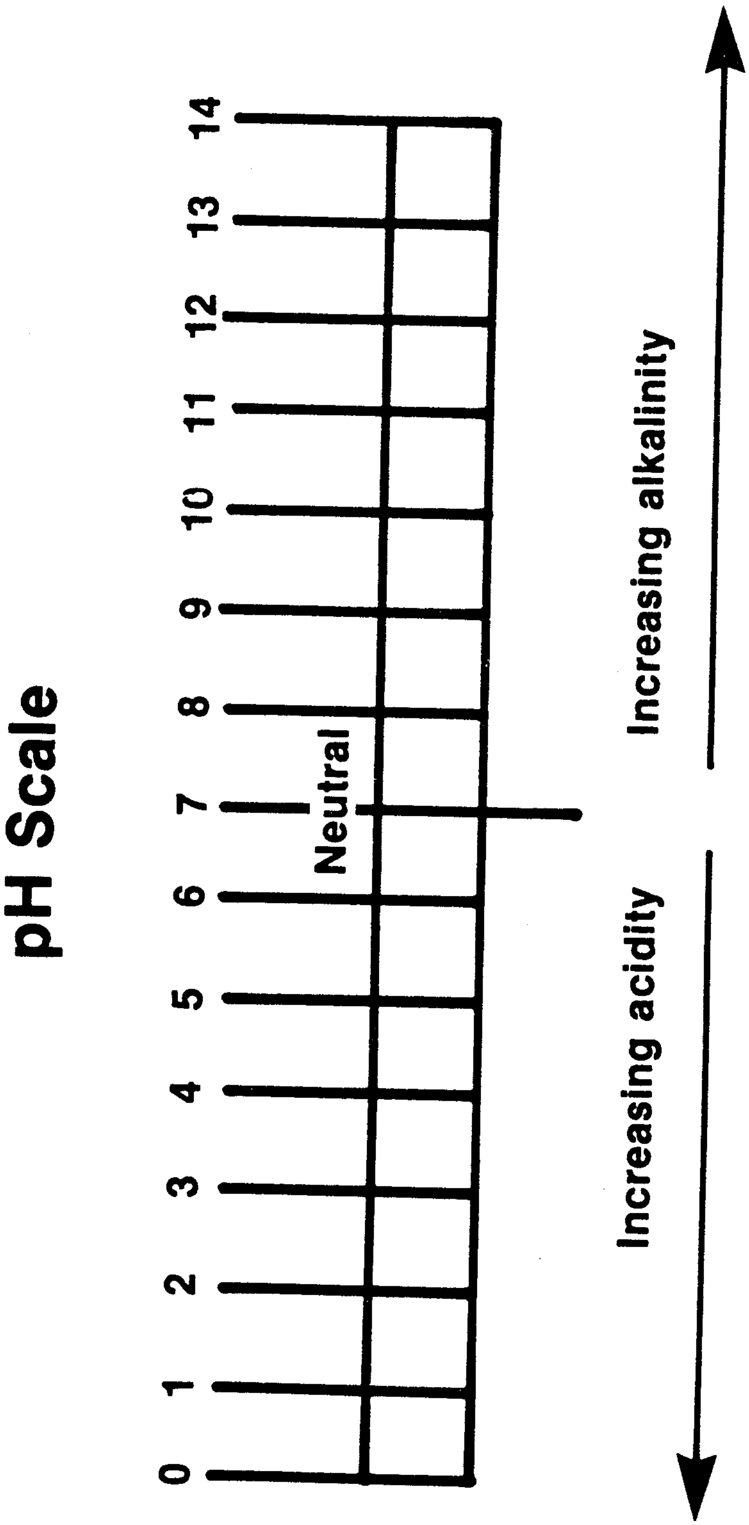

Soil Structure
SINGLE GRAIN
BLOCKY
PLATY
MASSIVE
GRANULAR
PRISMATIC

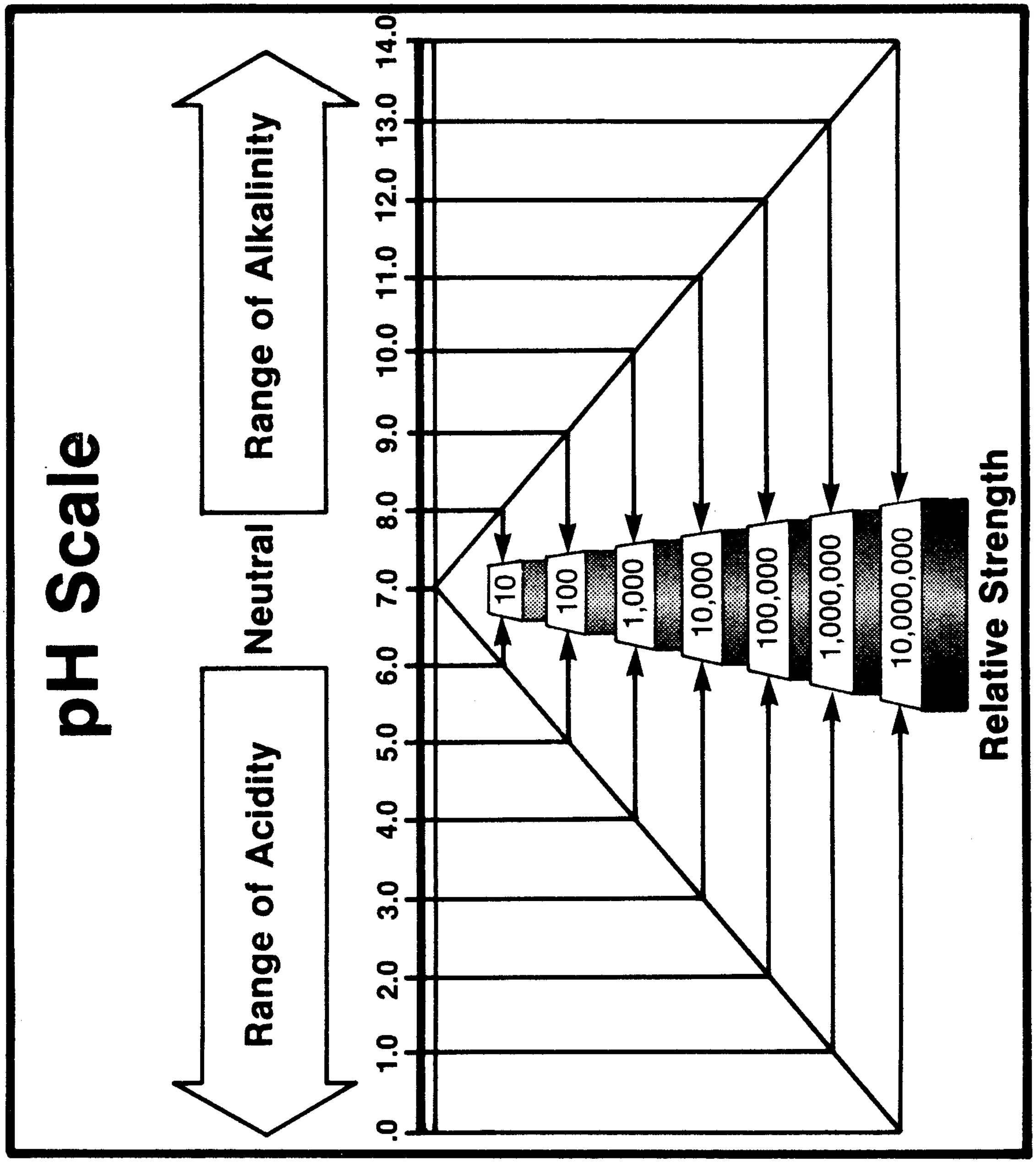
Hard Pans Effect On Soil Depth



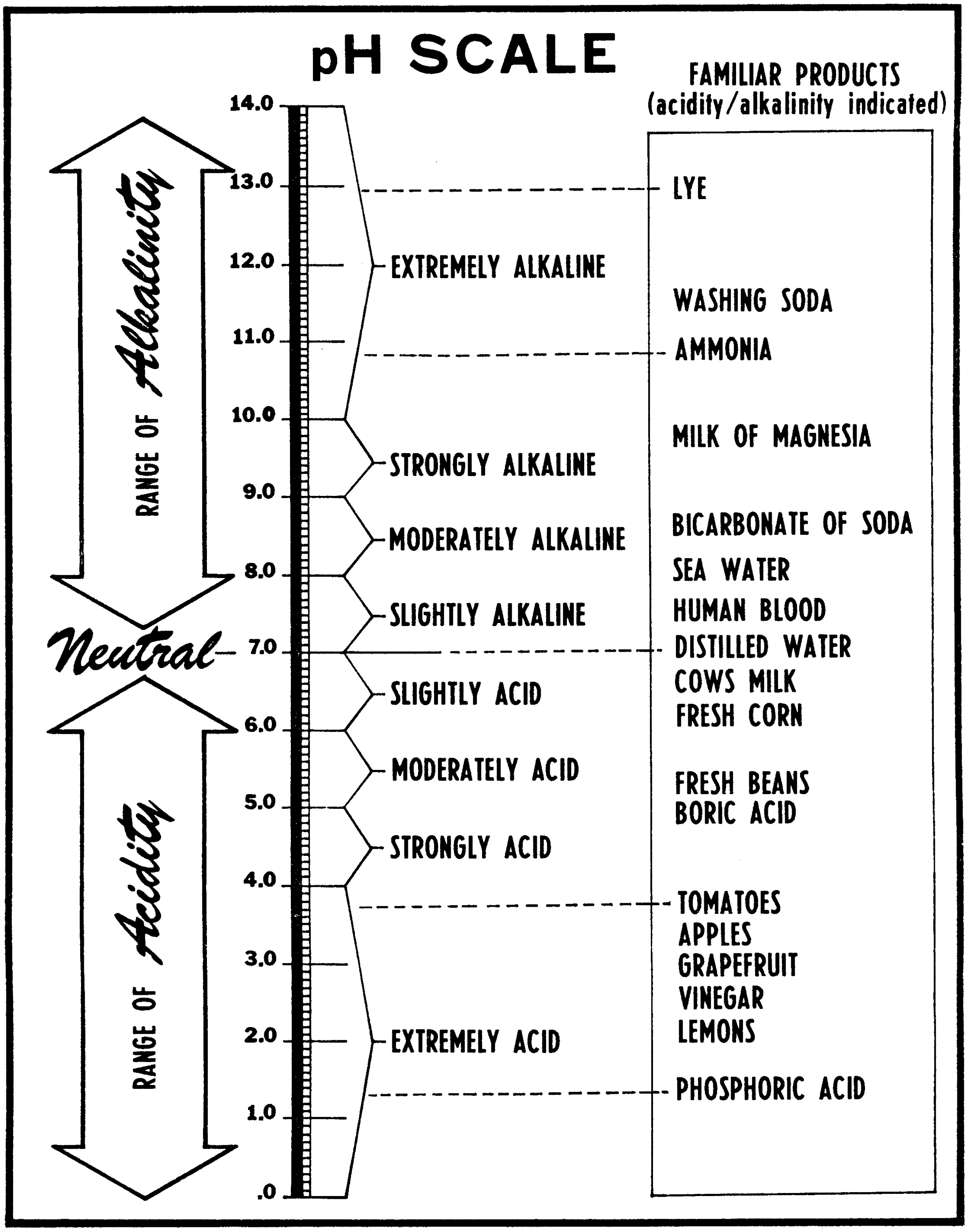
A hardened layer of soil is called a hard pan. A hard pan can prevent water, air and nutrients from moving through the soil, and will limit root growth to that part of the soil profile above the restrictive layer.

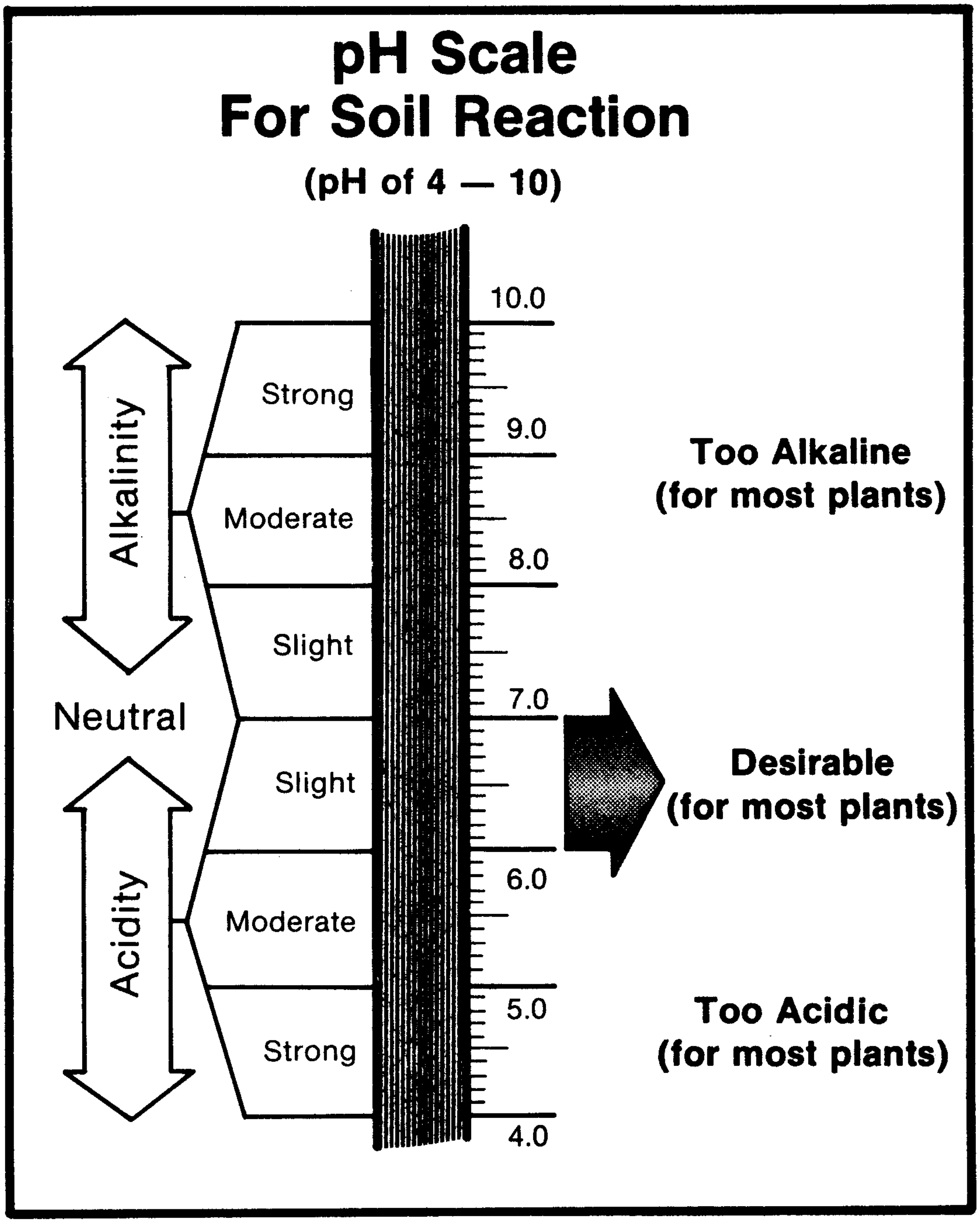

Soil Profile
01 Undecomposed organic matter
02 Decomposed organic matter
A Horizon
Accumulated decomposed organic matter and mineral materials - usually dark in color
B Horizon
Mineral materials which accumulate organic matter, clay, iron, aluminum, etc. from layer above
C Horizon
Mineral material of weathered rock or other unconsolidated material
TM 13


pH Scale
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Neutral
Increasing acidity
Increasing alkalinity

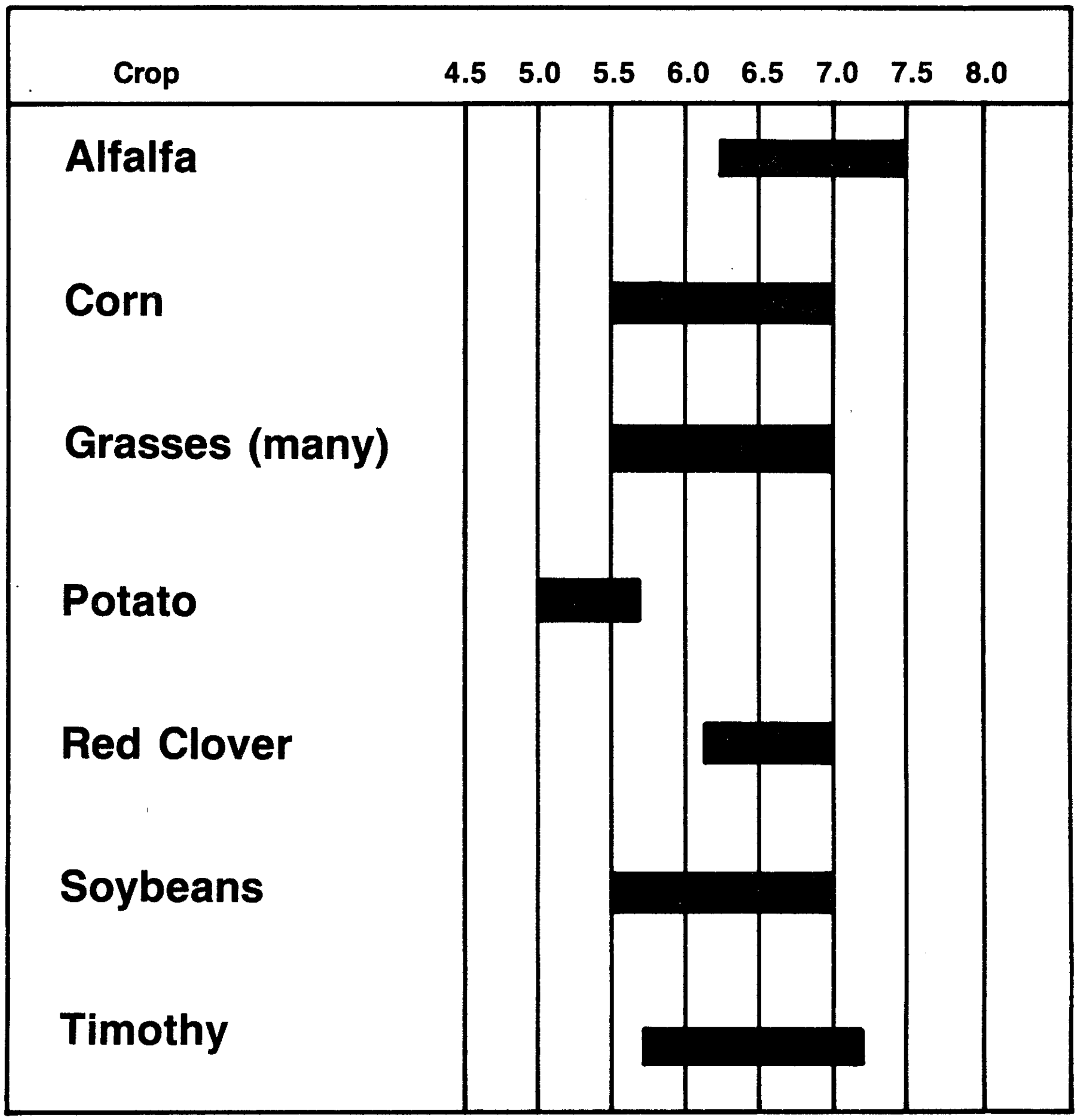


pH Scale
Range of Acidity
Neutral
Range of Alkalinity
.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
10
100
1,000
10,000
100,000
1,000,000
10,000,000
Relative Strength

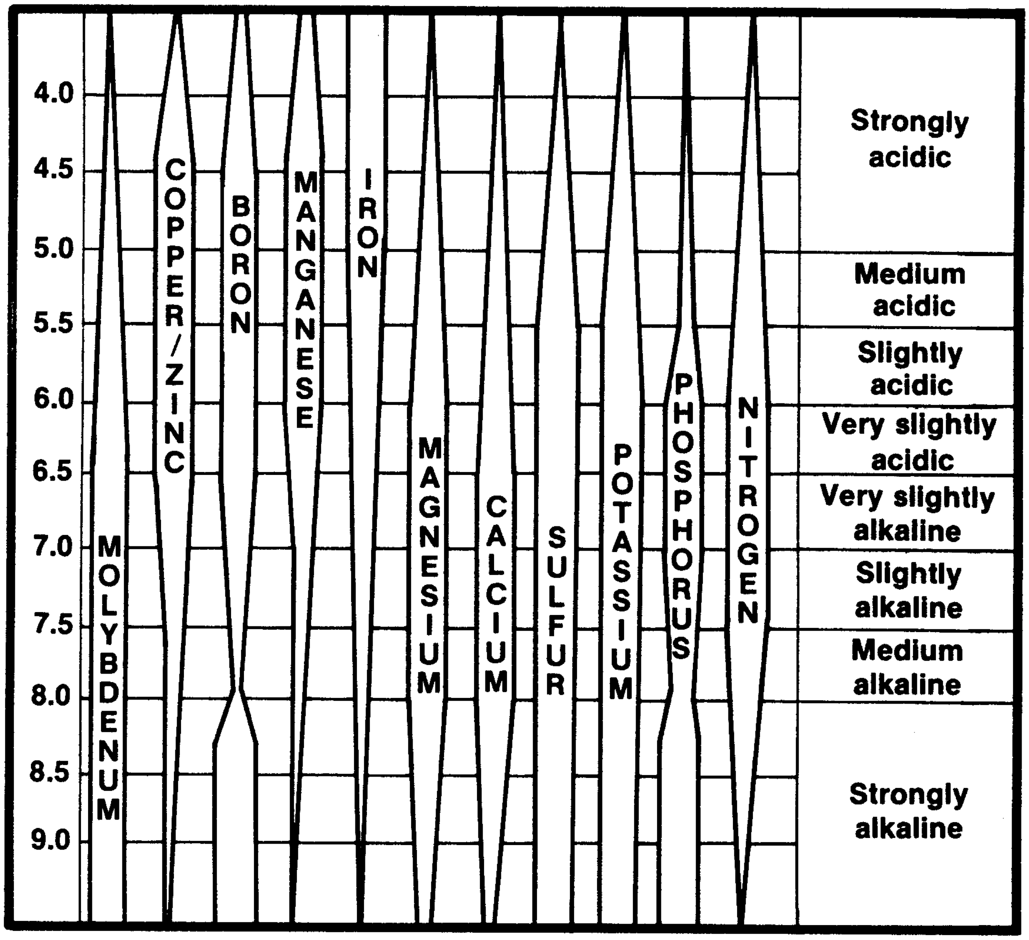

pH SCALE
FAMILIAR PRODUCTS
(acidity/alkalinity indicated)
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.0
RANGE OF Alkalinity
Neutral
RANGE OF Acidity
EXTREMELY ALKALINE
STRONGLY ALKALINE
MODERATELY ALKALINE
SLIGHTLY ALKALINE
SLIGHTLY ACID
MODERATELY ACID
STRONGLY ACID
EXTREMELY ACID
LYE
WASHING SODA
AMMONIA
MILK OF MAGNESIA
BICARBONATE OF SODA
SEA WATER
HUMAN BLOOD
DISTILLED WATER
COWS MILK
FRESH CORN
FRESH BEANS
BORIC ACID
TOMATOES
APPLES
GRAPEFRUIT
VINEGAR
LEMONS
PHOSPHORIC ACID


pH Scale
For Soil Reaction
(pH of 4 — 10)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
Alkalinity
Strong
Moderate
Slight
Neutral
Slight
Moderate
Strong
Acidity
Too Alkaline
(for most plants)
Desirable
(for most plants)
Too Acidic
(for most plants)

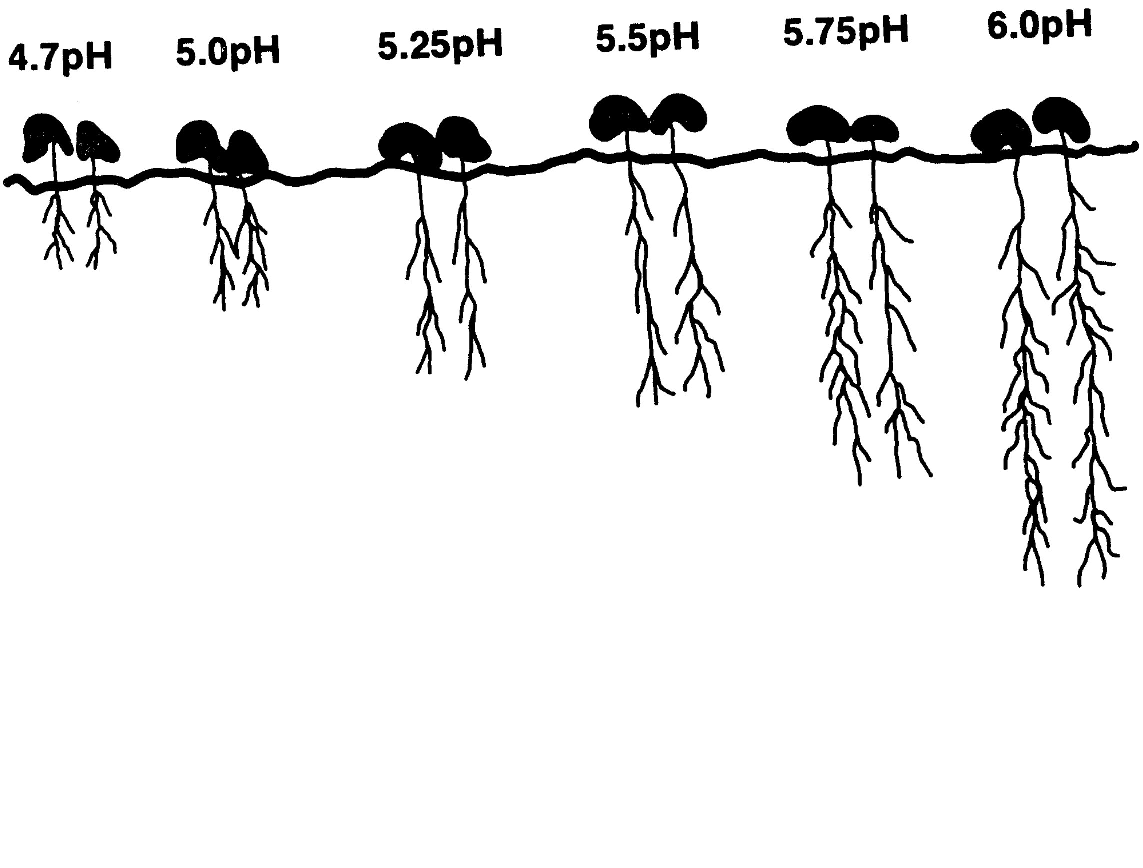
pH Requirements of Crops



Soil pH Governs Nutrient Release
Acidity or alkalinity (pH) controls relative nutrient availability.



Low pH Limits Root Growth



Ion Exchange of Soil Particles

Figures 1:
Mineral nutrients held on the surface of a soil particle are absorbed

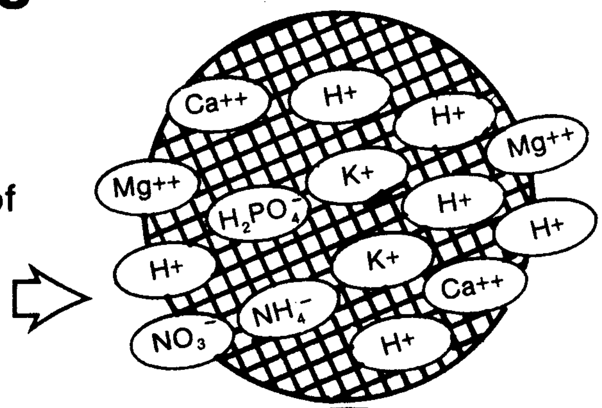


Figure 2:
A soil particle with mostly hydrogen ions tests ACID

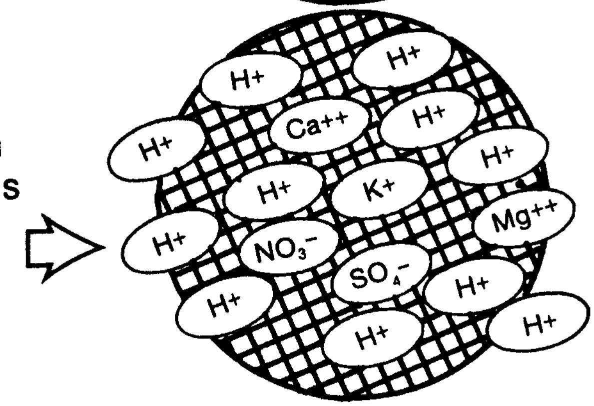
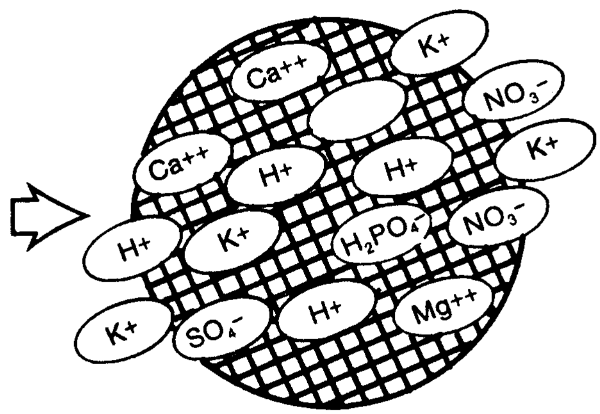


Figure 3:
A soil particle with mostly basic ions tests ALKALINE



ELEMENTARY STUDY OF SOILS

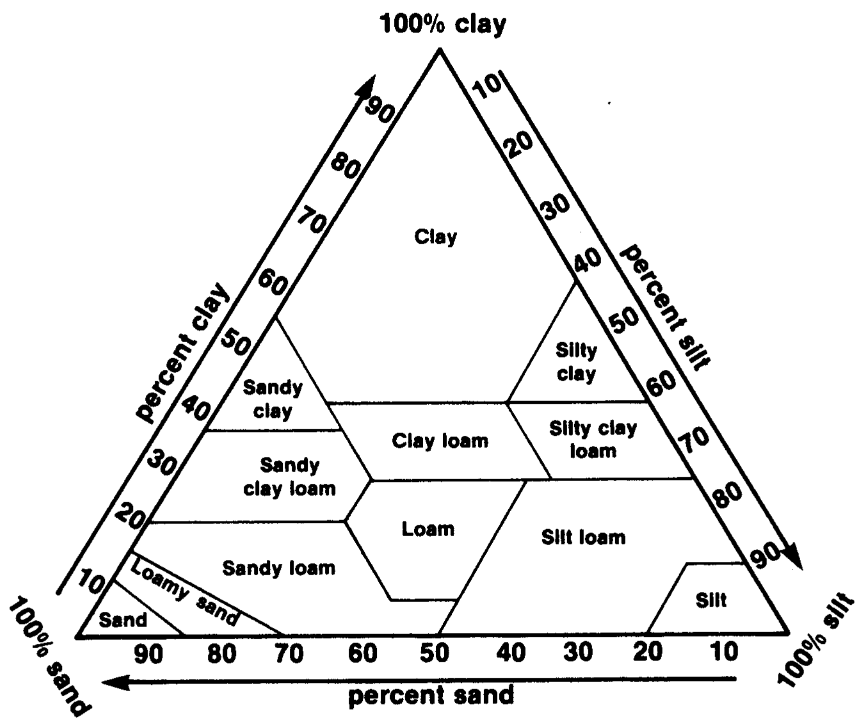
AG 150 - A

ASSIGNMENT SHEET #1--USING THE TEXTURAL TRIANGLE

Name__________________________________ Score____________________________________

Part I

The textural triangle (Figure 1) can be used to determine the textural class of a soil sample. The percentage of sand, silt and clay can be calculated by mechanical analysis.



To use the triangle, locate the percent sand along the bottom of the triangle. From this point move upward and to the left. The percent sand is the same along this line. Next locate the percent clay on the left side of the triangle and move horizontally to the right. The textural class is located where the clay and sand percents meet. This textural class can be checked by locating the silt percentage on the right side of the triangle and moving downward to the left. All points should intersect. If all lines intersect on a division line between classes, move towards the finer textured soil.

Part II

A. How much sand must a soil contain before it is called a

1. Sandy clay loam ________
2. Loamy sand ________
3. Sand ________
4. Sandy clay ________

B. How much clay must a soil contain before it is called a

1. Clay ________
2. Clay loam ________
3. Sandy clay loam ________
4. Sandy clay ________

C. Given the relative amounts of sand, clay and silt, find the textural classes of the following:

1. 20% sand
   20% clay ____________________________
   60% silt

2. 55% sand
   40% clay ____________________________
   5% silt

3. 30% sand
   40% clay ____________________________
   30% silt

4. 20% sand
   70% clay ____________________________
   10% silt

5. 85% sand
   10% clay ____________________________
   5% silt

ELEMENTARY STUDY OF SOILS

AG 150 - A

ANSWERS TO ASSIGNMENT SHEET

1. **Part I**--Evaluated to satisfaction of instructor.

2. **Part II**

A.	1.	45%	2.	70%	3.	85%	4.	45%
B.	1.	40%	2.	27%	3.	20%	4.	35%

C.
1. Silt loam
2. Sandy clay
3. Clay
4. Clay
5. Loamy sand

ELEMENTARY STUDY OF SOILS

AG 150 - A

LABORATORY EXERCISE #1--DETERMINE SOIL TEXTURAL CLASS BY MECHANICAL ANALYSIS

Name ____ Score _______________________

I. Equipment needed

A. Quart fruit jars with lids

B. 8% calgon solution

C. Ruler, pencil and paper

D. Tablespoon

E. A variety of soil samples

II. Procedure

A. Fill the quart fruit jar 1/2 full of soil

B. Add 5-6 tablespoons of calgon solution and neatly fill the quart jar with water

C. Put the lid on the jar and shake for 5 minutes. Let the jar stand for 24 hours

D. Measure the depth of the settled soil at the end of 24 hours. This is the total depth

E. Thoroughly shake for 5 minutes. Let the jar set

F. Measure the depth of the settled soil at the end of 40 seconds. This is the sand layer

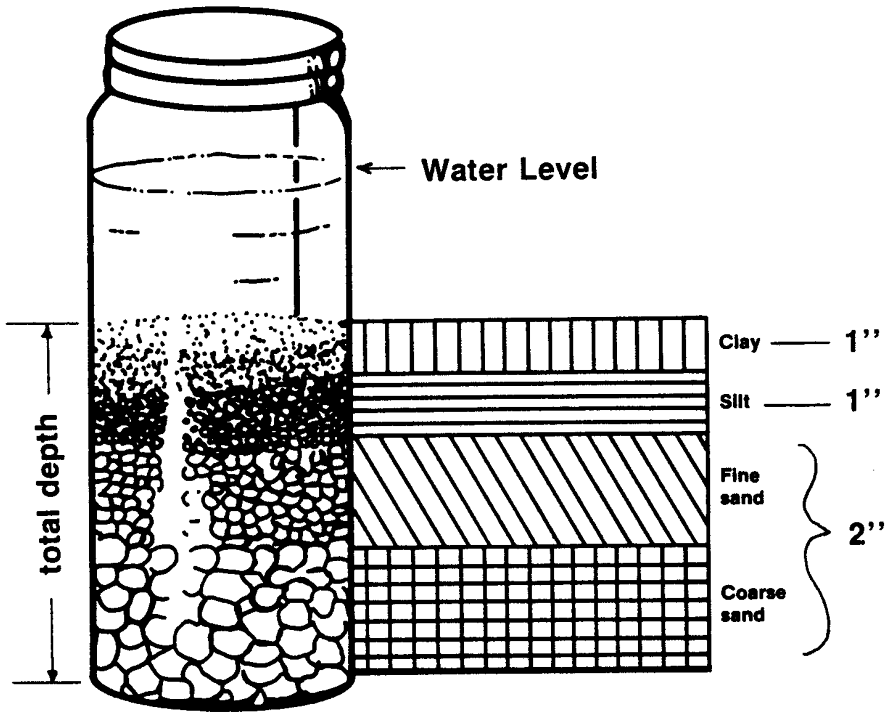
G. Measure the depth of the settled soil at the end of 30 minutes

H. Subtract the first depth (sand) from this new depth of soil. This is the depth of the silt layer

I. Subtract the depth of sand and silt from the original total depth to determine the amount of clay

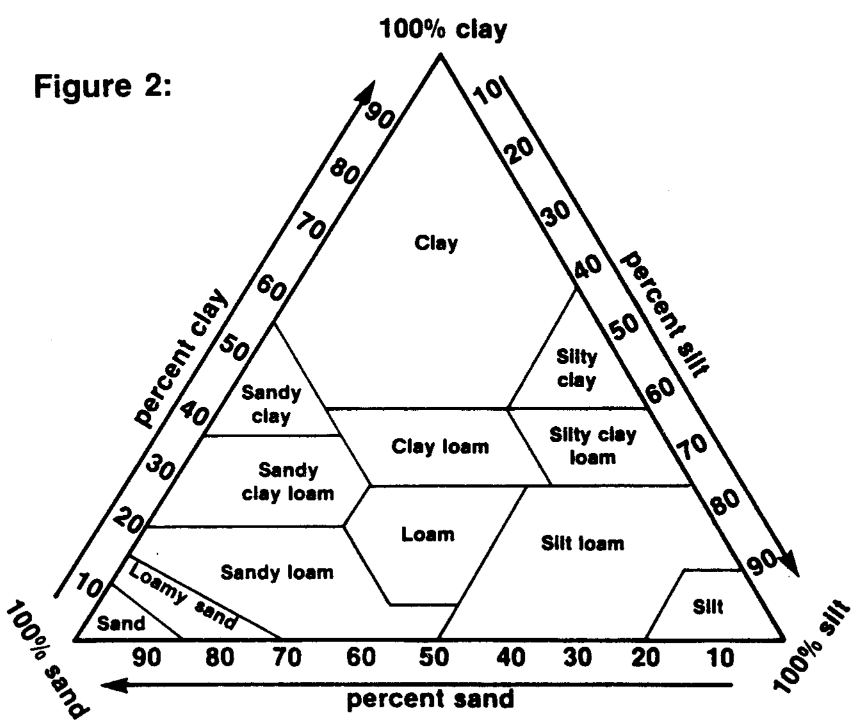
J. Calculate the percentage of each soil separately by dividing the depth of each soil separately by the original total depth (Figure 1)

Figure 1:



K. Determine the soil textural classification by using the soil textural triangle (Figure 2)

Figure 2:



ELEMENTARY STUDY OF SOILS

AG 150 - A

LABORATORY EXERCISE #2--DETERMINE SOIL TEXTURAL CLASS BY FEEL

Name ____ Score _______________________

I. Equipment needed

   A. Spray bottle filled with water

   B. Sink (to wash hands)

   C. Paper towels

   D. A variety of soil samples

II. Procedure

   A. Review soil textural class characteristics

      1. Sand or loamy sand: Dry--loose, single grained; gritty; no or very weak clods; Moist--gritty; forms easily crumbled ball; does not ribbon; Wet--lacks stickiness, but may show faint clay stainings (loamy sand especially); Individual grains can be both seen and felt under all moisture conditions

      2. Sandy loam: Dry--clods break easily; Moist--moderately gritty to gritty; forms balls that stands careful handling; ribbons very poorly; Wet--definitely stains fingers; may have faint smoothness or stickiness, but grittiness dominates; Individual grains can be seen and felt under nearly all conditions

      3. Loam: This is the most difficult texture to place since characteristics of sand, silt and clay are all present but none predominates; Suggests other textures; Dry--clods slightly difficult to break; somewhat gritty; Moist--forms firm ball; ribbons poorly; may show poor fingerprint; Wet--gritty, smooth and sticky all at same time; Stains fingers

      4. Silt or silt loam: Dry--clods moderately difficult to break and rupture suddenly to a floury powder that clings to fingers; shows fingerprint; Moist--has smooth, slick, velvety or buttery feel; forms firm ball; may ribbon slightly before breaking; shows good fingerprint; Wet--smooth with some stickiness from clay; stains fingers; Grittiness of sand is well masked by other separates; (Texture most like silt loam; there are few silt soils)

      5. Sandy clay loam: Dry--clods break with some difficulty; Moist--forms firm ball that dries moderately hard; forms 1/2" ribbons that hardly sustain own weight; may show poor to good fingerprint; Wet--grittiness of sand and stickiness of clay about equal, masking smoothness of silt; stains fingers

6. Clay loam: Dry--clods break with difficulty; Moist--forms firm ball that dries moderately hard; ribbons fairly well, but ribbons barely support own weight; shows fair to good fingerprint; Wet--moderately sticky with stickiness dominating over grittiness and smoothness; stains fingers

7. Silty clay loam: Resembles silt loam but with more stickiness of clay; Dry--clods break with difficulty; Moist--shows a good fingerprint; forms a firm ball drying moderately hard; ribbons 1/2" that can be fairly thin; Wet--stains fingers; has sticky-smooth feel with little grittiness of sand

8. Sandy clay: Dry--often cloddy, clods broken only with extreme pressure; Moist--forms very firm ball, drying quite hard; shows fingerprint; squeezes to thin, long, somewhat gritty ribbon; Wet--stains fingers; clouds water; usually quite sticky and plastic, but has some grittiness present

9. Silty clay: Dry--see sandy clay; Moist--forms very firm ball becoming quite hard on drying; shows fingerprint; squeezes out to a thin, long, smooth ribbon; Wet--stains fingers; clouds water; stickiness dominates over smoothness, grittiness is virtually absent

10. Clay: Dry--cloddy, clods often cannot be broken even with extreme pressure; Moist--forms firm, easily molded ball drying very hard; squeezes out to a very thin ribbon 2 to 3 inches long; Wet--stains fingers, clouds water; usually very sticky with stickiness masking both smoothness and grittiness; wets slowly

B. Examine the dry soil sample

(Note: Look for clods and ease of crumbling them between your fingers. Remember soils high in sand are seldom cloddy. Soils high in silt may be cloddy but usually break easily. Clay soils are usually cloddy and are often hard to break.)

C. Take a quantity of soil about the size of a golf ball. Moisten it with water from the spray bottle to the consistency of putty

D. Try to form a ball with the moistened soil sample; then try to form a "ribbon" by working the soil between the thumb and forefinger

(Note: Soils high in sand feel gritty and ribbon poorly unless also high in clay. Soils high in silt feel smooth or floury. They may also form a short ribbon in varying length depending on the clay content. Soils high in clay can be rolled out into very thin ribbons.)

E. Saturate the soil sample and note staining on the fingers

(Note: Clay or loam soil is indicated if the moist soil ball stains your fingers.)

F. Compare several soil samples of different textures

(Note: Compare the amount of grittiness of sand to the smoothness of silt and the stickiness of clay. Sand gives a grinding sound when held close to the ear. Grittiness indicates a sandy soil. Silt is smooth and velvety. Clay is sticky.)

ELEMENTARY STUDY OF SOILS

AG 150 - A

UNIT TEST

Name________________________________ Score___________________________________

1. Match terms associated with elementary study of soils to the correct definition. Write the correct numbers in the blanks.

_____a. A mixture of particles of rock, organic materials, living organisms, air and water

_____b. Removal of water soluble soil components from the downward action of water

_____c. Total thickness of a soil from the topsoil to the parent material

_____d. Dark colored upper layer of soil that may vary from several inches to 2 or more feet thick

_____e. A vertical cross-section of the soil from the surface through all its horizons

_____f. Mass or cluster of soil particles such as a clod, crumb or granule

_____g. Soil having a pH value greater than 7.0

_____h. General term for inorganic elements in the soil

_____i. A name given a textural group based on the relative proportions of the various soil separates

_____j. A layer of soil approximately parallel to the land surface, differing from other layers in color, structure, texture, pH, etc.

_____k. The layer of soil directly beneath the topsoil

_____l. General term for plant and animal material in or on the soil in all stages of decomposition

_____m. Indication of the amount of organic matter and moisture of the soil

_____n. Soil with a pH of less than 7.0

1. Soil
2. Mineral matter
3. Organic matter
4. Parent material
5. Soil texture
6. Soil structure
7. Aggregate
8. Soil depth
9. Soil color
10. Soil profile
11. Soil horizon
12. Topsoil
13. Subsoil
14. Acid soil
15. Alkaline soil
16. Leaching
17. Reclamation
18. Cation
19. Anion
20. Exchange capacity

_____o. An ion that has lost an electron and has a positive (+) charge

_____p. The ability of a soil to absorb ions to the surface of the soil particle

_____q. Restoration to a better or useful stage, as of wasteland, desert, alkali, etc.

_____r. The combination or arrangement of soil particles into aggregates

_____s. The rock or other unconsolidated material from which the soil has developed

_____t. An ion that has gained an electron and has a negative (-) charge

2. Select from the following list reasons that soils are important. Write an "X" in the blank before each correct answer.

_____a. Holds the earth together

_____b. Provides food

_____c. Population is increasing

_____d. Productive soil is limited

_____e. Provides insulation

3. Discuss the function of soil as related to plant growth, development and maintenance.

____

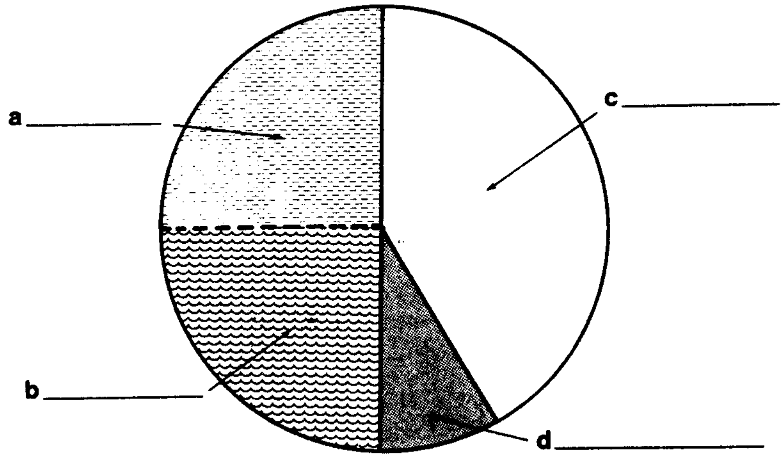
____

____

____

____

4. Label the drawing below showing the composition of an average soil. Write the correct names in the blanks.



5. Select from the following list factors that are important in soil formation. Write an "X" in the blank before each correct answer.

_____a. Freezing and thawing of parent material

_____b. The amount of rainfall

_____c. The type of soil structure

_____d. The steepness or flatness of the landscape

_____e. The presence of clay in the "B" horizon

_____f. The amount of vegetation present

6. Name the four physical properties of soil.

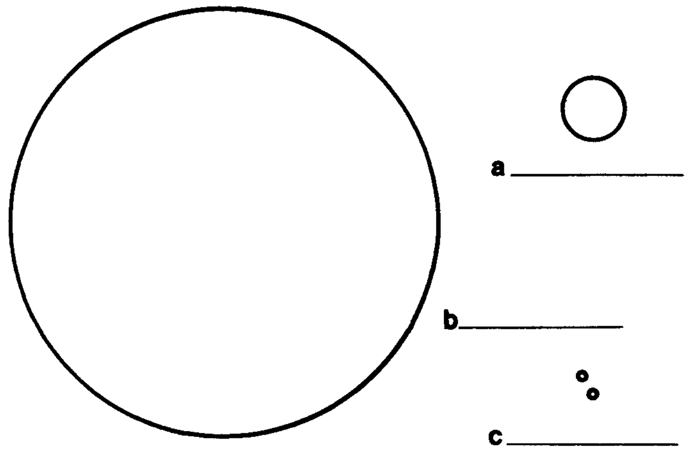
a. ____

b. ____

c. ____

d. ____

7. Identify the soil particles according to size.

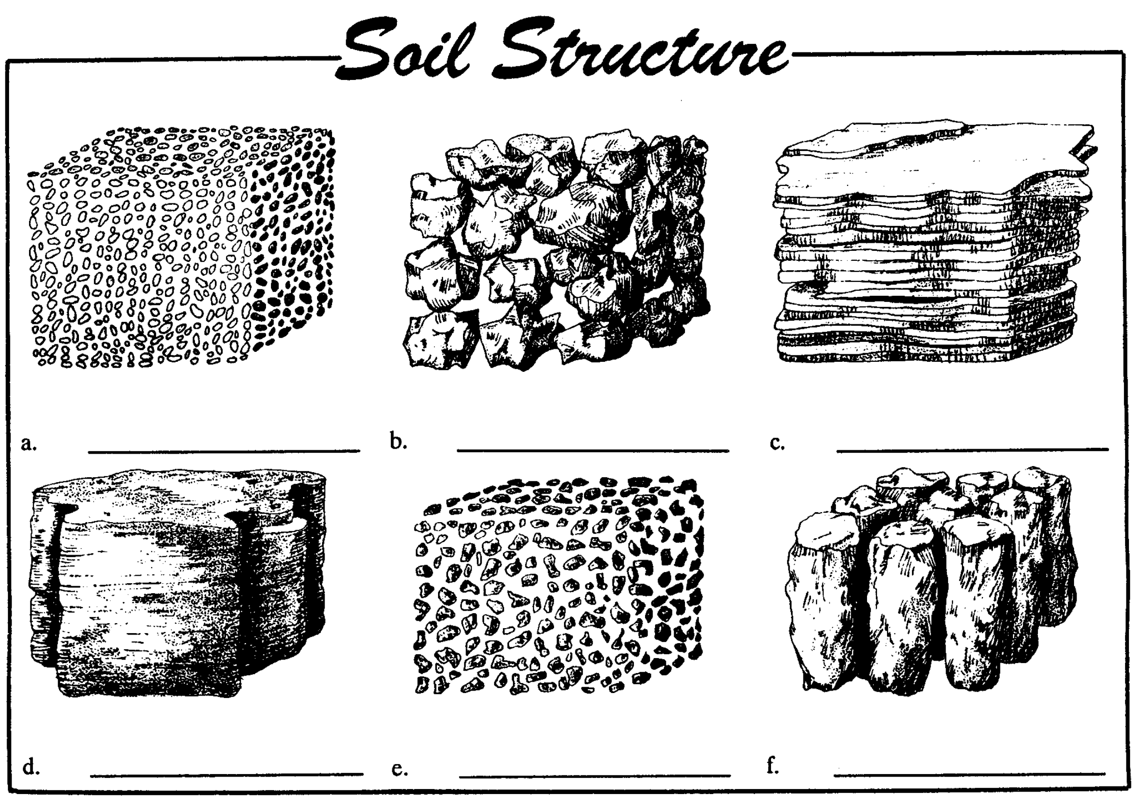


8. List two methods used to determine soil texture.

   a. ____

   b. ____

9. Identify the six kinds of soil structure in the illustration below.



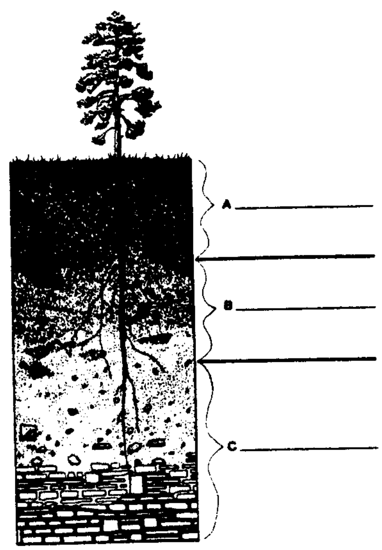
10. Match terms indicating soil depth to their correct description. Write the correct numbers in the blanks.

_____a.	40 to 60 inches deep	1.	Shallow
_____b.	20 to 40 inches deep	2.	Moderately deep
_____c.	10 to 20 inches deep	3.	Deep
_____d.	Less than 10 inches deep	4.	Very shallow
_____e.	Over 60 inches deep	5.	Very deep

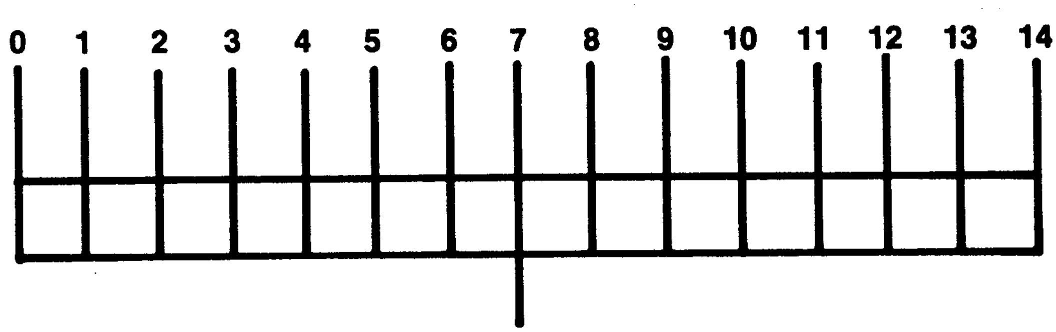
11. Match the colors of the soil to their correct description. Write the correct numbers in the blanks.

_____a.	High iron content	1.	Dark brown to black
_____b.	Caused by imperfect drainage	2.	Red or reddish-brown
_____c.	High organic matter content	3.	Yellow or gray

12. Label the illustration showing the layers if a soil profile. Write the correct names in the blanks.



13. Identify on the pH scale the area of acidity and the area of alkalinity.



14. Discuss the liming of soils to correct soil acidity.

15. Name three types of alkali soils.

a.

b.

c.

16. Discuss reclamation of alkali soils.

ELEMENTARY STUDY OF SOILS

AG 150 - A

ANSWERS TO TEST

1.

a.	1	h.	2	o.	18
b.	16	i.	5	p.	20
c.	8	j.	11	q.	17
d.	12	k.	13	r.	6
e.	10	l.	3	s.	4
f.	7	m.	9	t.	19
g.	15	n.	14		

2. b, c, d

3. Answer should include the following information:

   Media for seed germination; Media for support of plants; Storehouse of plant nutrients; Storehouse of water for the plant

4. a. Air
   b. Water
   c. Mineral matter
   d. Organic matter and living organisms

5. a, b, d, f

6. Soil structure; Soil texture; Soil depth; Soil color

7. a. Silt
   b. Sand
   c. Clay

8. Mechanical analysis; Feel method

9. a. Single grain
   b. Blocky
   c. Platy
   d. Massive
   e. Granular
   f. Prismatic

10. a. 3 b. 2 c. 1 d. 4 e. 5

11. a. 2 b. 3 c. 1

12. a. "A" horizon
    b. "B" horizon
    c. "C" horizon

13. Acid--pH values less than 7.0
    Alkaline--pH values greater than 7.0

14. Answer should include the following information: The function of lime is to neutralize hydrogen (H^+) ions that cause soil acidity; Amount of lime to apply depends on the degree of acidity of the soil, crops to be grown, grade or purity of lime materials, frequency of application, soil texture and soil exchange capacity

15. Saline; Sodic; Saline-sodic

16. Discussion should include the following information:

    <u>Saline</u>: Flood with water and leach out salts; Install drainage tiles to remove accumulated salts; Grow salt tolerant crops
    <u>Sodic</u>: Apply gypsum; Grow sodic tolerant crops
    <u>Saline-sodic</u>: Correct sodic problem first, then salt problem

SOIL FERTILITY

AG 150 - B

UNIT OBJECTIVE

After completion of this unit, students should be able to match function and deficiency symptoms to the correct nutrient and select factors that influence the use of fertilizers. Students should also be able to list sources of nutrients, match fertilizers to their descriptions and complete a soil test report form. This knowledge will be demonstrated by completion of assignment sheets and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with soil fertility to the correct definitions.
2. Match the functions of nutrients for crop growth to the correct nutrient.
3. Match nutrients to their correct deficiency symptoms.
4. Select factors that influence the use of fertilizers.
5. Discuss major points in collecting and handling a representative soil sample.
6. List four sources of nutrients.
7. Match types of fertilizers to their correct description.
8. Calculate problems comparing cost per pound of nutrient.
9. List three methods of fertilizer application.
10. Complete a soil test report form.

SOIL FERTILITY

AG 150 - B

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Crop Management Series--No-Till and Minimum Tillage Farming: Fertilizer Band Location for Cereal Root Access*, available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.50; order no. PNW 283.

b. *Fertilizer Placement,* available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.35; order no. CIS 757.

c. *Fertilizer Primer: Terminology, Calculations and Application,* available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.35; order no. CIS 863.

d. *How to Calculate Manure Application Rates in the Pacific Northwest,* available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.25; order no. PNW 239.

e. Making Soil Fertility Decisions, 120-page instructional unit; available from IAVIM Center, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $7.50; order no. 226.

f. Pamphlets on fertilizer use; available from Potash and Phosphate Institute, 2801 Buford Hwy., N.E., Suite 401, Atlanta, Georgia 30329; approximate cost 25¢ each.

g. Principles of Soil Sampling, available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.50; order no. WREP 9.

h. Soil Sampling, available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.50; order no. EXT 704.

i. *Taking Soil Samples*, 25-page instructional manual; available from IAVIM Center, ATTN: Thomas A. Hoerner, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $2.50; order no. 212.

j. *University of Idaho Soils Handbook;* includes basic soils information and soils-related Current Information Series (CIS) publications published by the College of Agriculture; available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $27.

k. Using the Soil Test Report Form, available from Agricultural Communications Center, Building J40, University of Idaho, Moscow, Idaho 83843-4196, (885-7982); approximate cost $.25; order no. CIS 363.

2. Filmstrips, slideshows, etc.

a. *Fertilizer Purchase*, 1 disk and worksheet; available from Teaching Aids, Inc., P.O. Box 1789, Costa Mesa, California 92626; approximate cost $22.00; order no. ACS-9.

b. Fertilizer Quarterly, 1 disk and worksheet; available from Teaching Aids, Inc., P.O. Box 1789, Costa Mesa, California 92626; approximate cost $22.00; order no. ACS-10.

c. Fertilizers and Soil Fertility, 3 cassettes, 3 filmstrips, program guide and reproducible masters; available from Teaching Aids, Inc., P.O. Box 1789, Costa Mesa, California 92626; approximate cost $105.00; order no. P1321.

d. Soil pH and Limestone, 7 slides, cassette and 1 film loop, 24 minutes; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $31.20; order no. D21.

e. Soil Sampling and Soil Testing, 63-frame filmstrip and script; available from IAVIM Center, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $8.75; order no. 314.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet.

D. Provide students with information and assignment sheets.

E. Discuss unit and specific objectives.

F. Discuss information and assignment sheets.

G. Take soil sample from schoolyard or school farm for analysis.

H. Have students bring a soil sample from home farm for analysis.

I. Develop a fertilizer test plot for students to observe different fertilizing methods, rates and results.

J. Contact local fertilizer dealer for samples of different fertilizers.

K. Review and give test.

L. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Nitrogen Deficiency in Corn

2. TM 2--Phosphate Deficiency in Corn

3. TM 3--Potash Deficiency in Corn

4. TM 4--Factors That Influence Fertilizer Use

5. TM 5--Soil Sampling (A-B)

6. TM 6--Soil Sampling (C-D)

7. TM 7--Soil Sampling (E-F)

8. TM 8--Soil Sampling (G-H)

9. TM 9--Soil Sampling

10. TM 10--Soil Sample Bag

11. TM 11--Soil Test Report

12. TM 12--Nutrient Sources

13. TM 13--Plant Nutrient Blends

14. TM 14--Compare Cost Per Pound of Nutrient, NOT Cost Per Pound of Fertilizer

E. Assignment sheets

1. AS 1--Calculate Cost Per Pound of Nitrogen for Different Fertilizer Analyses

2. AS 2--Complete a Soil Test Report Form

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. *Agronomy Curriculum Workshop*, Iowa State University, Department of Agricultural Education, Ames, Iowa, 1980.

B. Cooper, Elmer L., Agriscience Fundamentals and Applications, Delmar Publishers, Inc., Albany, New York 12212, 1990.

C. Crops, Soils, and Fertilizer Resource Manual, Vo Ed No. 73, University of Idaho, Department of Agricultural Education, Moscow, Idaho, 1978.

D. Donahue, Roy L., Follett, Roy H., Tulloch, Rodney W., Our Soils and Their Management, 5th edition, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1983.

E. Fridline, Clarence R., Field Crop Nutrition, Ohio Agricultural Curriculum Materials Service, Ohio State University, Columbus, Ohio.

F. Hartmann, Hudson T., Kofranek, Anton M., Rubatzky, Vincent E., Flocker, William J., Plant Science: Growth, Development and Utilization of Cultivated Plants, 2nd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1988.

G. Knuti, Williams and Hide, Profitable Soil Management, 3rd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

H. Oklahoma Curriculum Guide, Oklahoma State University and the Oklahoma State Board for Vocational-Technical Education, Stillwater, Oklahoma.

I. Soils Handbook, Cooperative Extension Service, College of Agriculture, University of Idaho, Moscow, Idaho.

J. Texas Curriculum Guide, Vocational Instruction Services, Texas State Board for Vocational Education.

K. Tisdale and Nelson, Soil Fertility and Fertilizers, 2nd edition, The MacMillan Co., Toronto, Canada, 1969.

L. Western Fertilizer Handbook, Soil Improvement Committee, California Fertilizer Association, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1980.

SOIL FERTILITY

AG 150 - B

INFORMATION SHEET

I. Terms and definitions

A. Essential nutrient--Element necessary for plant growth and reproduction, for example: nitrogen, phosphorus and potassium

B. Deficiency--Plant condition where an essential nutrient is not sufficiently available

C. Symptom--A visual sign or condition that results from a deficiency; symptoms aid in diagnosing a deficiency

D. Fertilizer--Natural, manufactured or processed material or mixture of materials that contains one or more of the essential nutrients; available in dry, liquid or gaseous form

E. Analysis--Percentage water soluble content of nitrogen (N), phosphorus (P) expressed as P2O5, and potassium (K) expressed as K2O in the fertilizer

F. Brand--Trademark of the company which produced the fertilizer

G. Complete fertilizer--Fertilizer which supplies all three of the primary nutrients (N, P, K)

II. Functions of nutrients for crop growth

A. Carbon, hydrogen and oxygen are needed in the plant processes of photosynthesis and respiration

(Note: Importance of photosynthesis to net gain in weight should be emphasized. Approximately 95% of weight of crop plants comes from products of photosynthesis.)

B. Primary nutrient functions

1. Nitrogen (N)

a. Gives green color to plant

b. Induces vigorous, rapid growth in plants

c. Increases protein and yield

d. Aids and promotes seed and fruit development

(Note: Excess nitrogen causes vegetative growth and poor seed and fruit production. Nitrogen constitutes 80% of the atmosphere, yet it is one of the most critical elements for plant growth. The reason is that plants cannot utilize nitrogen as a gas; it must be combined with other elements into a plant available form.)

2. Phosphorus (P)

a. Important to germinating seedlings

b. Contributes to early maturing crops

c. Necessary for seed and fruit formation

d. Stimulates root growth

3. Potassium (K)

a. Necessary for production and translocation of carbohydrates

b. Produces plumper seeds

c. Controls water intake and respiration

d. Stiffens straw and stalks

C. Secondary nutrient functions

1. Sulphur (S)

a. Necessary for nodule formation on legumes

b. Associated with plant enzyme systems

c. Stimulates seed production

d. Affects protein and crop quality

2. Calcium (Ca)

a. Speeds decay of organic matter

b. Stimulates formation of nitrates

c. Promotes root and leaf growth

d. Necessary for nodulation of legumes

3. Magnesium (Mg)

   a. Necessary for chlorophyll or green plant color

   b. Increases absorption of phosphorus

   c. Aids in formation of fats and oils

   d. Important in plant enzyme system

III. Symptoms of nutrient deficiencies

A. Primary nutrient deficiency symptoms

1. Nitrogen (N) (Transparency 1)

   a. Stunted and spindly

   b. Yellow, yellowish-green or light green color in foliage (chlorosis)

   c. Older leaves affected first

   (Note: Yellowing or browning starts at the tip and moves along the middle of the leaf. This occurs first on the lowest leaves of the plant.)

2. Phosphorus (P) (Transparency 2)

   a. Stunted growth

   b. Very dark green color

   c. Purple leaves or portions of leaves in advanced stages

   d. Older leaves affected first

3. Potassium (K) (Transparency 3)

   a. Shorter plants

   b. Bronzing or browning of leaf color

   c. Lodging (bending of the stem) occurs

   (Note: Leaves show yellow to brown coloring along leaf margins followed by complete browning.)

B. Secondary nutrient deficiency symptoms

1. Sulphur (S)

   a. Young plants have stunted appearance

   b. Leaves have a light-green to yellow coloring

c. Stems are thin and spindly

(Note: Sulphur deficiency symptoms are similar in appearance to nitrogen deficiency symptoms.)

2. Magnesium (Mg)

a. Leaf parts between veins show a whitish color

b. Leaf tissue becomes yellow, veins remain green (interveinal chlorosis)

c. Leaves curl upward along the margins

(Note: It is important to note that other conditions besides nutrient shortages may cause abnormal plant growth. Cold, wet weather, lack of sunlight, disease, insect damage and improperly applied chemicals are examples.)

IV. Factors that influence fertilizer use (Transparency 4)

A. Fertility of the soil

(Note: The fertility of the soil is dependent on the availability of total nutrients in the soil, soil organic matter and can be determined by soil test.)

B. Physical condition of the soil

(Note: Moisture content, soil texture, soil structure and the ability to prevent leaching are important physical conditions to consider in fertilizer use.)

C. Crop to be grown

(Note: Nutrient needs vary between crop plants. The cost of the type of fertilizer compared to the value of the crop is an important consideration.)

D. Climatic conditions, such as temperature and moisture

E. Time of application--fall, spring or during season

V. Soil testing to determine nutrient needs (Transparencies 5, 6, 7, 8, 9, 10, 11)

(Note: If you apply fertilizer that is not needed, you are wasting money. On the other hand, you will lower crop yields if you don't apply enough. Confusing? Sure. That's why soil testing is so highly recommended. A soil test is a guide to fertilizer needed for your farm. Consult your cooperative extension agent or refer to the "Soils Handbook" published by the College of Agriculture, University of Idaho, for more information on procedure and cost.)

A. Five main steps involved in taking a good soil sample

1. Obtain needed materials for the sample

2. Select a good time to take the sample

3. Select good sampling areas

4. Collect representative samples

5. Send the sample to a soil testing laboratory

   (Note: Soil tests are only as good as the samples taken.)

B. Materials needed for sampling

1. Soil auger or shovel to take soil cores

   (Note: Always use clean tools so sample will not be contaminated.)

2. Plastic pail for mixing core samples

   (Note: Mix sample well so sample will be representative of soil cores.)

3. Soil sample bags and information sheet

4. Map of your fields

C. When to take sample

1. After harvest, before fall fertilization

2. Spring, before spring fertilization

   (Note: Do not sample after a lime, fertilizer or manure application or when soil is excessively wet. Sampling at other times such as in winter or in a growing crop can be satisfactory if you can divide the field into uniform sampling areas and take soil samples at the proper depth.)

D. Choosing good sampling areas

1. Sampling areas depend on field size and soil types in field

2. Sampling area should represent an area with similar past management and soil types

   (Note: Soil survey maps from local SCS may be helpful in determining areas with common soil type, slope and erosion. If a recent soil survey map is not available, sampling areas should be separated on the basis of visual differences, such as texture, color and slope. Avoid areas not representative of the uniform field area, such as old fence lines, eroded areas, etc.)

E. Collecting representative samples

1. Take 8 to 12 separate cores in a zig-zag pattern from a ten-acre sampling area

1		3		5		7		9	
	2		4		6		8		10

2. Take 10 to 15 cores if the area is variable

3. Take core samples by 12 inch increments

   (Note: For nitrogen, sulphur and other mobile nutrients, sample to rooting depth. For phosphorus, potassium and the micronutrients, sample to 12 inches.)

4. Place cores in a clean, plastic pail and mix cores thoroughly

   (Note: Be sure to clear away any plant material or surface trash where core is to be taken. Plastic pail is recommended because the sample can absorb nutrients (especially zinc) from the metal coating on the bucket and give you erroneous results on the soil test.)

F. Sending sample to be tested

1. Each soil sample bag should be identified and numbered before filling

   (Note: Label all samples correctly and identify area on farm map where sample was taken.)

2. Fill soil sample bag one-half to two-thirds full with thoroughly mixed soil from pail

3. Securely close the bag

4. Complete the soil test report

   (Note: Information on cropping history and the crop to be grown is usually required on information sheet for accurate fertilizer recommendations.)

5. Send samples and the completed soil test report to the desired soil testing laboratory

   (Note: Be sure to indicate type of soil test desired. Some of the more common tests are the following: phosphorus, potassium, nitrogen, organic matter, zinc, sulphur and soil pH. Consult county agent or soil specialist in your area for the soil tests you need.)

Note: In Idaho, take samples to local county agent, or mail to:

Soil Testing Laboratory
Ag Science Building
University of Idaho
Moscow, ID 83843

G. How often to test soil

1. Each field should be sampled every 3 to 5 years or once in a crop rotation; nitrogen should be run each year

(Note: If fertilizer applications do not appear to be beneficial, resampling should be done.)

VI. Completing a soil test report form--Interpreting soil test results

(Note: Numbers are meaningless without interpretation. Interpretations are based on research on response of the crop at various soil test levels. Fertilizer guides are available for most agronomic crops raised in Idaho. These guides are used in conjunction with the University of Idaho soil test results, but may also be used with soil test results from private laboratories. Each guide is specific to a crop and an area of the state. The fertilizer guides are accurate if: (1) the soil sample submitted was properly taken and represents the area to be fertilized, (2) the crop to be grown and previous history are known, and (3) reasonable management occurs.)

VII. Nutrient sources (Transparency 12)

A. Animal manure--The liquid and solid excrement of animals mixed with bedding material; used to supply nutrients for plant growth; helps add organic matter to the soil

(Note: Organic matter is the soil's storehouse for nitrogen. Almost all of the N in the soil is part of the organic matter. When organic matter decomposes, N is released and changes to available forms for plant use. The nutrient content of animal manure may vary considerably under different livestock production systems, amount and type of bedding and methods of handling the manure produced.)

B. Crop residues--Leaves, stems, roots and other parts of plants remaining in the field after harvest, for example: wheat stubble, corn stover, potato vines, sugarbeet tops, etc.

C. Green manure crops--A crop grown to be plowed under in a green, succulent condition for soil improvement purposes; usually a legume crop which fixes atmospheric nitrogen, such as black peas, clover or vetch

D. Commercial fertilizers--Commercially prepared plant nutrients are applied to soils to increase their productivity by supplying additional essential nutrients

VIII. Types of fertilizers

A. Liquid--Fertilizer made by dissolving the correct proportion of the solid plant nutrient carriers into water; may be in solution or suspension

B. Dry mixed--Granulated fertilizer made by combining selected plant nutrient materials to obtain certain ratios and quantities of plant nutrients

C. Gas--Liquid fertilizer containing solid fertilizer materials which is dispensed under pressure and usually contains a higher analysis than clear liquid mixes

IX. Comparing costs of fertilizer materials (Transparencies 13, 14)

(Note: Compare fertilizer prices on the basis of cost per pound of nutrient, not on the cost per pound of fertilizer material.)

A. Calculating cost per pound of nutrients:

$$\frac{\text{Price of Fertilizer Per Pound of Material}}{\text{Guaranteed Percentage}}$$

Example: Fertilizer analysis -- 20 - 10 - 10
Fertilizer cost -- $150.00/ton or 7.5¢/lb

$$\frac{7.5¢/\text{lb}}{40\%} = 18.75¢/\text{lb of nutrient}$$

B. Calculating cost of materials that contain only one nutrient

(Note: The same formula is used.)

Example: Fertilizer analysis -- 45 - 0 - 0 (Urea)
Fertilizer cost -- $240.00/ton or 12¢/lb

$$\frac{12¢/\text{lb}}{0.45} = 26.6¢/\text{lb of N}$$

X. Methods of fertilizer application

A. Broadcast

1. Truck mounted fertilizer spreader

2. Trailer mounted fertilizer spreader

3. Truck mounted liquid fertilizer applicator

4. Field sprayer

5. Aerial application

B. Soil injection

1. Anhydrous ammonia

2. Nitrogen liquid solution under pressure

C. Banding

1. Dry fertilizer with planter

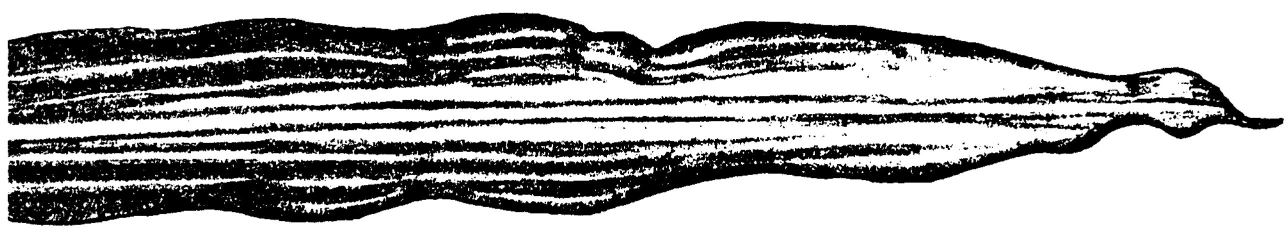
2. Liquid or suspension fertilizer with planter

3. Liquid or suspension with side dress application

D. With irrigation water

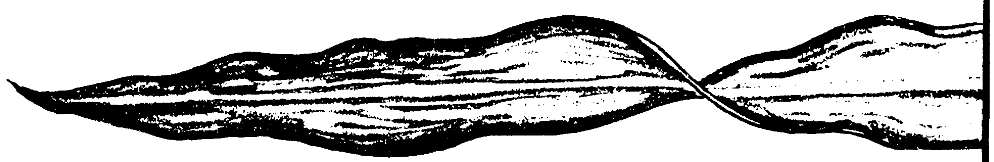
NITROGEN deficiency in corn

SMALL EARS AND LOW PROTEIN CONTENT
RESULT FROM N DEFICIENCY

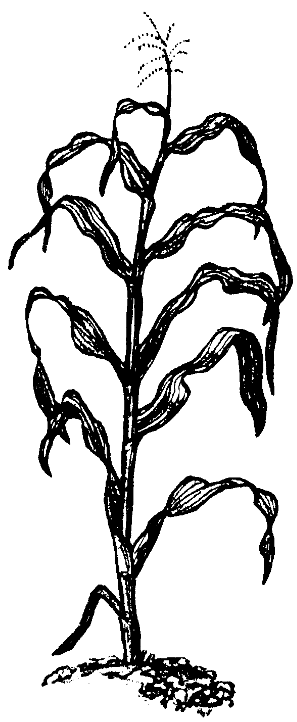


YELLOWING STARTS AT TIP AND MOVES
ALONG MIDDLE OF LEAF

PHOSPHATE deficiency in corn

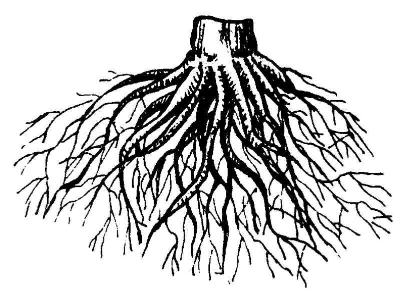


P SHORTAGE MARKS LEAVES WITH REDDISH-PURPLE COLOR

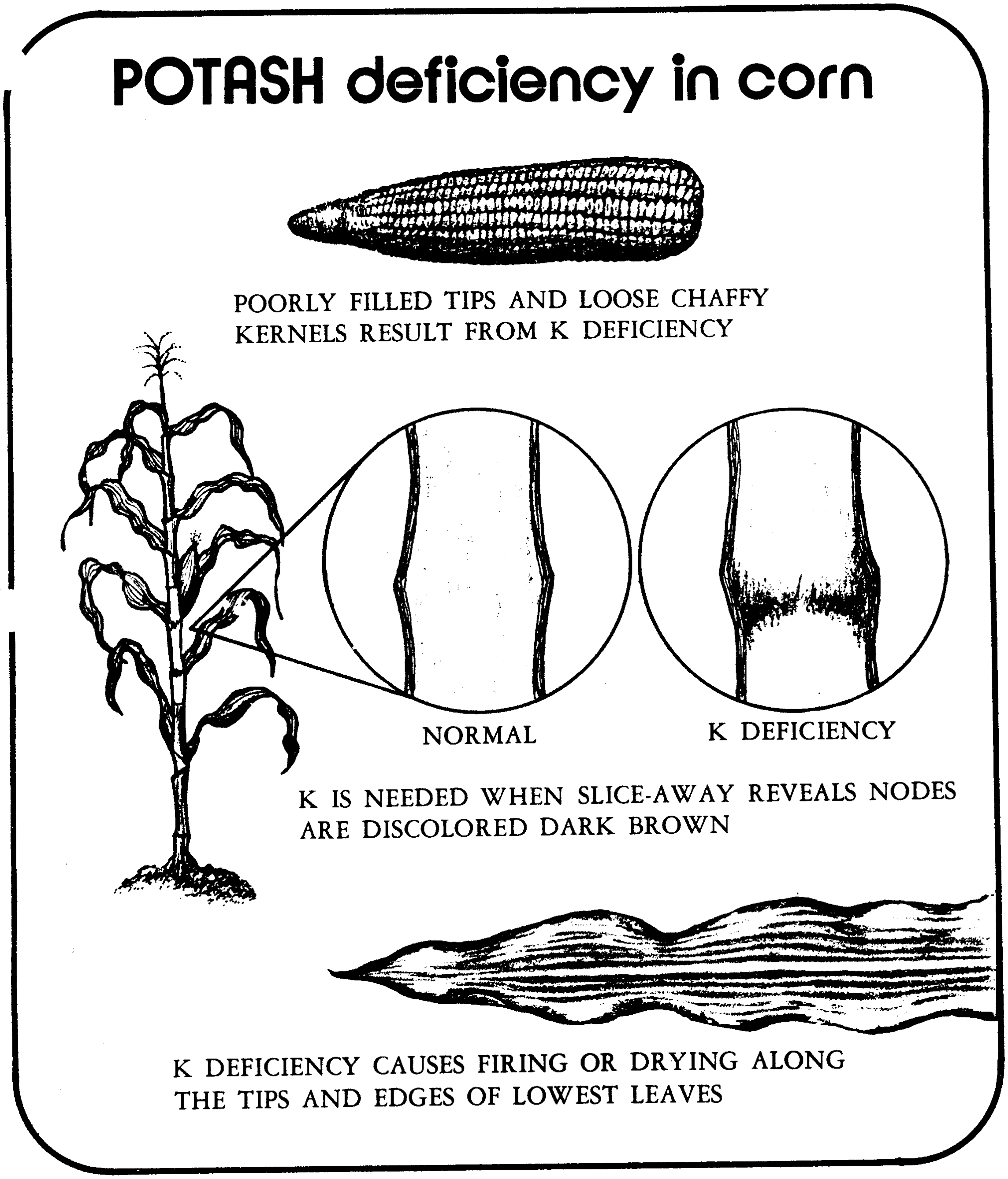


P CONTROLS STALK SIZE AND EAR SET; WHEN THERE'S A SHORTAGE, STALKS ARE WEAK, SPINDLY AND OFTEN BARREN OF EARS

P IS NEEDED WHEN EARS ARE SMALL AND TWISTED AND KERNELS ARE UNDEVELOPED

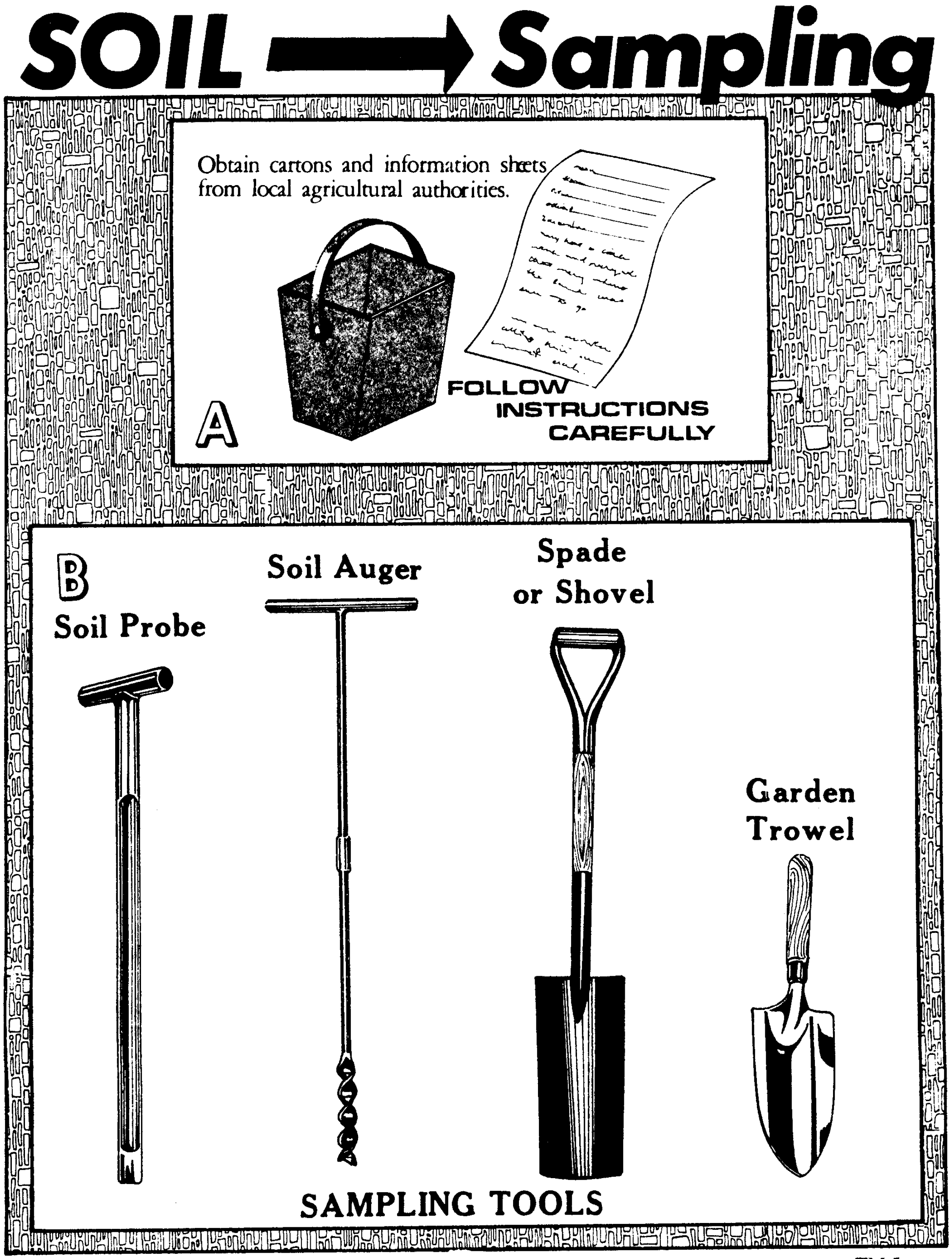


P SHORTAGE DURING EARLY WEEKS CAUSES A SHALLOW ROOT SYSTEM WITH LITTLE SPREAD

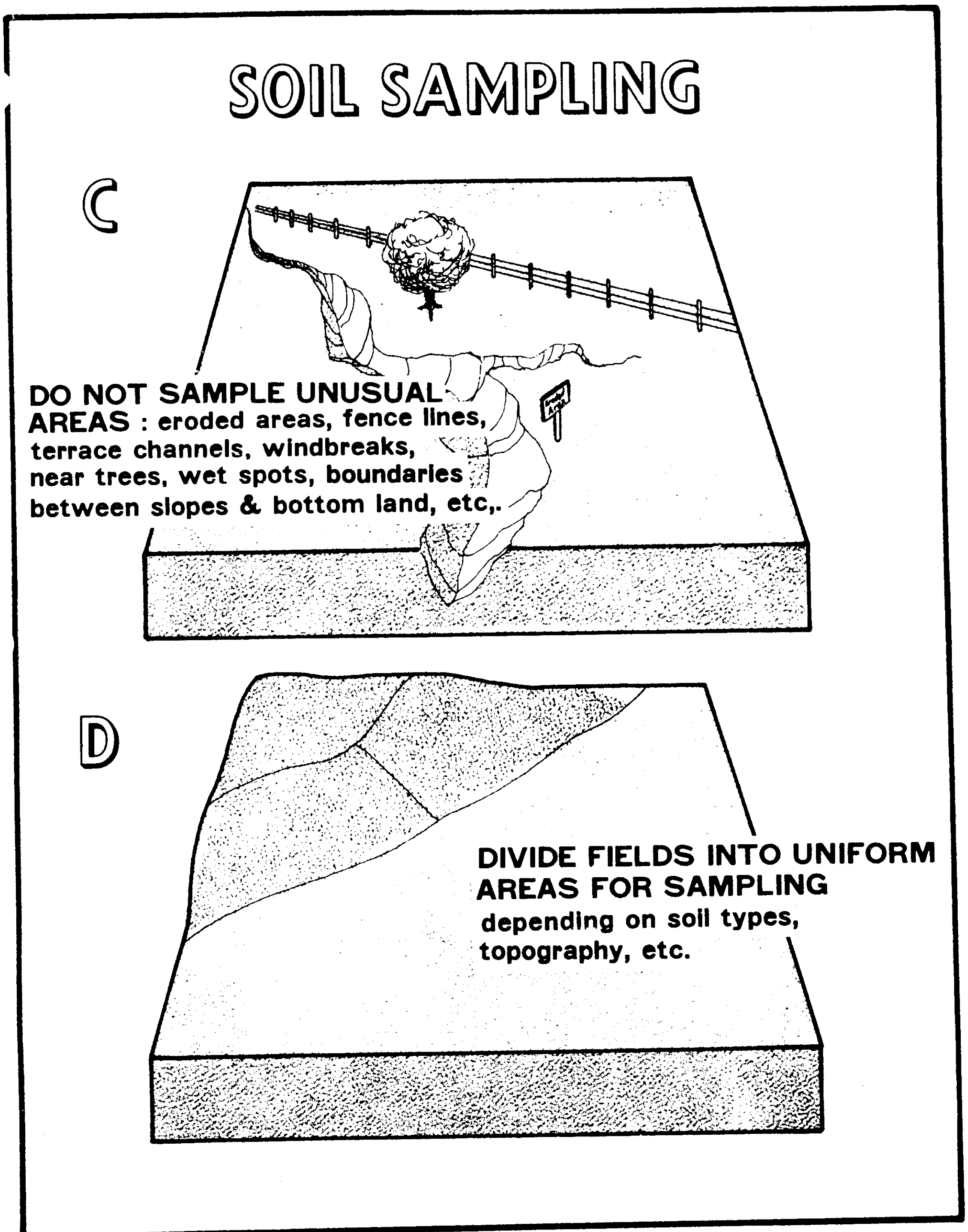

POTASH deficiency in corn
POORLY FILLED TIPS AND LOOSE CHAFFY KERNELS RESULT FROM K DEFICIENCY
NORMAL
K DEFICIENCY
K IS NEEDED WHEN SLICE-AWAY REVEALS NODES ARE DISCOLORED DARK BROWN
K DEFICIENCY CAUSES FIRING OR DRYING ALONG THE TIPS AND EDGES OF LOWEST LEAVES

Factors That Influence Fertilizer Use

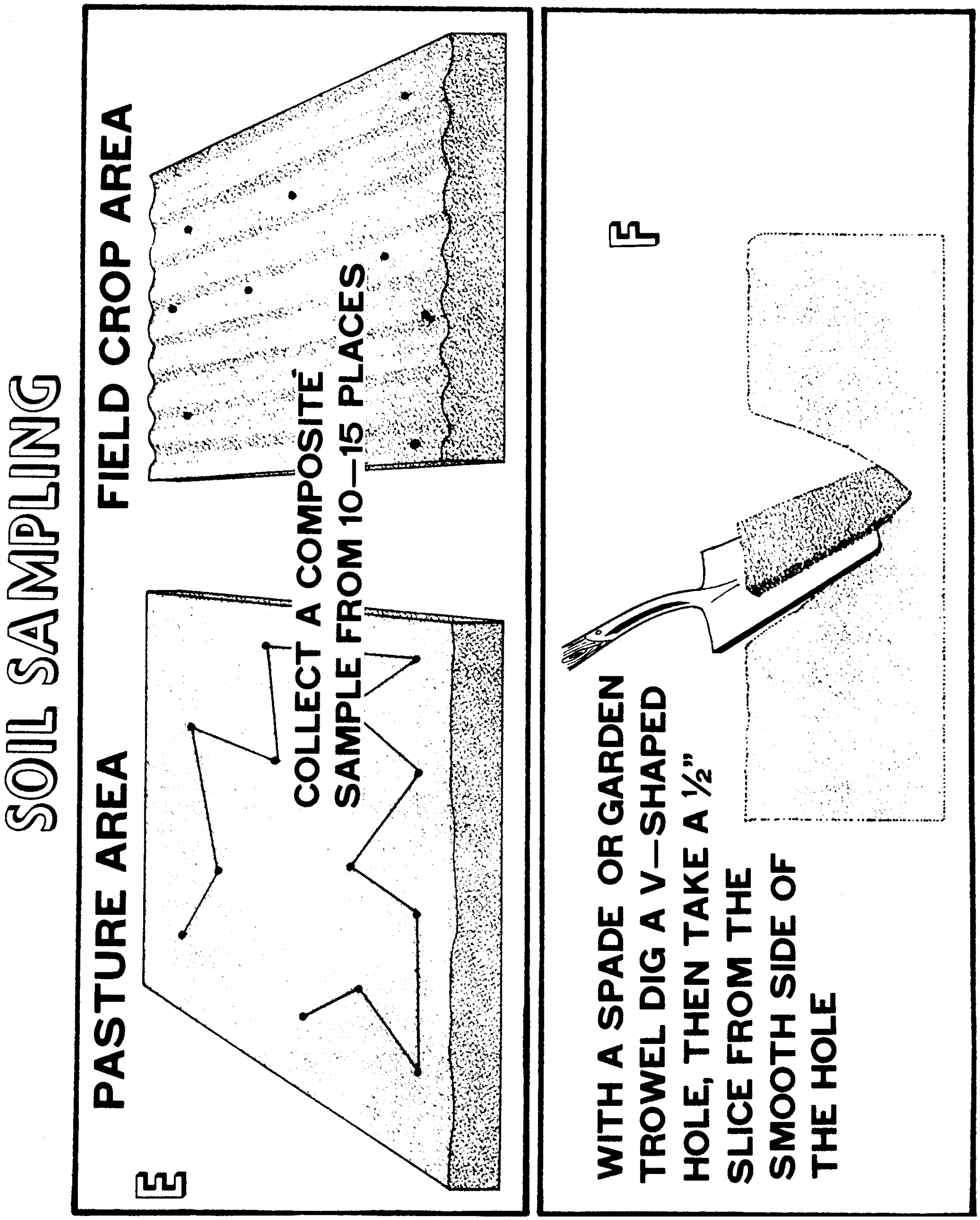
1. Chemical condition of the soil
2. Physical condition of the soil
3. Crop to be grown
4. Climatic conditions
5. Time

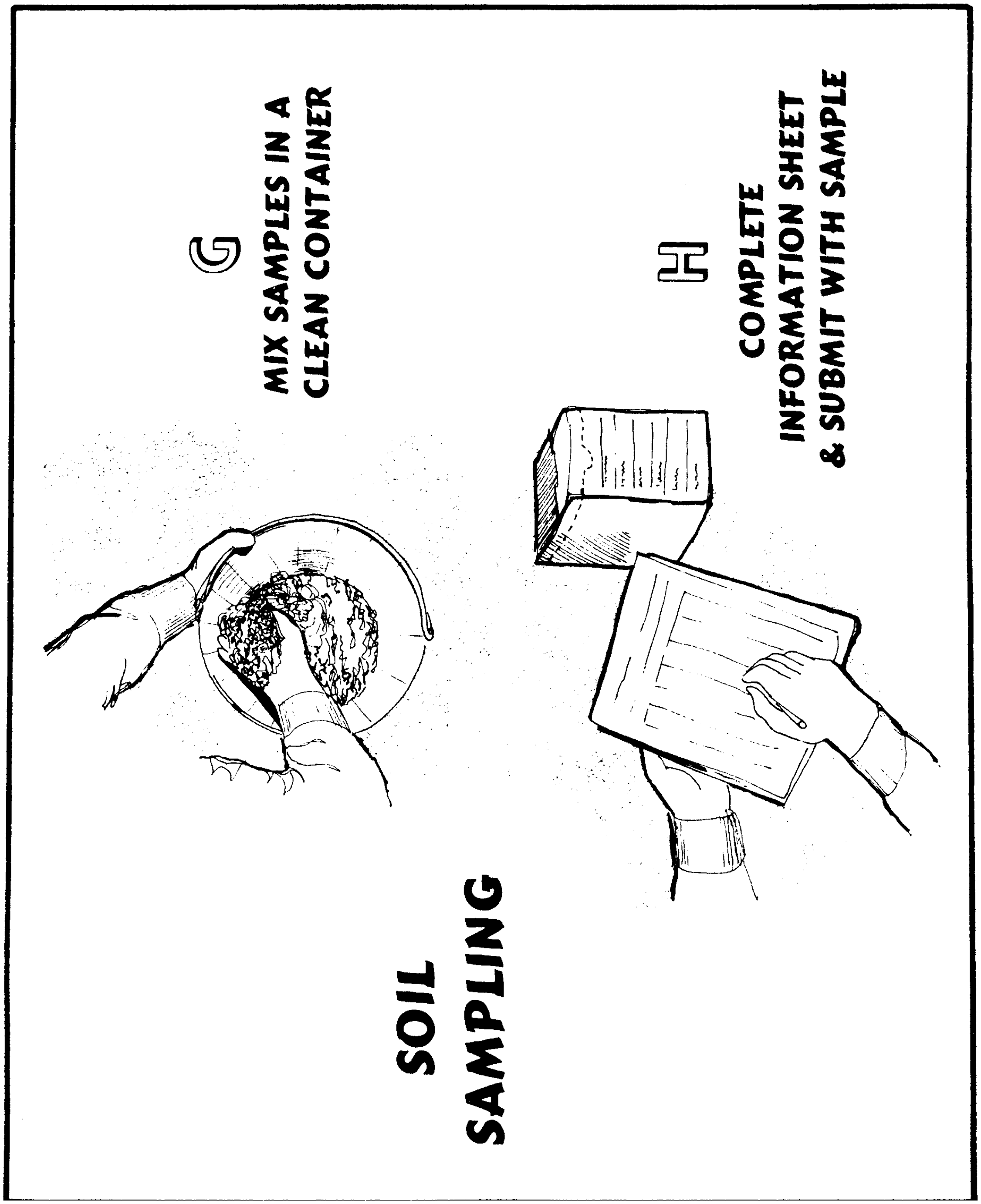

SOIL Sampling
Obtain cartons and information sheets from local agricultural authorities.
A
FOLLOW INSTRUCTIONS CAREFULLY
B
Soil Probe
Soil Auger
Spade or Shovel
Garden Trowel
SAMPLING TOOLS

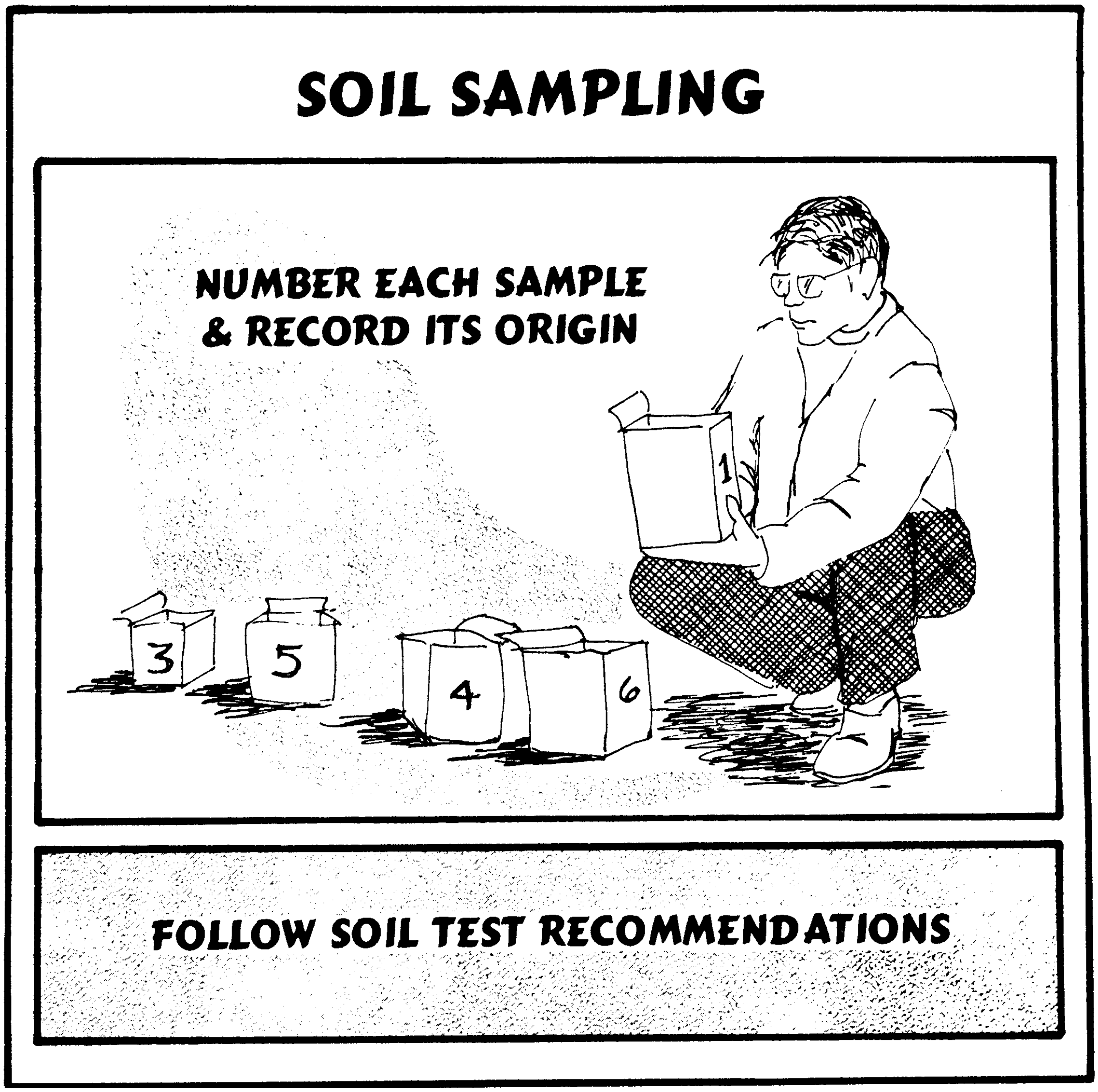
TM 5


SOIL SAMPLING
C
DO NOT SAMPLE UNUSUAL AREAS : eroded areas, fence lines, terrace channels, windbreaks, near trees, wet spots, boundaries between slopes & bottom land, etc,.
D
DIVIDE FIELDS INTO UNIFORM AREAS FOR SAMPLING
depending on soil types, topography, etc.

TM 6

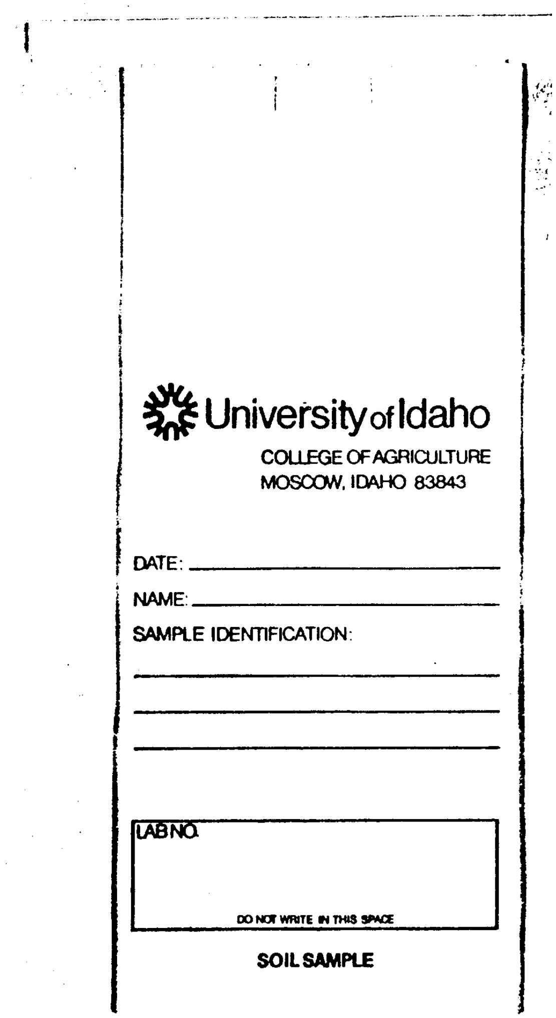

SOIL SAMPLING
PASTURE AREA
FIELD CROP AREA
COLLECT A COMPOSITE SAMPLE FROM 10—15 PLACES
E
F
WITH A SPADE OR GARDEN TROWEL DIG A V—SHAPED HOLE, THEN TAKE A ½" SLICE FROM THE SMOOTH SIDE OF THE HOLE


SOIL
SAMPLING
G
MIX SAMPLES IN A
CLEAN CONTAINER
H
COMPLETE
INFORMATION SHEET
& SUBMIT WITH SAMPLE


SOIL SAMPLING
NUMBER EACH SAMPLE & RECORD ITS ORIGIN
1
3
5
4
6
FOLLOW SOIL TEST RECOMMENDATIONS

Soil Sample Bag

1. Identify and number each sample before filling.
2. Fill soil sample bag 1/2 to 2/3 full with mixed soil from pail.
3. Securely close the bag.
4. Complete soil test report form by filling in field information section and checking the soils tests desired.
5. Send immediately to testing laboratory.



Soil Test Request and Report Form

Form #88

DO NOT WRITE IN THIS SPACE
Lab no. ________
Fee ________
Status: Paid Bill Other ________
Check no. ________

Analytical Services Laboratory
College of Agriculture
Moscow, ID 83843-4196
(208) 885-6201

University of Idaho

Mailing Name ________ Phone: ________

Address ________

Date: ________

FIELD INFORMATION			
Irrigation: ☐ Sprinkler ☐ Furrow ☐ None			
Rotation	Crop	Fertilizer applied lb/acre	Yield
Next crop			
Previous crop			
Grown in 19( )			
Grown in 19( )			

County: ________

Grower: ________

Sample Identification:

☑ CHECK TEST REQUIRED: Please make checks payable to **Bursar, University of Idaho.**

☐ Standard Fertility Test* ($10.00)
*Includes drying and grinding ($1.50), pH, P, K and O.M.

___ Bicarbonate P & K ___ Acetate P & K

☐ pH (soil reaction)	$ 1	
☐ Available P (ppm P)	$ 3	
☐ Available K (ppm K)	$ 3	
☐ Organic matter (%)	$ 3	
Other Tests:		
☐ Sulfate-S (ppm S)	$ 3	
☐ Boron (ppm B)	$ 5	
☐ Total Salts (E.C.) (mmhos/cm)	$ 2	
☐ Gypsum Requirement	$20	
☐ Lime Requirement	$ 4	
☐ Cation Exchange Capacity (meq/100g)	$ 7	
☐ Zinc (ppm Zn)	$ 4	
☐ Copper (ppm Cu)	$ 4	
☐ Manganese (ppm Mn)	$ 4	
☐ Iron (ppm Fe)	$ 4	

Depth (feet)	Nitrate N (ppm)	Ammonium N (ppm)	Available Moisture (inches)
0-1	☐	☐	☐
1-2	☐	☐	☐
2-3	☐	☐	☐
3-4	☐	☐	☐
4-5	☐	☐	☐
5-6	☐	☐	☐
6-7	☐	☐	☐
Total			

$3 per test ppm × 4 = lb/acre

Cations:	Extractable	Soluble
Calcium	☐	☐
Magnesium	☐	☐
Sodium	☐	☐
Potassium	☐	☐

$3 per test SAR ________

Contact the Analytical Services Laboratory for other special analyses.

FERTILITY GUIDE

Pounds Per Acre						
N	P_2O_5	K_2O				

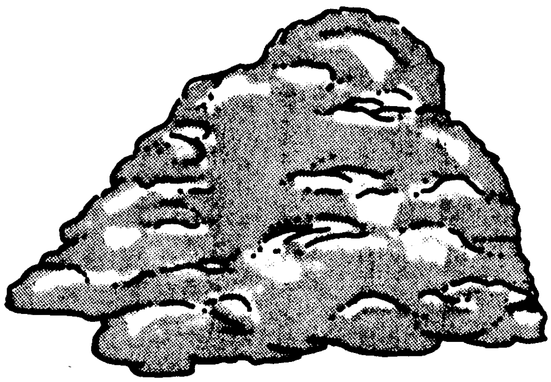
Remarks: ________

TM 11

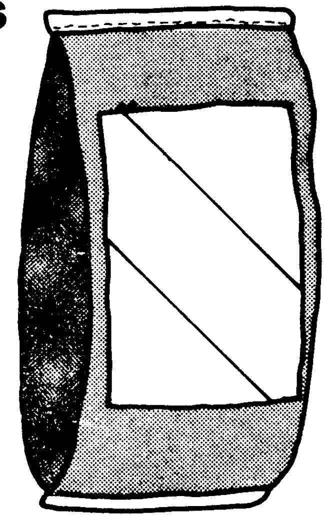
If you wish further details or have questions concerning the soil analysis, please contact your University of Idaho County Extension Agent.

White — Grower copy • Yellow — Fertilizer Dealer copy • Pink — Ag Agent copy • Goldenrod — Laboratory copy

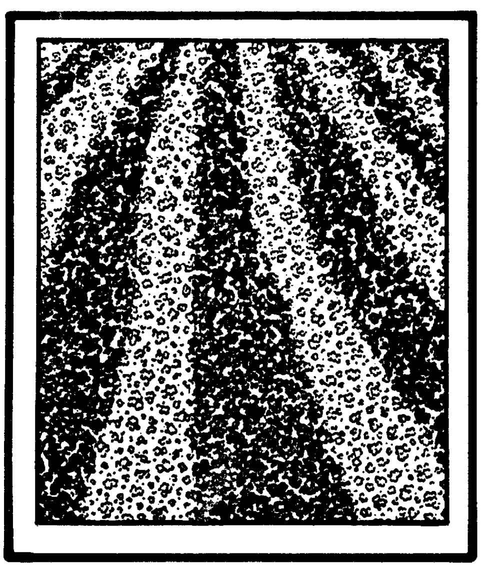
Nutrient Sources



Animal manure



Commercial fertilizers

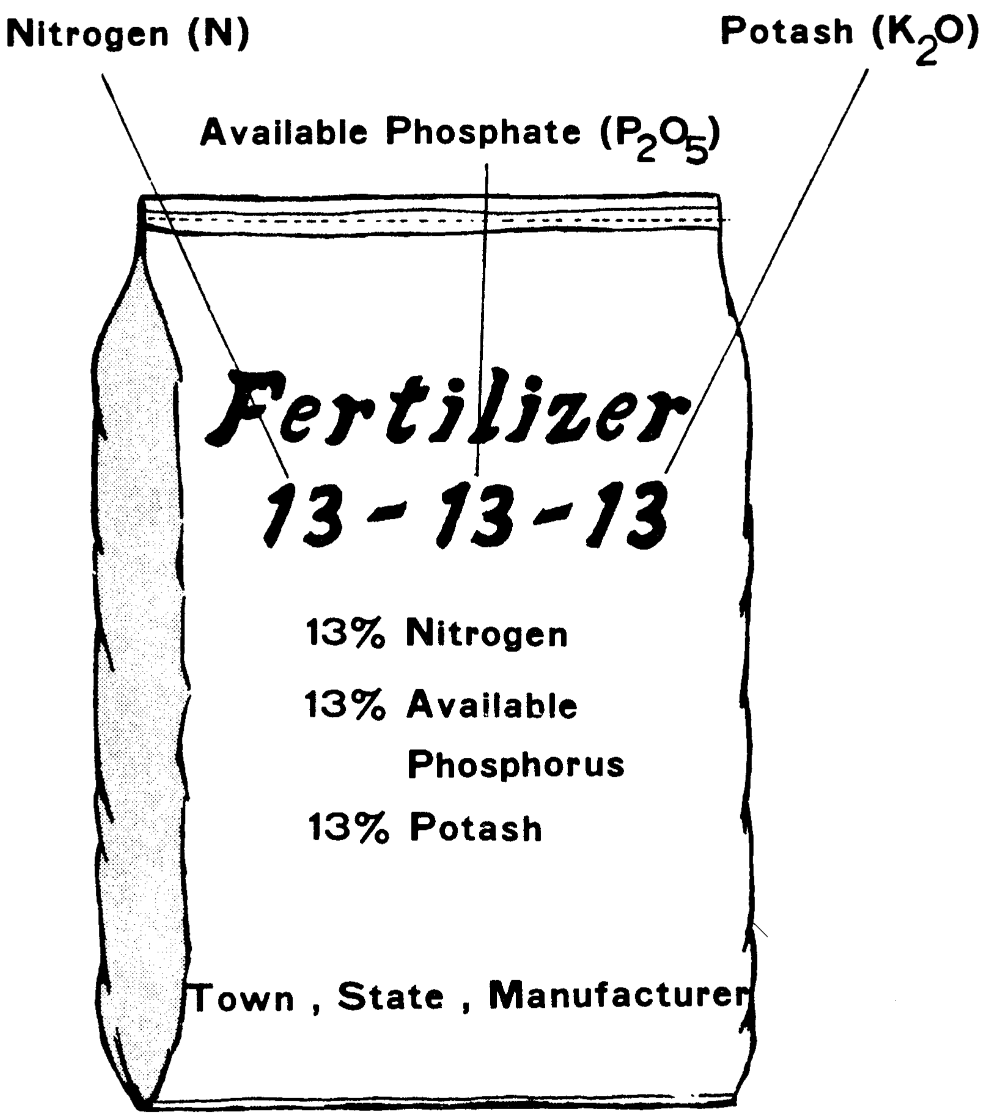


Crop residues

Green manure crop

TM 12

PLANT NUTRIENT BLENDS



13 N — 13 P_2O_5 — 13 K_2O = 1—1—1 Ratio

13 Lbs. of Each Primary Nutrient = 39 Lbs. per 100 Lbs. of Fertilizer

TM 13

Compare Cost Per Pound of Nutrient, **Not** Cost Per Pound of Fertilizer!

$$\frac{\text{Price of fertilizer}}{\text{Net weight in lbs.} \times \text{Guaranteed \%}} = \text{Price per pound of nutrient}$$

SOIL FERTILITY

AG 150 - B

ASSIGNMENT SHEET #1--CALCULATE COST PER POUND OF NITROGEN FOR DIFFERENT FERTILIZER ANALYSES

Name ______________________ Score ______________________

Compare the cost per pound of actual nitrogen for each fertilizer. When you have completed the problems, return to your instructor for evaluation. Ask instructor for the local price per ton of each analysis.

	Fertilizer	Local price/ton	Cost per pound N
1.	Ammonium nitrate 33.0%	____________	____________
2.	Anhydrous ammonia 82.0%	____________	____________
3.	Urea 45.0%	____________	____________
4.	Ammonium sulfate 21.0%	____________	____________

SOIL FERTILITY

AG 150 - B

ASSIGNMENT SHEET #2--COMPLETE A SOIL TEST REPORT FORM

Name ______________________________________ Score __________________________________

Secure a soil sample and answer the necessary information concerning the crop to be grown and the cropping history of the plot. Check the type of soil test desired. Have the sample analyzed. Using fertilizers available in your community and local prices, recommend the fertilizers to use and the amount. When completed, return to instructor for evaluation and discussion purposes.

(Note: Soil Test Report Forms, fertilizer guides and instructions may be obtained from your local cooperative extension agent.)

Available Fertilizers	Cost/Ton	Amount Required	Total Cost
1.			
2.			
3.			
4.			

SOIL FERTILITY

AG 150 - B

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Cost will vary according to local cost of fertilizers.

Assignment Sheet #2

Evaluated to satisfaction of instructor.

SOIL FERTILITY

AG 150 - B

UNIT TEST

Name ____ Score ____________________________________

1. Match terms associated with soil fertility to the correct definitions. Write the correct numbers in the blanks.

_____a.	Natural, manufactured or processed material or mixture of materials that contains one or more of the essential nutrients; available in dry, liquid or gaseous form	1.	Essential nutrient
_____b.	Plant condition where an essential nutrient is not sufficiently available	2.	Deficiency
_____c.	Percentage water soluble content of nitrogen (N), phosphorus (P) expressed as P_2O_5 and potassium (K) expressed as K_2O in the fertilizer	3.	Symptom
_____d.	Trademark of the company which produced the fertilizer	4.	Fertilizer
_____e.	A visual sign or condition that results from a deficiency; aids in diagnosing a deficiency	5.	Analysis
_____f.	Fertilizer which supplies all three of the primary nutrients (N, P, K)	6.	Brand
_____g.	Element necessary for plant growth and reproduction, for example: nitrogen, phosphorus and potassium	7.	Complete fertilizer

2. Match the functions of nutrients for crop growth to the correct nutrient. Write the correct numbers in the blanks.

_____a.	Gives dark green color to plant; promotes rapid growth; increases protein and yields; aids and promotes seed and fruit development	1.	Nitrogen (N)
		2.	Phosphorus (P)
_____b.	Speeds decay of organic matter; stimulates formation of nitrates; promotes root and leaf growth; is necessary for nodulation of legumes	3.	Potassium (K)
		4.	Sulphur (S)
_____c.	Necessary for production and translocation of carbohydrates; produces plumper seeds; controls water intake and respiration; stiffens straw and stalks	5.	Calcium (Ca)
		6.	Magnesium (Mg)

_____d. Necessary for chlorophyll or green plant color; increases absorption of phosphorus; aids in formation of fats and oils; important in plant enzyme system

_____e. Important to germinating seedlings; contributes to early maturing crops; necessary for seed and fruit formation; stimulates root growth

_____f. Necessary for nodule formation on legumes; associated with plant enzyme systems; stimulates seed production; affects protein and crop quality

3. Match nutrients to the correct deficiency symptoms. Write the correct numbers in the blanks.

_____a. Stunted and spindly; yellow, yellowish-green or light green color in foliage; older leaves affected first

_____b. Stunted growth; very dark green color; purple leaves in advanced stages; older leaves affected first

_____c. Shorter plants; bronzing or browning of leaf color; lodging occurs

_____d. Young plants have stunted appearance; leaves light green to yellow color; stems are thin and spindly

_____e. Leaf parts between veins show a whitish color; interveinal chlorosis; leaves curl upward along the margins

1. Magnesium
2. Sulphur
3. Nitrogen
4. Potassium
5. Phosphorus

4. Select from the following list factors that influence the use of fertilizers. Write an "X" in the blank before each correct answer.

_____a. Fertility of soil

_____b. Crops to be grown

_____c. Physical condition of soil

_____d. Insects

_____e. Climatic conditions

_____f. Diseases

_____g. Time of application

5. Discuss the major points in collecting and handling a representative soil sample.

____

____

____

____

____

____

____

____

____

6. List four sources of nutrients.

a.____

b. ____

c.____

d. ____

7. Match the types of fertilizers to the correct description. Write the correct numbers in the blanks.

_____a.	Granulated fertilizer made by combining selected plant nutrient materials to obtain certain ratios and quantities of plant nutrients	1.	Liquid
		2.	Dry mixed
_____b.	Liquid fertilizer containing solid fertilizer materials which is dispensed under pressure and usually contains a higher analysis than clear liquid mixes	3.	Gas
_____c.	Fertilizer made by dissolving the correct proportion of the solid plant nutrient carriers into water; may be in solution or suspension		

8. By calculating the cost per pound of nitrogen for each of the following fertilizers, determine which is the cheapest source of nitrogen. Show all work.

   a. 34-0-0 (ammonium nitrate) at $122/ton

   ____

   ____

   ____

   b. 82-0-0 (anhydrous ammonia) at $160/ton

   ____

   ____

   ____

   c. Cheapest source of N is ______________________________

9. List three methods of fertilizer application.

   a. ______________________________

   b. ______________________________

   c. ______________________________

SOIL FERTILITY

AG 150 - B

ANSWERS TO TEST

1. a. 4
   b. 2
   c. 5
   d. 6
   e. 3
   f. 7
   g. 1

2. a. 1
   b. 5
   c. 3
   d. 6
   e. 2
   f. 4

3. a. 3 b. 5 c. 4 d. 2
   e. 1

4. a, b, c, e, g

5. Answer should include information from the following: (for more detailed information, refer to pages 150B-9 - 150B-12)

   Steps involved in taking a good soil sample; Materials needed to collect sample; When to take sample; Sampling area; Collecting a representative sample; Sending sample to be tested; How often to test soil

6. Animal manure; Crop residues; Green manure crops; Commercial fertilizers

7. a. 2 b. 3 c. 1

8. a. 18¢/lb of N
   b. 10¢/lb of N
   c. 82-0-0 (anhydrous ammonia)

9. Answer should include three of the following:

   Broadcast; Soil injection; Banding; With irrigation water

IRRIGATION

AG 150 - C

UNIT OBJECTIVE

After completion of this unit, students should be able to list the components of different irrigation systems, determine water intake rates and available moisture, and calculate irrigation frequency. Students should also be able to discuss factors that affect the selection of irrigation systems. This knowledge will be demonstrated by completion of assignment sheets and a unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with irrigation to the correct definitions.
2. List three reasons for irrigating.
3. Select factors that affect water intake rates.
4. Calculate the total available moisture of a soil.
5. Name three methods used for estimating soil moisture in the crop root zone.
6. Calculate days remaining until next irrigation.
7. Name two units of volume measurement and two units of flowrate measurement of water.
8. Convert cubic feet per second into other units of water measurement.
9. Name three devices for measuring water in motion.
10. Name four types of irrigation systems.
11. Match the basic parts of a surface irrigation system to the correct definitions.
12. Match the basic parts of sprinkler irrigation system to the correct definitions.
13. Select factors that affect the selection of irrigation systems.
14. Discuss costs involved with irrigation.

IRRIGATION

AG 150 - C

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Farm Drainage*, instructional package, 10 pages notes, 26 transparencies; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112.

b. *Planning for an Irrigation System*, a paperback discussing different irrigation systems; available from AAVIM, 120 Engineering Center, Athens, Georgia 30602.

c. The following Current Information Series (CIS) publications are available from Agricultural Communications Center, Building J40, Idaho Street, University of Idaho, Moscow, Idaho 83843-4196 (208-885-4196).

Application of Agricultural Chemicals in Pressurized Irrigation Systems, approximate cost $.35; order no. CIS 673.

Available Water-Holding Capacities of Soils in Southern Idaho, approximate cost $.35; order no. CIS 236.

Buying a Low Energy Irrigation System, approximate cost $.25; order no. CIS 572.

Investment Costs for Center Pivot Systems, approximate cost $.25; order no. CIS 579.

Investment Costs for Gravity Irrigation Systems, approximate cost $.35; order no. CIS 578.

Investment Costs for Sprinkler Systems, approximate cost $.35; order no. CIS 577.

Irrigation Runoff Control Strategies, approximate cost $.25; order no. PNW 287.

Irrigation Scheduling, approximate cost $.25; order no. PNW 288.

Irrigation System Walk-Through Inspection Analysis, approximate cost $.25; order no. PNW 293.

Reducing Soil Losses with Filter Strips, approximate cost $.35; order no. CIS 587.

Solid Set Sprinkler Systems, approximate cost $.35; order no. CIS 272.

2. Filmstrips, slideshows, etc.

    a. *Irrigation*, 6 cassettes, 6 filmstrips and study guide; available from Teaching Aids, Inc., P. O. Box 1798, Costa Mesa, California 92626; approximate cost $229.00; order no. B263.

    b. *The Irrigation System Explained*, 6 filmstrips and 6 cassettes; available from Agrimedia Corporation, Garden City, New York 11530; approximate cost $154.00; order no. 401.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information and assignment sheets and discuss.

E. Review and give test.

F. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Soil Texture and Water Intake Rates

2. TM 2--Average Water Holding Capacity of Soils Representing Different Textural Classes

3. TM 3--Effective Root Zones of Common Crops

4. TM 4--Soil Moisture Scheduling Procedure

5. TM 5--Crop Stress Point

6. TM 6--Units of Water Measurement

7. TM 7--Conversion of Units of Water Measurement

8. TM 8--Equivalent Rate of Flow

9. TM 9--Types of Weirs

10. TM 10--Types of Flumes

11. TM 11--Types of Flowmeters

12. TM 12--Parts of a Surface Irrigation System

13. TM 13--Level Systems of Surface Irrigation

14. TM 14--Graded Systems of Surface Irrigation

15. TM 15--Parts of a Sprinkler Irrigation System

16. TM 16--Common Types of Sprinklers

17. TM 17--Types of Sprinkler Irrigation Systems

18. TM 18--Factors That Affect the Selection of Irrigation Systems

19. TM 19--Comparison of Investment Costs for Irrigation Systems

E. Assignment sheets

1. AS 1--Calculate Total Available Moisture

2. AS 2--Calculate Days Until Next Irrigation

3. AS 3--Calculate Irrigation Length

4. AS 4--Convert Units of Water Measurement

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. *Crops, Soils, and Fertilizer Resource Manual*, Vo-Ed No. 73, University of Idaho, Department of Agricultural Education, Moscow, Idaho, 1978.

B. Knuti, Williams and Hide, *Profitable Soil Management*, 4th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

C. Marr, James C., *Furrow Irrigation*, Manual No. 37, Agricultural Publications, University of California at Berkeley, Berkeley, California, 1967.

D. Pair, Hinz, Reid and Frost, *Sprinkler Irrigation*, 47th edition, Sprinkler Irrigation Association, Silver Springs, Maryland, 1975.

E. Turner and Anderson, *Planning for an Irrigation System*, 2nd edition, American Association for Instructional Materials, Athens, Georgia, 1980.

IRRIGATION

AG 150 - C

INFORMATION SHEET

I. Terms and definitions

A. Irrigation--To supply land with water by means of ditches, sprinklers or other system

B. Soil texture--A name given a textural group based on the relative proportions of the soil separates (sand, silt, clay)

C. Soil structure--The combination and arrangement of soil particles (sand, silt, c clay) into aggregates

D. Slope--A measurement of difference in elevation from one point to another; it is generally referred to as a percent--the number of feet difference in elevation for 100 feet of horizontal distance

E. Water table--The level at which the soil is saturated with water; usually below the soil surface

F. Soil profile--A vertical cross-section of the soil from the surface through all its horizons

G. Root zone--That part of the soil profile from which growing plants can utilize water and nutrients

H. Irrigation frequency--The number of days between irrigations

I. Weir--An obstruction placed in a stream or channel diverting the water through a device to measure the flow of water; types include rectangular, cipolleti and v-notch

J. Measuring flume--Chute placed in a stream or channel to measure the flow of water

K. Flowmeter--A device used for measuring water flow from a well or pipeline

L. Corrugate--A series of parallel furrows commonly used in surface irrigation systems to direct the flow of water between seedbeds

M. Ditch--Channel for carrying water for drainage or irrigation of the soil

N. Tilth--The physical condition of soil as related to its ease of tillage and fitness as a seedbed

II. Reasons for irrigating

A. Provide water for crops in the right amount at the right time

(Note: Some areas have sufficient yearly rainfall, but it does not come when the crop needs it most. Crops suffer because the time between rainfalls is too long, drought conditions occur, plants suffer and yields decrease.)

B. Increase crop yield

(Note: Reasons that yields increase when ample water is available from irrigation are (1) better assurance of a good stand, (2) more plants per acre can be grown, (3) more efficient use of fertilizer, and (4) improved varieties can be planted.)

C. Improve crop quality

(Note: Many examples from research and experience can be cited to show that irrigation improves quality. Fruit is larger and more uniform in size. Ears of corn are more uniform and you get a larger percentage of No. 1 potatoes.)

III. Soil properties that affect water intake rates

A. Soil texture (Transparency 1)

1. Coarse sand - 0.75-1.00 inches/hr

2. Fine sands - 0.50-0.75 inches/hr

3. Fine sandy loams - 0.35-0.50 inches/hr

4. Silt loams - 0.25-0.40 inches/hr

5. Clay loams - 0.10-0.30 inches/hr

B. Soil structure

(Note: Soil structure plays an important part in the productivity of different soils, affecting the ease with which roots can penetrate, the water intake rate and the movement of water in the soil.)

C. Slope

(Note: As the slope of a field increases, the chance for the water to run off before entering the soil increases.)

D. Other factors

1. Presence of impermeable layer in soil profile

2. General tilth of surface soil

3. Moisture content of the soil profile

IV. Total available moisture of the soil (Transparency 2)

A. The amount of water that can be held in the soil which is available for crop use

(Note: The soil profile is much like a sponge, the sponge having the capability to absorb water. Like the soil profile, the sponge has a saturation point where it cannot absorb any more water.)

1. Factors that affect total available moisture

a. Texture of surface and subsurface horizons

b. Depth of the soil profile

(Note: If a layer is present in the soil profile which is impenetrable to water, air and roots, the soil depth would be that part of the profile above this layer.)

B. Information needed to calculate the total available moisture for a crop growing in a soil

1. Soil type

2. Water holding capacity of that soil type

3. Root zone depth (Transparency 3)

Example: A crop, alfalfa, is growing in a loamy textured soil which has a water holding capacity of 1.69 inches of moisture per foot. The average root zone is four feet. What is the total available moisture of the root zone?

1.69 inches/foot x 4 feet = 6.75 inches

V. Estimate soil moisture in crop root zone

A. Plant and field methods--Crop stress point is determined by the plant showing signs of moisture stress

(Note: Plant symptoms that indicate moisture stress include wilted leaves and color change in leaves. By the time symptoms are noticeable, considerable damage has been done to the plant. This is not a recommended procedure for determining soil moisture.)

B. Feel method for estimating soil moisture

(Note: The use of this method of determining soil moisture requires much experience for the results to be very accurate. A pamphlet is available from the University of Idaho College of Agriculture, miscellaneous series #39, that describes soil types, percent available moisture and characteristics of each for a ball test, ribbon test and open-palm test. This method can be acceptable once fingertips are "calibrated".)

C. Tensiometers--Mechanical devices placed at several representative places in a field to measure soil moisture

(Note: Tensiometers are usually placed at two depths in the root zone. This is an accurate way of determining soil moisture to guide you in irrigation scheduling.)

VI. Soil moisture scheduling procedure (Transparency 4)

A. Determine total available moisture of crop root zone

Example: Potatoes on silt loam soil

1. Root zone depth (from Table 1)--2.0 ft.

Table 1
Effective Crop Root Zone Depth (no soil barriers)

Crop	Depth (ft)
Alfalfa	4.0
Beans	2.0
Field corn	3.0
Sweet corn	2.5
Mint	2.0
Onions	1.5
Potatoes	2.0
Small grains	3.5
Sugarbeets	3.0
Peas	2.0
Pasture	2.0

2. Available water-holding capacity of the soil (from Table 2) = 2.2 inches/ft

Table 2
Average Available Water-Holding Capacity of Soils

Soil type	inches/ft
Sand	1.0
Sandy loam	1.5
Loam, silt loam, clay	2.2

3. Total available moisture of crop root zone--2 ft x 2.2 in/ft = 4.4 in

B. Determine present soil moisture available for crop use

1. Determine present soil moisture

(Note: When using feel method, use soil auger to check moisture in crop root zone. Estimate soil moisture in 1 foot increments, or obtain information from reading on tensiometer to determine average soil moisture of crop root zone.)

Example: Potato field monitored on July 25. Soil moisture determinations indicate there is 80% available moisture in the first foot, 90% in the second foot or a crop root zone average of 85%

2. Crop stress point (from Table 3)--65% (Transparency 5)

Table 3
Crop Stress Point or Percent Moisture
Remaining at Irrigation

Crop	Season	First Irrigation	Later Irrigation	
Potatoes	65	65	50	(at vine kill)
Sugarbeets	50	50	50	
Sweet corn	60	40	60	
Field corn	50	40	50	
Mint	60	60	60	
Beans	60	60	60	
Small grains	40	40	60	(from boot stage through flowering)
Onions	70	60	70	
Alfalfa hay	50	50	50	
Pasture	50	50	50	

3. Percent moisture remaining for plant use: 85 - 65 = 20%

(Note: In this example, 100% available moisture is equivalent to 4.4 inches of water. Therefore, the amount of water remaining for plant use: 4.4 inches x 20% = 0.88 inches.)

C. Estimate crop water use

1. Find water use (E_t) from estimated crop water use table in newspaper

(Note: E_t = evapotranspiration loss of water from the soil both by evaporation and by transpiration from the plants or crop water use. For more information contact your county agent, fieldman or irrigation consultant.)

Example: E_t for potatoes on July 25 of 0.27 inches/day

D. Calculate days remaining until next irrigation

Example: .88 ÷ 0.27 = 3.3 days; therefore, the next irrigation should be July 28

VII. Units of water measurement (Transparency 6)

A. Volume measure

1. Gallons

2. Acre-inches--Amount of water required to cover one acre one inch deep (27,154 gallons)

3. Acre-feet--Amount of water required to cover one acre one foot deep (325,850 gallons)

B. Flow rate

1. Gallons per minute

2. Cubic feet per second

3. Miner's inch

VIII. Conversion of units of water measurement (Transparencies 7, 8)

1 gallon	= 231 cubic inches = 8.33 lbs
1 cubic foot	= 7.48 gallons = 62.4 lbs
1 acre-foot	= 43,560 cubic feet = 325,850 gallons = 12 acre-inches
1 acre-inch	= 27,154 gallons = 8,630 cubic feet
1 gallon per minute	= 0.00223 cubic feet per second
1 cubic ft per second	= 7.48 gallons per second = 450 gallons per minute = 646,272 gallons per day (24 hours) = 1.983 acre-feet per day (24 hours) = 50 miner's inches in Idaho

IX. Common measuring devices for water in motion

A. Weirs (Transparency 9)

1. Rectangular weirs

(Note: Originally used but aren't very accurate because the deeper the head of water, the greater the pressure and flow of water over the crest of the weir.)

2. Cipolleti weirs

   (Note: Angle of side walls compensates for the pressure due to additional height of water coming over the weir. This is the most accurate and is most commonly used.)

3. V-notch weirs

   (Note: This weir is relatively accurate but not a common weir. It is used mainly to measure small streams which come from small pumps.)

B. Flumes (Transparency 10)

1. Cutthroat

2. Parshall

3. Trapezoidal

C. Flow meters (Transparency 11)

X. Types of irrigation systems

A. Surface

B. Sprinkler

C. Trickle

D. Subsurface

XI. Surface irrigation (Transparency 12)

A. Water is applied on the ground at the ground level; it flows by gravity over the surface of the fields

B. Basic parts of a surface irrigation system

1. Water supply

   (Note: Common sources of water include: farm ponds, rivers, canals and wells.)

2. Field supply line--The means by which water is delivered from the source to the field; it may be an open ditch or a pipeline

   (Note: The ditch may be unlined or lined with such materials as concrete, asphalt or plastic. The most commonly used materials for pipelines are steel, aluminum, plastic, asbestos cement and concrete.)

3. Head ditch or head pipeline--The means by which water is made available from the field supply line to the different areas of the field

   (Note: The head ditch or head pipeline extends along one end or one side of the field to be irrigated.)

4. Turnouts--Used for releasing the water from the head ditch or pipeline onto the land to be irrigated

   (Note: On a head ditch, turnouts may be flood gates or siphon tubes. On a pipeline, turnouts may be gates such as on gated pipe or hydrant valves.)

5. Tail water ditch--Used for collecting excess water for reuse

   (Note: The tail water ditch is located at the end or side of the field opposite to the head ditch. This arrangement is important for several reasons: it allows a higher flow rate through the irrigated strip which increases the uniformity of water application; it saves the excess water and makes it available for reuse by pumping it back to the head ditch or pipe, or into another area to be irrigated.)

C. Types of surface irrigation systems

(Note: Surface systems are designed to fit two conditions: (1) level land--that with less than .1 percent slope, and (2) sloping land--that with .1 percent slope to as much as 15 percent. The type of surface system you consider will be determined by the amount of slope you have in the area you plan to irrigate.)

1. Level systems (Transparency 13)

   a. Border

   b. Contour levee

   c. Furrow

2. Graded systems (Transparency 14)

   a. Border

   b. Contour ditch

   c. Furrow

   d. Corrugation

   e. Contour furrow

XII. Sprinkler irrigation

A. Water is sprayed through the air and it falls to the ground like rain; this is accomplished by using either one or more rotating sprinklers or spray nozzles

B. Basic units of a sprinkler system (Transparency 15)

1. Pumping unit--Takes water from its source and makes it available under pressure to the system

   (Note: Pumping units are driven either by an electric motor or an internal combustion engine.)

2. Mainline pipe--Delivers the water from the pumping unit to the laterals

   (Note: Mainline pipe may be either permanent or portable. Pipe installed above ground is usually steel or aluminum. Pipe installed below ground is usually plastic, asbestos cement or steel.)

3. Lateral pipe--Delivers the water from the mainline pipe to the sprinklers

   (Note: Lateral pipe is of the same type and materials as mainline pipe but usually a smaller size.)

4. Sprinklers--Located at intervals along the lateral, the sprinklers break up the water into various size drops and distribute over the ground

   a. Types of sprinklers (Transparency 16)

      (1) Rotary sprinklers

      (2) Spray-type nozzle

C. Types of sprinkler irrigation systems (Transparency 17)

1. Solid set (permanent)

2. Hand lines (portable)

3. Lateral move (self-propelled)

4. Center pivot (self-propelled)

5. Big guns (portable or self-propelled)

XIII. Factors that affect the selection of different types of irrigation systems (Transparencies 18, 19)

A. Land slope

B. Water intake rate of soil

C. Water tolerance of crops

D. Wind action

E. Shape of field

F. Maximum height of crop

G. Labor required

H. Cost

XIV. Irrigation costs

(Note: The specific costs involved will depend on the type of irrigation system.)

A. Initial costs

1. Well (drilling, casing)

2. Reservoir pump (line shaft, propeller, turbine, centrifugal)

3. Power unit (electric, gasoline, diesel, natural gas or propane)

4. Miscellaneous (electric switch, gas line, fuel tank, land plane, land development)

5. Water pipe (underground or above ground)

6. Pipe trailer

7. Sprinkler systems (hand-moved, tractor-moved, self-moved, self-propelled, permanent)

8. Surface systems (land grading)

9. Subsurface systems (ditches, pipelines)

10. Land drainage, etc.

B. Annual depreciation cost (based on)

1. Initial cost of system

2. Interest

3. Taxes and insurance

4. Fixed charges (for example, stand-by charges for electricity)

5. Loss of income from land taken out of production for water development

6. Life expectancy of system

C. Annual operating cost

1. Fuel

2. Oil

3. Electricity
4. Equipment repair and maintenance
5. Reservoir and field maintenance
6. Water use charges
7. Labor

Soil Texture and Water Intake Rates

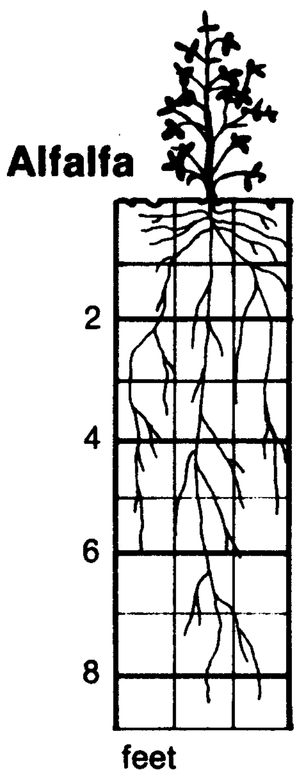
Texture Class	Basic Intake Rate
Coarse sand	0.75 - 1.00"/hr
Fine sands	0.50 - 0.75"/hr
Fine sandy loams	0.35 - 0.50"/hr
Silt loams	0.25 - 0.40"/hr
Clay loams	0.10 - 0.30"/hr

Average water holding capacity of soils representing different textural classes.

Soil Texture Class	WHC (in/ft)
Sand	0.43
Loamy Sand	0.84
Sandy loam	1.67
Sandy clay loam	1.12
Loam	2.10
Silt loam	2.44
Silt	2.12
Clay loam	1.08
Silty clay loam	2.10
Silty clay	2.91
Clay	1.94

Effective Root Zones of Common Crops

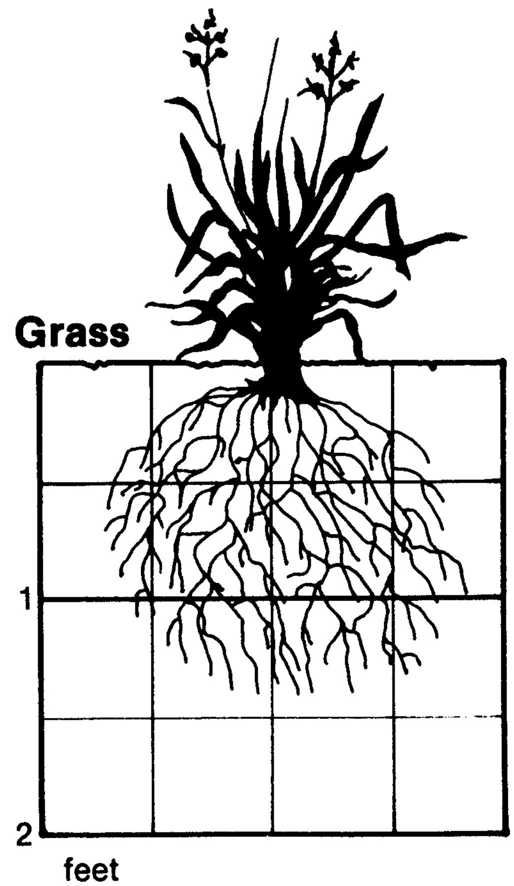
Taproot



Effective crop root zone depth (no soil barrier)

Crop	Depth (ft)
Alfalfa	4.0
Beans	2.0
Field corn	3.0
Sweet corn	2.5
Mint	2.0
Onions	1.5
Potatoes	2.0
Small grains	3.5
Sugar beets	3.0
Peas	2.0
Pasture	2.0

Fibrous Root



Soil Moisture Scheduling Procedure

1. Determine total available moisture of crop root zone.
2. Determine present soil moisture available for crop use.
3. Determine crop stress point, and calculate percent moisture remaining for plant use.
4. Estimate crop water use from E_t table.
5. Calculate days remaining until next irrigation by dividing the number of inches of water remaining by the E_t value.

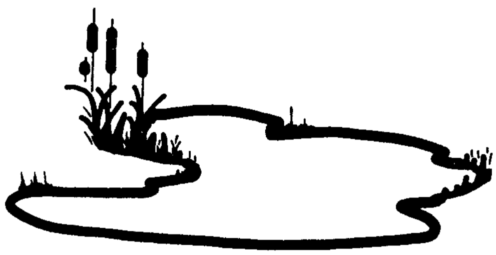
Crop Stress Point* or Percent Moisture Remaining at Irrigation

Crop	First irrigation	Later irrigation
Potatoes	65	50 (at vine kill)
Sugar beets	50	50
Sweet corn	40	60
Field corn	40	50
Mint	60	60
Beans	60	60
Small grains	40	60 (from boot stage through flowering)
Onions	60	70
Alfalfa hay	50	50
Pasture	50	50

*Check soil moisture for crop stress point approximately one-third the depth of crop root zone (potatoes, 8 to 10 inches deep).

Units of Water Measurement

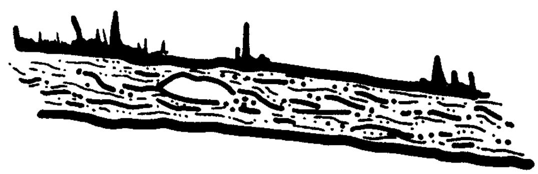
Volume



Pond or Reservoir

1. Gallons
2. Acre-inches
3. Acre-feet

Flow Rate



Stream or Ditch

1. Gallons per minute
2. Cubic feet per second
3. Miners inches

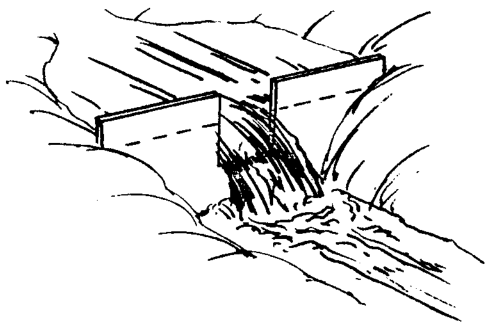
Conversion of Units of Water Measurement

1 gallon	= 231 cubic inches
	= 8.33 lbs
1 cubic foot	= 7.48 gallons
	= 62.4 lbs.
1 acre-foot	= 43,560 cubic feet
	= 325,850 gallons
	= 12 acre-inches
1 acre-inch	= 27,154 gallons
	= 8,630 cubic feet
1 gallon per minute	= 0.00223 cubic feet per second
1 cubic foot per second	= 7.48 gallons per second
	= 450 gallons per minute
	= 646.272 gallons per day
	= 1.983 acre foot per day
	= 50 miners inches in Idaho

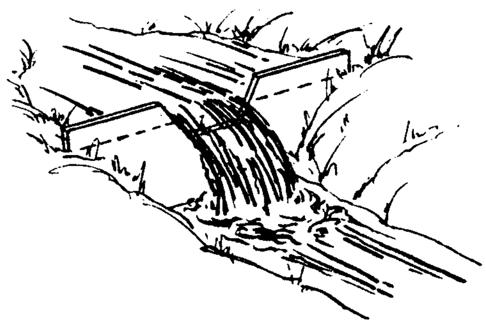
Equivalent Rate of Flow

Cubic feet per second (cfs)	Gallons per minute (gpm)	Acre-inches per hour	Acre feet per day (24 hours)	Idaho miner's inches
0.2	90	0.2	0.4	10
0.4	180	0.4	0.8	20
0.6	270	0.6	1.2	30
0.8	360	0.8	1.6	40
1.0	450	1.0	2.0	50
1.2	540	1.2	2.4	60
1.4	630	1.4	2.8	70
1.6	720	1.6	3.2	80
1.8	810	1.8	3.6	90
2.0	900	2.0	4.0	100
2.2	990	2.2	4.4	110
2.4	1080	2.4	4.8	120
2.6	1170	2.6	5.2	130
2.8	1260	2.8	5.6	140
3.0	1350	3.0	6.0	150
3.2	1440	3.2	6.4	160
3.4	1530	3.4	6.8	170
3.6	1620	3.6	7.2	180
3.8	1710	3.8	7.6	190
4.0	1800	4.0	8.0	200
5.0	2250	5.0	10.0	250
6.0	2700	6.0	12.0	300
7.0	3150	7.0	14.0	350
8.0	3600	8.0	16.0	400
9.0	4050	9.0	18.0	450
10.0	4500	10.0	20.0	500

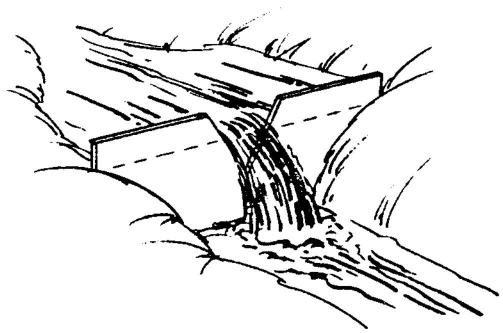
Types of Weirs



Rectangular weir

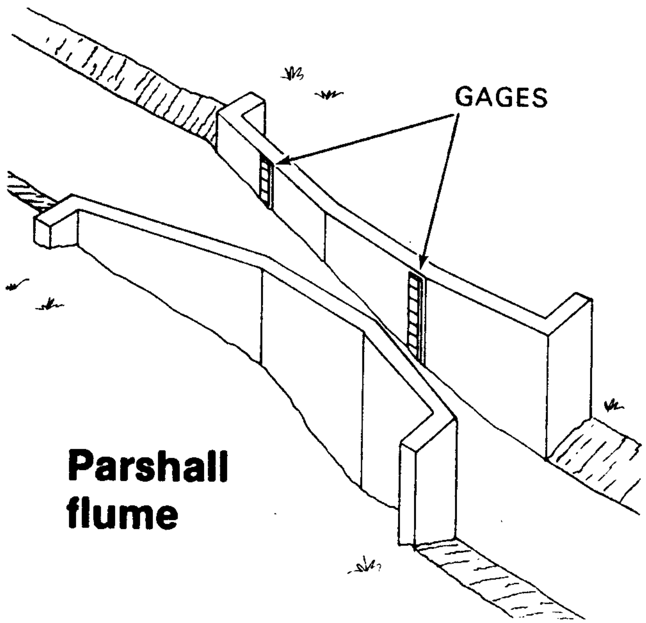


Cipolletti weir

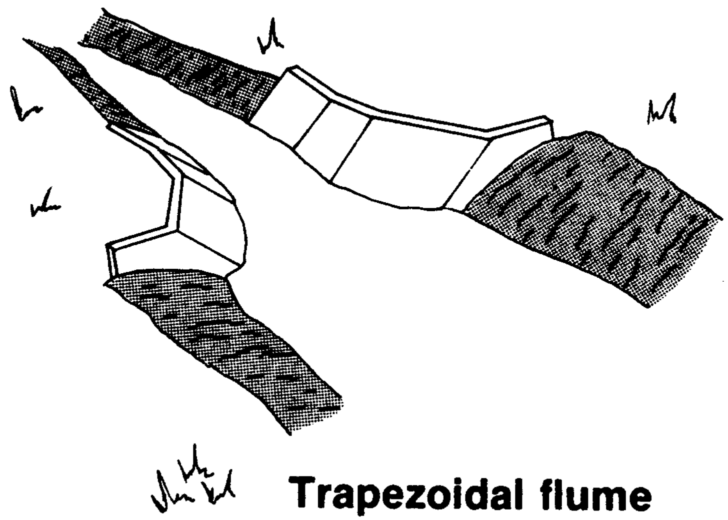


V-notch weir

Types of Flumes

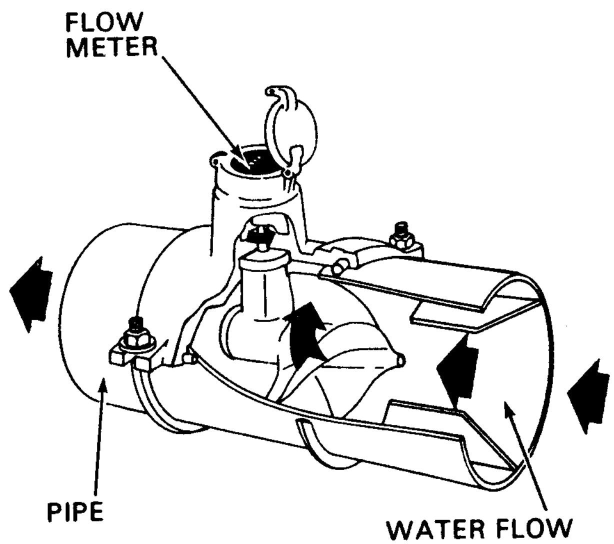


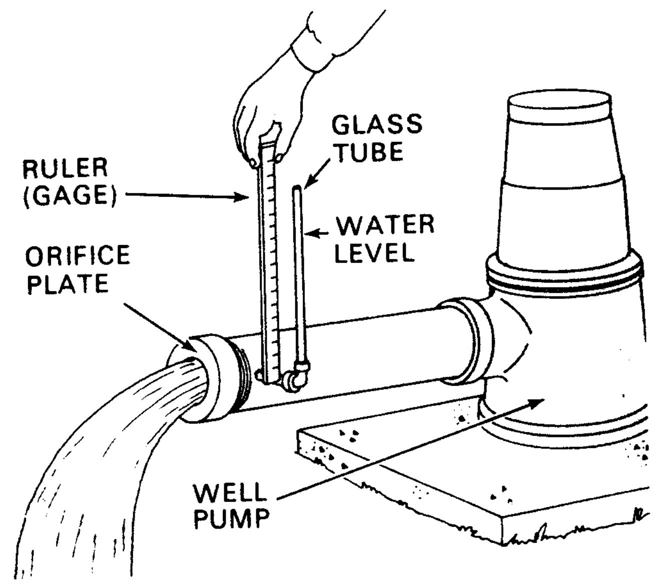
Parshall flume



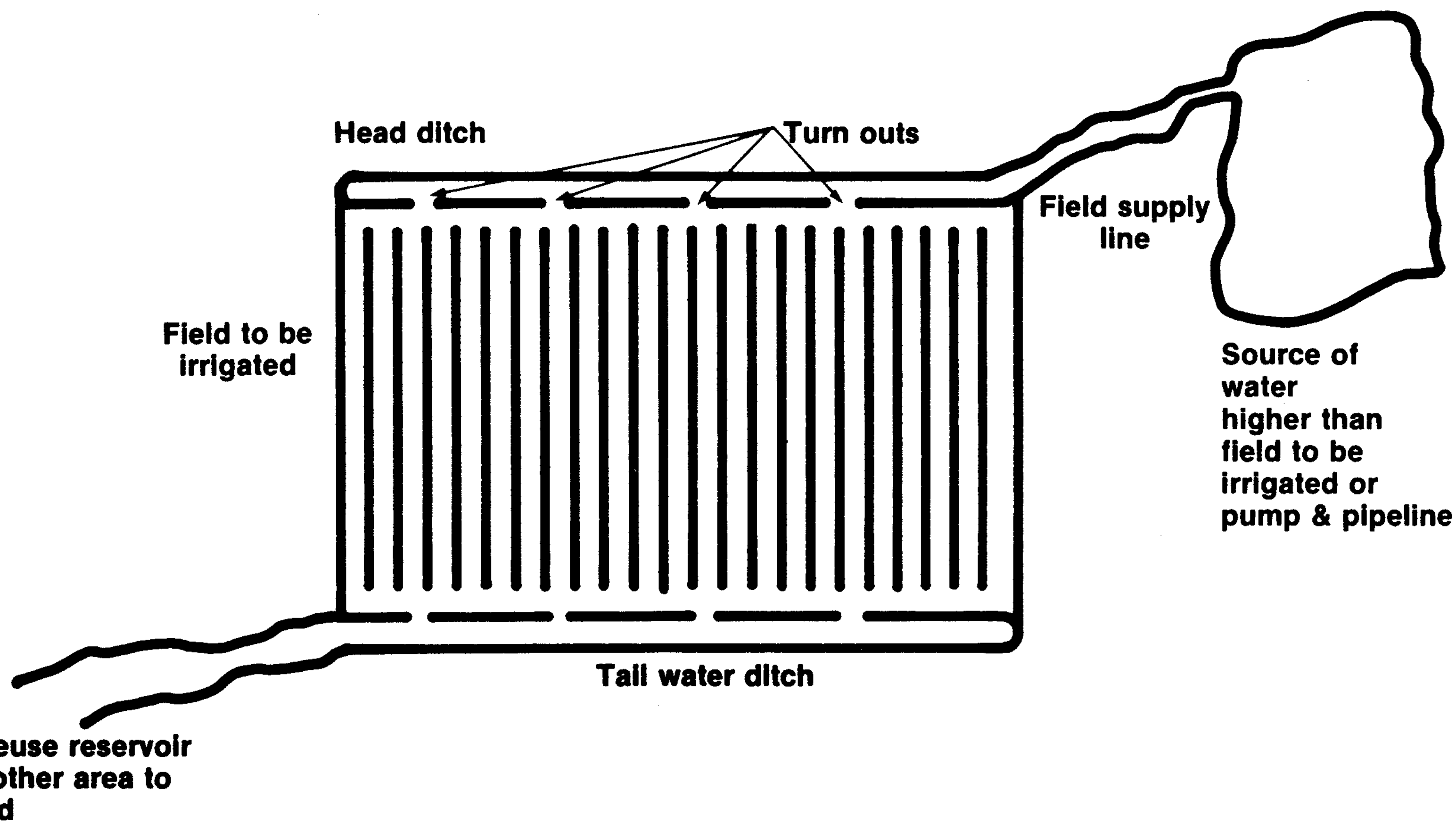
Trapezoidal flume

Types of Flowmeters

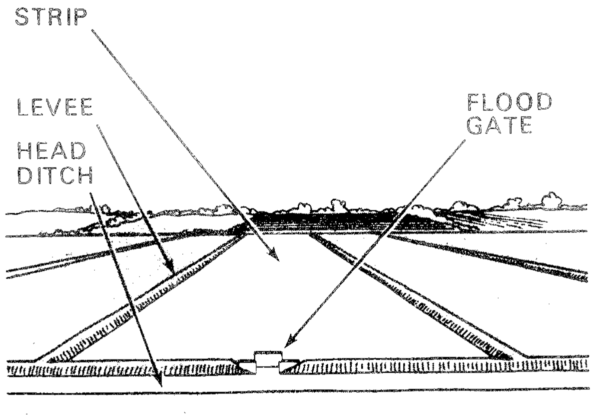




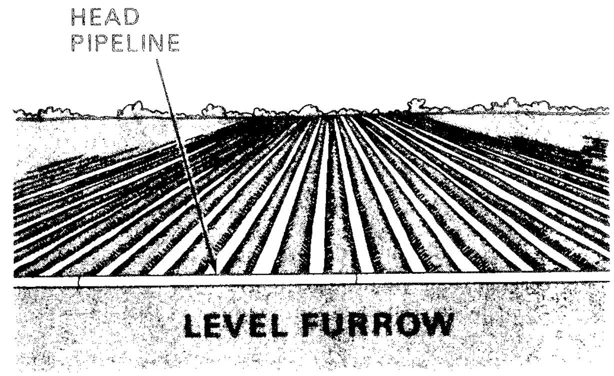
Parts of a Surface Irrigation System



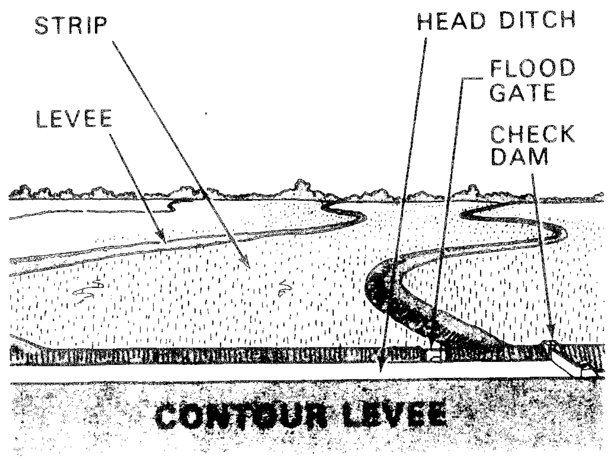
Level Systems of Surface Irrigation



LEVEL BORDER

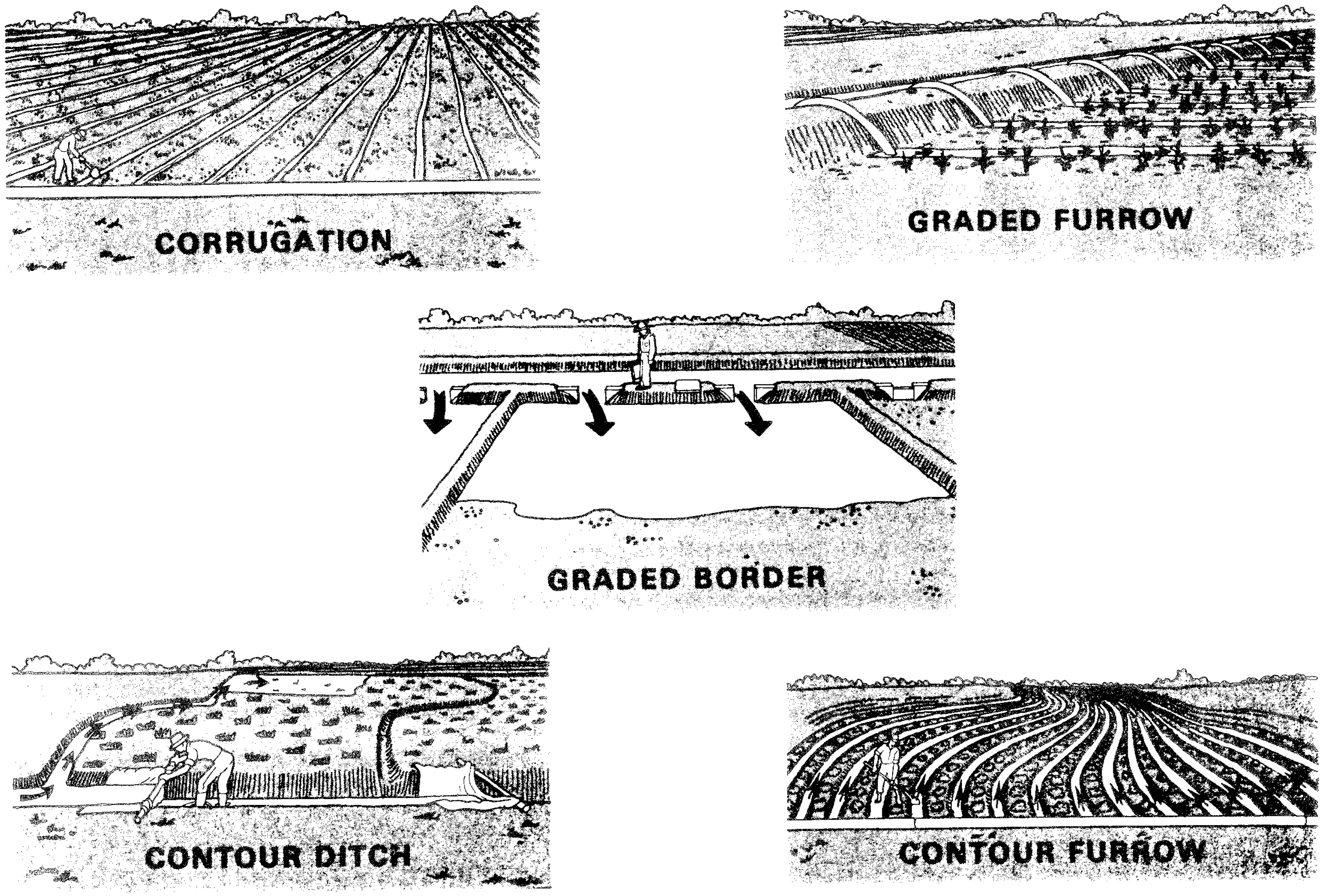


LEVEL FURROW

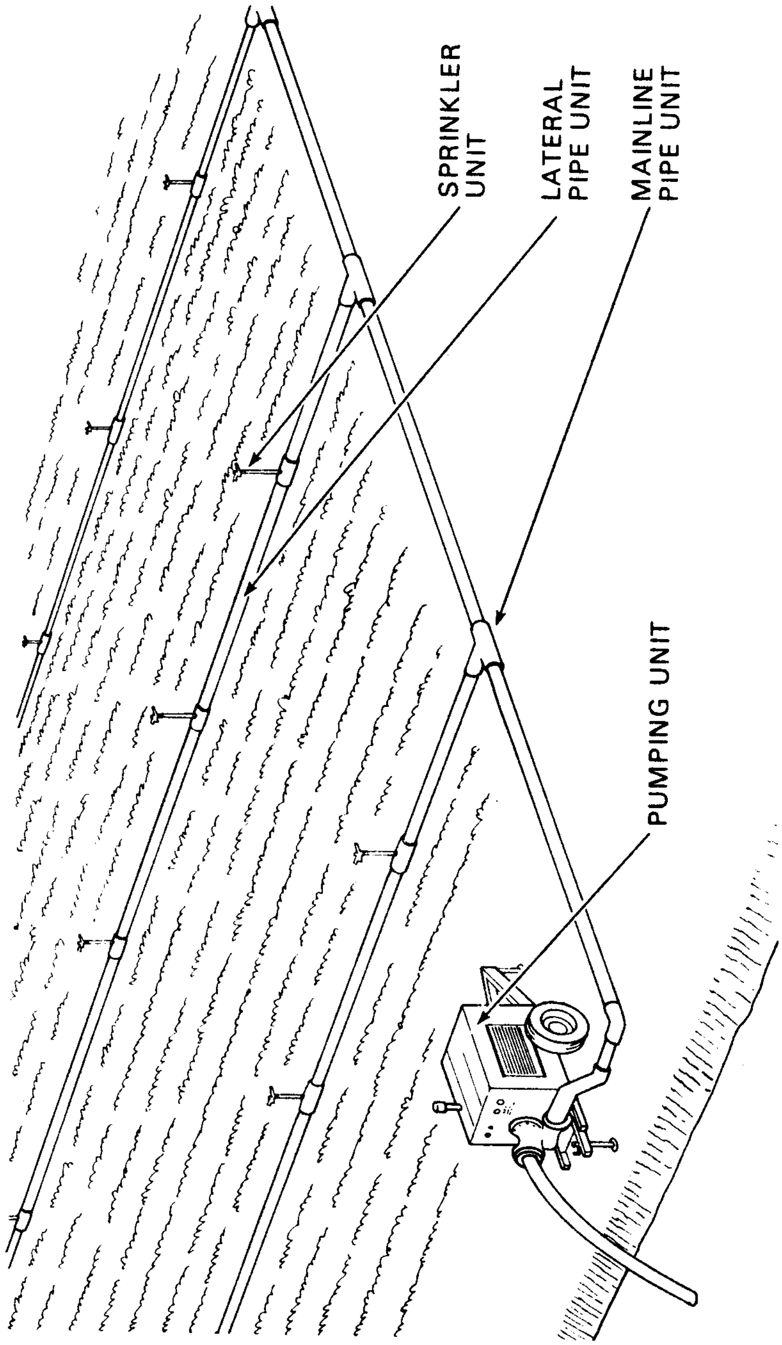


CONTOUR LEVEE

Graded Systems of Surface Irrigation

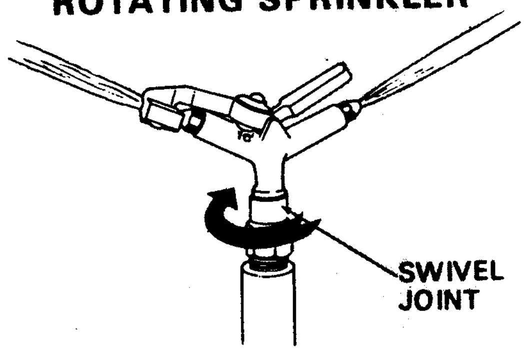


Parts of a Sprinkler Irrigation System

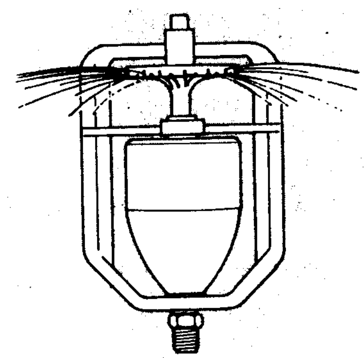


Common Types of Sprinklers

ROTATING SPRINKLER

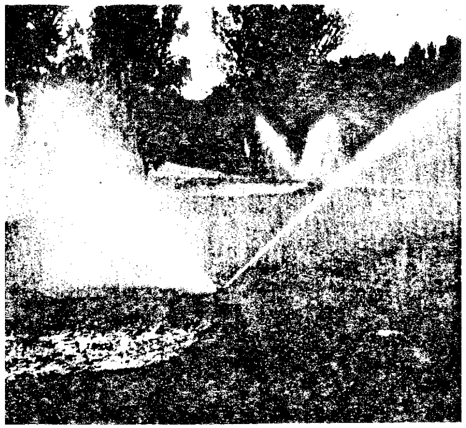


SPRAY NOZZLE



Types of Sprinkler Irrigation Systems

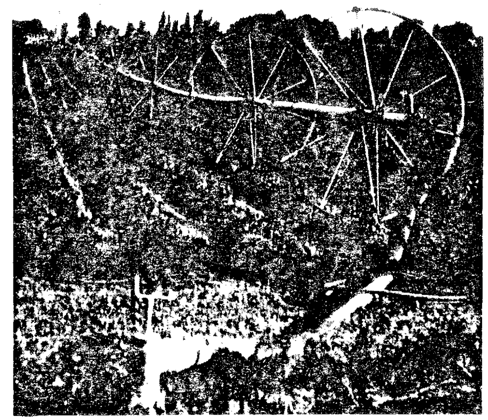
Solid set (permanent)



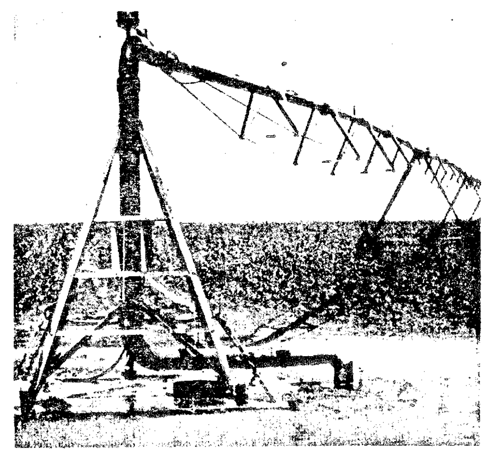
Hand lines (portable)

Big gun (portable)

Lateral move



Center pivot



Factors That Affect the Selection of Irrigation Systems

A. Land slope
B. Water intake rate of soil
C. Water tolerance of crops
D. Wind action
E. Shape of field
F. Maximum height of crop
G. Labor required
H. Cost

Comparison of Investment Costs for Irrigation Systems

	Center pivot 1	Center pivot with end gun 1	Wheel line sprinkler system 2	Handline sprinkler system 2	Solid set sprinkler system 2	Gated pipe gravity system 3	Siphon tuber gravity system 3
System investment per acre	$385.58	$420.14	$338.18	$361.48	$1,028.32	$297.98	$114.24
Variable costs per irrigated acre	35.01	36.80	36.65	52.62	56.69	13.90	17.88
Fixed costs per irrigated acre	61.16	66.78	52.99	54.97	164.22	45.02	17.45
Total fixed and variable costs per irrigated acre	96.17	103.58	89.64	107.59	220.91	58.92	35.33

1 CIS Bulletin #579
2 CIS Bulletin #578
3 CIS Bulletin #577

IRRIGATION

AG 150 - C

ASSIGNMENT SHEET #1--CALCULATE TOTAL AVAILABLE MOISTURE

Name ________________________________ Score ______________________________

Using the information given, calculate the total available moisture (TAM) of the soil and how much water will be applied at each irrigation. Assume that irrigation will take place when 50% of the water has been depleted from the root zone. When completed, return to instructor for evaluation.

a. Corn is growing in a silt loam soil (TAM of 2.55 inches/ft) with an average root zone of 7 feet.

TAM ______________________________

Amount to apply ______________________

b. Wheat is growing in a sandy loam soil (TAM of 1.67 inches/ft) with an average root zone of 2 feet.

TAM ______________________________

Amount to apply ______________________

c. Alfalfa is growing in a silty clay soil (TAM of 2.91 inches/ft) with average root zone of 6 feet.

TAM ______________________________

Amount to apply ______________________

IRRIGATION

AG 150 - C

ASSIGNMENT SHEET #2--CALCULATE DAYS UNTIL NEXT IRRIGATION

Name ______________________________ Score ______________________________

Using the information given, calculate the number of days until next irrigation. Round numbers to the lesser whole number. When completed, return to instructor for evaluation.

a. Barley

Soil type--silt loam
Root zone depth--3.5 feet
Average soil moisture--80%
Crop stress point--40%
E_t--.05

b. Potatoes

Soil type--sand
Root zone depth--2.0 feet
Average soil moisture--90%
Crop stress point--65%
E_t--.27

c. Corn

Soil type--sandy loam
Root zone depth--3.0 feet
Average soil moisture--75%
Crop stress point--50%
E_t--.30

d. Sugarbeets

Soil type--loam
Root zone depth--3.0 feet
Average soil moisture--70%
Crop stress point--50%
E_t--.27

IRRIGATION

AG 150 - C

ASSIGNMENT SHEET #3--CALCULATE IRRIGATION LENGTH

Name ____ Score ____________________________________

Using the information given, calculate the length of each irrigation in hours. When completed, return to instructor for evaluation.

a. A medium texture soil has a water intake rate of .25 inches per hour. How many hours will it take to apply 3 inches of water?

b. A light texture soil has a water intake rate of .50 inches per hour. How many hours will it take to apply 3 inches of water?

c. A heavy texture soil has a water intake rate of .10 inches per hour. How many hours will it take to apply 3 inches of water?

IRRIGATION

AG 150 - C

ASSIGNMENT SHEET #4--CONVERT UNITS OF WATER MEASUREMENT

Name ____ Score ____________________________________

Using the conversion of units of flow from the information section, answer the following questions. When completed, return to instructor for evaluation.

a. A quarter-mile sprinkler line has 32 nozzles which deliver 5 gpm. What is your flow in cubic feet per second?

________cubic feet/second

b. A flow of 2 c.f.s. equals how many gallons per minute?

________gallons per minute

c. 1 c.f.s. flowing for 24 hours equals how many acre-inches and acre-feet?

________acre-inches

________acre-feet

d. 130 sprinkler nozzles are delivering 6.5 gpm. How many miner's inches are needed by the system?

________miner's inches

e. With a flow of 2 c.f.s., how many acre-inches will be delivered in 48 hours?

________acre-inches

IRRIGATION

AG 150 - C

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

a. TAM = 17.85 inches
Amount to apply = 8.9 inches

b. TAM = 3.34 inches
Amount to apply = 1.7 inches

c. TAM = 17.46 inches
Amount to apply = 8.7 inches

Assignment Sheet #2

a. 61 days
b. 2 days
c. 3 days
d. 4 days

Assignment Sheet #3

a. 12 hours
b. 6 hours
c. 30 hours

Assignment Sheet #4

a. .36 c.f.s
b. 900 gpm
c. 1.983 acre-feet, 23.8 acre-inches
d. 94 miner's inches
e. 47.6 acre-inches

IRRIGATION

AG 150 - C

UNIT TEST

Name ______________________________________ Score ___________________________________

1. Match terms associated with irrigation to the correct definitions. Write the correct numbers in the blanks.

_____a. That part of the soil profile from which growing plants can utilize water and nutrients

_____b. A measurement of difference in elevation from one point to another; it is generally referred to as a percent--the number of feet difference in elevation for 100 feet of horizontal distance

_____c. A device used for measuring water flow from a well or pipeline

_____d. The combination or arrangement of soil particles (sand, silt, clay) into aggregates

_____e. A vertical cross-section of the soil from the surface through all its horizons

_____f. Chute placed in a stream or channel to measure the flow of water

_____g. A series of parallel furrows commonly used in surface irrigation systems to direct the flow of water between seedbeds

_____h. To supply land with water by means of ditches, sprinklers or other system

_____i. The number of days between irrigations

_____j. Channel for carrying water for drainage or irrigation of the soil

_____k. A name given a textural group based on the relative proportions of the soil separates (sand, silt, clay)

_____l. The level at which the soil is saturated with water; usually below the soil surface

1. Irrigation
2. Tilth
3. Soil structure
4. Slope
5. Water table
6. Soil profile
7. Root zone
8. Irrigation frequency
9. Weir
10. Measuring flume
11. Flowmeter
12. Corrugate
13. Ditch
14. Soil texture

_____m. An obstruction placed in a stream or channel diverting water through a device to measure the flow of water; types include rectangular, cipolleti and v-notch

_____n. The physical condition of soil as related to its ease of tillage and fitness as a seedbed

2. List three reasons for irrigating.

   a. ______________________________

   b. ______________________________

   c. ______________________________

3. Select from the following list factors that affect water intake rates of soils. Write an "X" in the blank before each correct answer.

_____a. Soil texture

_____b. Subsurface texture

_____c. Depth of soil profile

_____d. Slope

_____e. Soil structure

_____f. Root zone

_____g. Moisture content of soil profile

4. Calculate the total available moisture for barley, which has an effective root zone of 2.5 feet, grown on a sandy loam soil which has a water holding capacity of 1.67 inches/foot. Show all work.

   ____

   ____

   ____

5. Name three methods for estimating soil moisture in the crop root zone.

   a. ______________________________

   b. ______________________________

   c. ______________________________

6. Calculate the days remaining until the next irrigation for alfalfa using the following information. Show all work.

   a. Effective root zone--4.0 feet

   b. Silt loam soil--Water holding capacity of 2.2 inches/foot

   c. Soil moisture monitored on July 10

      1. 1st foot--50% available moisture

      2. 2nd foot--60% available moisture

      3. 3rd foot--80% available moisture

      4. 4th foot--90% available moisture

      (Note: The root zone average is 70% available moisture.)

   d. Stress point for alfalfa--50%

   e. E_t rate = .27 inches/day

   f. Days until next irrigation ______________________________

7. Name two units of volume measurement and two units of flow rate measurement of water.

   Volume measurement

   a. ______________________________

   b. ______________________________

   Flow rate measurement

   c. ______________________________

   d. ______________________________

8. Convert 5 cubic feet per second of water flow into:

   a. Gallons per minute ______________________________

   b. Acre-feet per day ______________________________

c. Acre-feet per day ______________________________

9. Name three devices for measuring water in motion.

a. ______________________________

b. ______________________________

c. ______________________________

10. List four types of irrigation systems.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

11. Match the basic parts of a surface irrigation system to the correct description. Write the correct numbers in the blanks.

_____a. Used for releasing the water from the head ditch or pipeline onto the land to be irrigated

_____b. The means by which water is delivered from the source to the field; it may be an open ditch or a pipeline

_____c. Used for collecting excess water for reuse

_____d. The means by which water is made available from the field supply line to the different areas of the field

_____e. Common sources include: farm ponds, rivers, canals and wells

1. Water supply
2. Field supply line
3. Head ditch or head pipeline
4. Turnouts
5. Tailwater ditch

12. Match the basic parts of a sprinkler irrigation system to the correct description. Write the correct numbers in the blanks.

_____a. Delivers the water from the mainline pipe to the sprinklers

_____b. Located at intervals along the lateral; break up water into various size drops and distribute over the ground

1. Pumping unit
2. Mainline pipe
3. Lateral pipe
4. Sprinklers

_____c. Takes water from its sources and makes it available under pressure to the system

_____d. Delivers the water from the pumping unit to the laterals

13. Select from the following list factors that affect the selection of an irrigation system. Write an "X" in the blank before each correct answer.

_____a. Soil texture

_____b. Cost

_____c. Average wind speed

_____d. Labor required

_____e. Soil profile

_____f. Slope of field

_____g. Shape of field

_____h. Water tolerance of crop

_____i. Maximum height of crop

14. Discuss costs involved with irrigation.

____

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IRRIGATION

AG 150 - C

ANSWERS TO TEST

1.
a.	7	f.	10	k.	14
b.	4	g.	12	l.	5
c.	11	h.	1	m.	9
d.	3	i.	8	n.	2
e.	6	j.	13		

2. Provide water for crops in the right amount at the right time; Increase crop yield; Improve crop quality

3. a, d, e, g

4. 4.2 inches

5. Plant and field methods; Feel method; Tensiometers

6. 6.52 or 6 days until next irrigation

7. a.-b. Answer should include two of the following: Gallons; Acre-inches; Acre-feet
   c.-d. Answer should include two of the following: Gallons per minute; Cubic feet per second; Miner's inch

8. a. 2250 gpm
   b. 9.92 acre-feet
   c. 250 miner's inches

9. Weir; Flume; Flowmeter

10. Surface; Sprinkler; Trickle; Subsurface

11. a. 4 b. 2 c. 5 d. 3 e. 1

12. a. 3 b. 4 c. 1 d. 2

13. b, c, d, f, g, h, i

14. Discussion should include information from the following:

Initial costs: Well (drilling, casing); Reservoir pump (line shaft, propeller, turbine, centrifugal); Power unit (electric, gasoline, diesel, natural gas or propane); Miscellaneous (electric switch, gas line, fuel tank, land plane, land development); Water pipe (underground or above ground); Pipe trailer; Sprinkler systems (hand-moved, tractor-moved, self-moved, self-propelled, permanent); Surface systems (land grading); Subsurface systems (ditches, pipelines); Land drainage, etc.
Annual depreciation cost (based on): Initial cost of system; Interest; Taxes and insurance; Fixed charges (for example, stand-by charges for electricity); Loss of income from land taken out of production for water development; Life expectancy of system
Annual operating cost: Fuel; Oil; Electricity; Equipment repair and maintenance; Reservoir and field maintenance; Water use charges; Labor

LAND PREPARATION

AG 150 - D

UNIT OBJECTIVE

After completion of this unit, students should be able to match terms and definitions and select from a list reasons for tillage. Students should also be able to identify equipment used in land preparation, determine when to plow and discuss the advantages of turning under crop residue. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with land preparation to the correct definitions.
2. Select reasons for tillage.
3. Name four characteristics of a good seedbed.
4. Classify tillage operations as primary or secondary.
5. Select factors that determine the time for primary tillage operation.
6. List two advantages of fall plowing and two advantages of spring plowing.
7. Select advantages of incorporating residue.
8. List two reasons for stubble mulching.
9. List two purposes of summer fallowing.
10. Select reasons to use minimum tillage.

LAND PREPARATION

AG 150 - D

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

      1. Literature

         a. *Tillage*, an FMO publication by John Deere and Co., 19 chapters on tillage and tillage equipment; available from John Deere Service Publications, Dept. F., John Deere Road, Moline, Illinois 62165.

         b. *Tillage and Seedbed Preparation*, class activity packet; available from Agri-Farm Publications, Inc., 1019 Market Street, Gowrie, Iowa 50543; approximate cost $8.50; order no. 1117.

      2. Filmstrips, slideshows, etc.

         a. *Tillage*, slide set; available from John Deere Service Publications, Dept. F., John Deere Road, Moline, Illinois 62165; approximate cost $124.00.

         b. *Tillage Machines*, 39 color slides; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $17.00; order no. 311.

   B. Provide students with objective sheet and discuss.

   C. Provide students with information sheet and discuss.

   D. Take class on field trip to an implement dealer to see types of tillage equipment used in the community.

   E. Have students collect pictures of tillage implements and bring to class.

   F. Assign each student a report on a single piece of tillage equipment to be presented to the class.

   G. Review and give test.

   H. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

C. Information sheet

D. Test

E. Answers to test

III. Unit references

A. *Crops, Soils, and Fertilizer Resource Manual*, Vo-Ed No. 73, University of Idaho, Department of Agricultural Education, Moscow, Idaho, 1978.

B. Delorit, Greub and Ahlgren, *Crop Production*, 4th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1974.

C. *Fundamentals of Machine Operation: Tillage*, John Deere Service Publications, Moline, Illinois, 1976.

D. *Instructional Materials for Vocational Agriculture*, Teaching Materials Center, Agricultural Education Department, Texas A & M University, College Station, Texas.

E. *Oklahoma Curriculum Guide for Vo Ag II*, Oklahoma State University and the Oklahoma State Board for Vocational-Technical Education, Stillwater, Oklahoma.

LAND PREPARATION

AG 150 - D

INFORMATION SHEET

I. Terms and definitions

A. Tillage--Cultivation used to prepare or maintain a seedbed and/or control weeds

B. Cultivate--To break up the surface soil around plants in order to kill weeds, prevent crusting, preserve moisture and form corrugates for irrigation

C. Crop residue--Part of the crop that is left on top or in the soil after harvesting

D. Stubble mulching--Tillage beneath the stubble without covering all the crop residue; operated just below soil surface; used to kill weeds and encourage water infiltration and storage

E. Erosion--Removal of soil by wind and/or water

F. Land preparation--Complete process of preparing the soil after a crop is harvested until a new crop is planted

G. Summer fallow--Cropland left idle for one growing season; the soil is being cultivated to control weeds, release nitrogen and conserve moisture

H. Minimum tillage--Method of tillage in which certain operations are combined or eliminated to reduce the number of trips across the field

I. Moldboard plow--Primary tillage implement made up of a series of plow bottoms; it cuts, lifts and turns the furrow slice, burying the crop residue

J. Plow bottom--A three-sided wedge which inverts the furrow slice; each bottom is attached to a standard, which in turn is attached to the plow frame

K. Disk plow--Primary tillage implement made up of a series of disks; it cuts, lifts and rolls, but does not invert the furrow slice

L. Disk--Round, concave, rotating blades made in a variety of diameters; used for primary and secondary tillage operations

M. Chisel plow--Primary tillage implement made up of a series of chisels; used to break up hard, dry soils for water penetration where coverage of crop residue is not required

N. Chisel--A narrow, straight shank tool often with a point; each chisel is attached directly to the plow frame

O. Sweep--A "V"-shaped blade used on a chisel plow for stubble mulching; each sweep is attached directly to the plow frame

P. Standard--Supports for soil working tools of primary tillage implements, such as bottoms on plows

Q. Plow pan--Compacted layer restricting root and water movement; may form in some soils just below the tilled area after several years of primary tillage to the same depth

II. Reasons for tillage

A. Eliminate weeds

(Note: It is important to control weeds as competitors against the cultivated crop for water, nutrients and sunlight. Chemicals are replacing tillage as a system of weed control.)

B. Improve soil condition for seed germination and plant growth

(Note: The preparation of the seedbed must be timed so that the crop seed can be planted when environmental factors favor germination of the seed and the establishment of the seedling as a new plant.)

C. Aerate the soil

D. Destroy insects

E. Prepare land surface for irrigation

F. Aid in erosion control

G. Conserve moisture

H. Incorporate crop residue

III. Characteristics of a good seedbed

(Note: Seedbed preparation is determined by the crop to be planted.)

A. Free of trash and weeds

B. Firm

(Note: The soil should be firm enough to prevent rapid drying and furnish a good medium for tiny root hairs. The seed must be in direct contact with the soil particles in order to receive adequate soil moisture.)

C. Loose and mellow

(Note: Loose soil will permit better air circulation and seedling growth. It is necessary that plant roots expand easily through the soil.)

D. Minimum of plant disease

(Note: Crop rotation, fall plowing and the use of fungicides help eliminate plant disease problems.)

E. Minimum of insects

(Note: Crop rotation, use of insecticides, shredding of stalks and weeds and fall plowing will help free the soil of insects.)

F. Absorbs and holds water

(Note: Moisture is necessary for germination and plant development. Moisture dissolves the nutrients, making them available to the plant roots.)

IV. Classification of tillage operations

A. Primary tillage--Cuts, shatters and/or mixes the soil; may bury residue by inversion, mix it into the tilled layer or leave it basically undisturbed

(Note: Primary tillage is a more drastic, relatively deep operation, usually leaving the surface rough.)

1. Implements used for primary tillage

a. Moldboard, disk and chisel plows

b. Bedders and listers

c. Subsoilers, chisels and rippers

d. Rotary tillers

B. Secondary tillage--Provides additional pulverization of soil; levels and firms the soil, closes air pockets, helps to conserve moisture and kills weeds

(Note: Secondary tillage works the soil to a shallower depth than primary tillage, usually leaving the surface smooth.)

1. Implements used for secondary tillage

a. Spring, spike and tine-tooth harrows

b. Roller harrows and packers

c. Rod weeders

d. Field cultivators

e. Disk tillers

V. Factors that determine time for primary tillage operation

A. Type of crop

(Note: Seedbed preparation is determined by the crop to be raised. In a minimum tillage operation, primary tillage may be eliminated, where in other cases it may be necessary every year.)

B. Weed problem

(Note: Weeds may tend to use the nitrates that may be lost to leaching in heavy rainfall areas; therefore, plowing may be delayed. Weed seeds should be allowed to germinate prior to tillage for weed control purposes.)

C. Erosion

(Note: Certain areas have heavy rainfall which cause a danger of water erosion. Late fall or winter tillage is considered unadvisable in such areas.)

D. Moisture

(Note: The amount of moisture in the soil can often delay primary tillage for seedbed preparation. If soils are too wet, the seedbed becomes seriously compacted if preparation is attempted. If a soil is too dry, it must be irrigated several days before preparation of the seedbed begins.)

VI. Advantages of fall and spring plowing

A. Fall

1. Incorporates residue to increase time for crop residue decomposition

2. Reduces spring workload; crops can be planted earlier

3. Helps hold moisture in low rainfall areas

4. Improves chance of forming a firm seedbed

5. Allows time for clods to crumble from freezing and thawing

B. Spring

1. Crop residue over winter aids in controlling wind erosion on sandy soil

2. Eliminates weeds which germinate in the spring

3. Standing residue catches snow

(Note: Fall plowing is usually preferred if the climate, soil and type of crop permits the practice. Experiments with corn, oats, barley and wheat in different parts of the United States show there is no production advantage between fall and spring plowing or seedbed preparation. Both systems of plowing produce about the same amount of grain per cropping season.)

VII. Advantages of incorporating crop residue

A. Increases organic matter in the soil

B. Returns plant nutrients to the soil

C. Increases microorganism activity, population and residue breakdown

D. Conserves moisture

(Note: The turning under of crop residue is classified as primary tillage. Residues left on or near the surface often reduce growth yields of the next crop. This has been attributed to toxic compounds leached from the residue or to microbial production of toxic compounds during decomposition. This condition is reduced if the crop residue is incorporated.)

VIII. Reasons for stubble mulching

A. Reduces wind and water erosion

(Note: Stubble-mulch plows cut off crop residue below the surface, leaving residue anchored to the surface, an advantage where limited quantities of residue are present and erosion is a problem.)

B. Increases water intake

IX. Purposes of summer fallowing

A. Conserves moisture

B. Controls weeds

(Note: This is the practice of allowing land to lie idle during a growing season to build up available moisture to produce a crop the following year. This is recommended in areas with less than 16 inches annual precipitation under dry land conditions.)

X. Reasons to use minimum tillage

A. Reduces number of trips across the field

B. Reduces costs for energy and labor

C. Conserves soil moisture

D. Reduces erosion

E. Lowers equipment investment

F. Permits earlier planting

G. Reduces soil compaction

(Note: Conservation tillage, mulch tillage, till-plant and no-till planting are types of minimum tillage systems. Weed control can be a problem with these systems, and the greater dependency on chemical weed control may offset savings in equipment and operating costs. If reduced-tillage cost savings exceed the value of possible yield reductions, net profit may be increased by accepting slightly lower yields.)

LAND PREPARATION

AG 150 - D

UNIT TEST

Name ____________________________________ Score ______________________________

1. Match terms associated with land preparation to the correct definitions. Write the correct numbers in the blanks.

_____a. Complete process of preparing the soil after a crop is harvested until a new crop is planted

_____b. Primary tillage implement made up of a series of plow bottoms; it cuts, lifts and turns the furrow slice, burying the crop residue

_____c. Part of the crop that is left on top or in the soil after harvesting

_____d. Round, concave, rotating blades made in a variety of diameters; used for primary and secondary tillage operations

_____e. A "V"-shaped blade used on a chisel plow for stubble mulching

_____f. Compacted layer restricting root and water movement; may form in some soils just below the tilled area after several years of primary tillage to the same depth

_____g. Cultivation used to prepare or maintain a seedbed and/or control weeds

_____h. A three-sided wedge which inverts the furrow slice; each is attached to a standard, which in turn is attached to the plow frame

_____i. To break up the surface soil around plants in order to kill weeds, prevent crusting, preserve moisture and form corrugates for irrigation

_____j. Primary tillage implement used to break up hard, dry soils for water penetration where coverage of crop residue is not required

_____k. Supports for soil working tools of primary tillage implements, such as bottoms on plows

_____l. Removal of soil by wind and/or water

1. Tillage
2. Cultivate
3. Crop residue
4. Stubble mulching
5. Erosion
6. Land preparation
7. Summer fallow
8. Minimum tillage
9. Moldboard plow
10. Plow bottom
11. Disk plow
12. Disk
13. Chisel plow
14. Chisel
15. Sweep
16. Standard
17. Plow pan

_____m. Method of tillage in which certain operations are combined or eliminated to reduce the number of trips across the field

_____n. A narrow, straight shank tool often with a point

_____o. Primary tillage implement that cuts, lifts and rolls, but does not invert the furrow slice

_____p. Cropland left idle for one growing season; the soil is being cultivated to control weeds, release nitrogen and conserve moisture

_____q. Tillage beneath the stubble without covering all the crop residue

2. Select from the following list reasons for tillage. Write an "X" in the blank before each correct answer.

_____a. Eliminate weeds

_____b. Aerate the soil

_____c. Improve water table

_____d. Aid in erosion control

_____e. Prepare land for irrigation

_____f. Destroy insects

_____g. Decrease costs

_____h. Conserve moisture

_____i. Incorporate crop residue

3. Name four characteristics of a good seedbed.

a. ____

b. ____

c. ____

d. ____

4. Classify the following tillage operations. Write "P" in the blank for primary tillage operation or "S" for secondary tillage operation.

_____a. Moldboard plow

_____b. Spring-tooth harrow

_____c. Roller harrow

_____d. Rotary tiller

_____e. Chisel plow

_____f. Rod weeder

_____g. Field cultivator

_____h. Disk plow

_____i. Spike-tooth harrow

_____j. Subsoiler

5. Select from the following list factors that determine the time for primary tillage operation. Write an "X" in the blank before each correct answer.

_____a. Type of crop

_____b. Time of day

_____c. Month

_____d. Weed problem

_____e. Erosion

_____f. Moisture

6. List two advantages of fall plowing and two advantages of spring plowing.

Fall plowing

a. ____

b. ____

Spring plowing

a. ____

b. ____

7. Select from the following list advantages of incorporating residue. Write an "X" in the blank before each correct answer.

_____a. Conserves moisture

_____b. Reduces weed problems

_____c. Reduces erosion

_____d. Returns plant nutrients to the soil

_____e. Increases organic matter in the soil

_____f. Decreases microorganism levels in the soil

8. List two reasons for stubble mulching.

a. ____

b. ____

9. List two purposes of summer fallowing.

a. ____

b. ____

10. Select from the following list reasons to use minimum tillage. Write an "X" in the blank before each correct answer.

_____a. Reduces number of trips across the field

_____b. Reduces weed problems

_____c. Reduces erosion

_____d. Conserves soil moisture

_____e. Reduces plant disease problems

_____f. Reduces soil compaction

_____g. Reduces costs for energy and labor

_____h. Permits earlier planting

LAND PREPARATION

AG 150 - D

ANSWERS TO TEST

1.

a.	6	g.	1	m.	8
b.	9	h.	10	n.	14
c.	3	i.	2	o.	11
d.	12	j.	13	p.	7
e.	15	k.	16	q.	4
f.	17	l.	5		

2. a, b, d, e, f, h, i

3. Answer should include four of the following:

   Free of trash and weeds; Firm; Loose and mellow; Minimum of plant disease; Minimum of insects; Absorbs and holds water

4.

a.	P	f.	S
b.	S	g.	S
c.	S	h.	P
d.	P	i.	S
e.	P	j.	P

5. a, d, e, f

6. (Fall plowing) Answer should include two of the following:

   Incorporates residue to increase time for crop residue decomposition; Reduces spring workload; Crops can be planted earlier; Helps hold moisture in low rainfall areas; Improves chance of forming firm seedbed; Allows time for clods to crumble from freezing and thawing

   (Spring plowing) Answer should include two of the following:

   Aids in controlling erosion on sandy soil; Eliminates weeds which germinate in the spring; Standing residue catches snow

7. a, d, e

8. Reduces wind and water erosion; Increases water intake

9. Conserves moisture; Controls weeds

10. a, c, d, f, g, h

SOIL CONSERVATION

AG 150 - E

UNIT OBJECTIVE

After completion of this unit, students should be able to list types of erosion and management practices that aid in conservation. Students should also be able to select from a list factors that determine cropping systems and conservation practices for reducing erosion. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with soil conservation practices to the correct definitions.
2. Name two types of erosion.
3. Match the four categories of water erosion to the correct description.
4. Select factors that influence soil erosion.
5. Select conservation practices for reducing wind erosion.
6. Select mechanical and cropping practices used in water erosion conservation.
7. Select factors that determine the type of cropping system to use.
8. Name two organizations involved with soil conservation.

SOIL CONSERVATION

AG 150 - E

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Conserving Soil: Teaching Soil and Water Conservation*, available from Soil Conservation Service, United States Department of Agriculture.

b. *Soil and Water Conservation*, 250-page loose-leaf packet; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $12.50; order no. 229.

c. The following Current Information Series publications are available from Agricultural Communications Center, Ag Publications Building, Building J40, Idaho Street, University of Idaho, Moscow, Idaho 83843-4196 (208-885-7982).

A Buried Drain Erosion and Sediment Loss Control System, approximate cost $.35; order no. CIS 760.

Conservation Tillage for Control of Soil Loss by Water Erosion Under Dryland Crop Production, approximate cost $.35; order no. CIS 824.

Crop Management Series: Effective Conservation Farming Systems; approximate cost $.50; order no. PNW 275.

Five-Point Program: Divided Slope Farming for Soil Erosion Control Under Dryland Crop Production, approximate cost $.35; order no. CIS 638.

Five-Point Program: Soil Erosion Control Under Dryland Crop Production, approximate cost $.25; order no. CIS 483.

Furrow Erosion and Topsoil Losses, approximate cost $.35; order no. CIS 586.

Furrow Erosion Reduces Crop Yields, approximate cost $.35; order no. CIS 761.

Reducing Soil Losses by Sediment Retention, approximate cost $.35; order no. CIS 696.

Reducing Soil Losses with Filter Strips, approximate cost $.35; order no. CIS 587.

Slot Mulching for Residue Management and Erosion Control, approximate cost $.25; order no. PNW 231.

Soil Erosion--How Much?, approximate cost $.35; order no. CIS 563.

The Chisel Planter--A Minimum Tillage System for Winter Wheat, approximate cost $.35; order no. CIS 476.

The Farmer and Erosion: Factors Influencing the Use of Control Practices, approximate cost $1.00; order no. EXP 601.

2. Filmstrips, slideshows, etc.

   a. *Conservation Farming*, slide set; available from John Deere Service Publications, Dept. F, John Deere Rd., Moline, Illinois 61265; approximate cost $109.00.

   b. *Conservation Tillage*, 2 cassettes, 2 filmstrips and program guide; available from Teaching Aids, Inc., P. O. Box 1798, Costa Mesa, California 92626; approximate cost $70.00; order no. P1319.

   c. *Universal Soil Loss Equation*, filmstrip with script; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $15.00; order no. 336.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information and assignment sheets.

E. Discuss information and assignment sheets.

F. Take students on field trips to see types of erosion and cropping systems.

G. Invite person from SCS to address the class on combating erosion in your community.

H. Review and give test.

I. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Generalized Soil Erosion Map of the United States

2. TM 2--Soil Detachment by Raindrops

3. TM 3--Water Erosion--Infiltration Rate Effects Erosion Due to Runoff

4. TM 4--Erosion Caused by Running Water

5. TM 5--Factors Influencing Soil Erosion

6. TM 6--Wind Erosion Control Practices

7. TM 7--Water Erosion Control Practices

8. TM 8--Management Practices Used in Controlling Erosion

E. Assignment sheets

1. AS 1--How Do You Rate as an FFA Conservationist?

2. AS 2--Conserving Soil Crossword Puzzle

3. AS 3--Locating Good and Poor Conservation Practices

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. *Conserving Soil*, United States Department of Agriculture, Soil Conservation Service.

B. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

C. *Crops, Soils, and Fertilizer Resource Manual*, Vo-Ed No. 73, University of Idaho, Department of Ag Education, Moscow, Idaho, 1978.

D. Donahue, Roy L., Follett, Roy H., Tulloch, Rodney W., *Our Soils and Their Management*, 5th edition, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1983.

E. Hartmann, Hudson T., Kofranek, Anton M., Rubatzky, Vincent E., Flocker, William J., *Plant Science: Growth, Development and Utilization of Cultivated Plants*, 2nd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1988.

F. *Instructional Materials for Vocational Agriculture*, Texas A & M University, Agriculture Education Department, Teaching Materials Center, College Station, Texas.

G. Knuti, Williams and Hide, *Profitable Soil Management*, 4th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

H. *Oklahoma Curriculum Guide for Vocational Agriculture*, Oklahoma State University and the Oklahoma State Board for Vocational-Technical Education, Stillwater, Oklahoma.

SOIL CONSERVATION

AG 150 - E

INFORMATION SHEET

I. Terms and definitions

A. Erosion--Removal of soil by tillage, wind and/or water

B. Water outlet--Ditch which carries the excess water from farm

C. Terracing--Structure designed to slow down running water and control erosion on sloping land

D. Crop rotation--Rotation of crops on a field from one crop to another

E. Strip-cropping--Practice of growing soil-conserving and soil-depleting crops in alternate strips running perpendicular to the slope of the land or the direction of prevailing winds for the purpose of reducing erosion

F. Diversion ditch--Ditch which prevents erosion by diverting water around a field rather than across

G. Cover crop--Crop used to cover the soil surface to decrease erosion

II. Types of erosion (Transparencies 1, 2, 3)

A. Water erosion

B. Wind erosion

C. Tillage erosion

III. Categories of water erosion (Transparency 4)

A. Splash--Caused by the effect of falling raindrops

(Note: A single raindrop may splash soil as far as 5 feet. A single beating one-inch rain may splash as much as one inch of soil depth by raindrop erosion. The weight of an acre of soil one inch deep is approximately 170 tons.)

B. Sheet--The removal of soil in a uniform layer from an entire surface area

(Note: This type of erosion occurs continuously over periods of time, and the landowner may hardly be aware of its existence.)

C. Rill--Small channels are made by running water over the surface of the soil

(Note: The tendency is for water to flow along the path of least resistance; therefore, it concentrates in low places to form channels. Continued flow in these channels develops minor rills. Number, size and pattern of rills depends on slope shape.)

D. Gully--An advanced stage of rill erosion; occurs when rills flow together into larger streams; cannot be crossed by equipment

IV. Factors influencing soil erosion (Transparency 5)

A. The nature of the soil

1. Texture

2. Structure

3. Organic matter content

B. Climate

(Note: Climate is the combined effect of wind, temperature and rainfall. When soil is frozen, the permeability of the soil is greatly reduced. If rainfall comes at this time, and other conditions are conducive, severe erosion will occur.)

C. Vegetative cover

(Note: Vegetation will hold the soil particles together, cushion the impact of raindrops, and increase infiltration, all of which will decrease wind and water erosion.)

D. Slope and horizontal length

(Note: The steepness and horizontal length of land will have a great effect on erosion. As water moves down a slope, it increases in velocity and carrying capacity. For example, doubling the percent of slope will increase the soil loss 2.5 times. Doubling the length of slope will increase soil loss 1.4 times.)

E. Management of the soil

(Note: The way a soil has been managed will determine, to a large degree, the amount of erosion. The good farmer recognizes erosion as a problem and works to overcome it.)

V. Wind erosion conservation practices (Transparency 6)

A. Strip-cropping

B. Prevention of burning

C. Prevention of overgrazing

D. Moisture conservation

E. Emergency cover crops

F. Emergency tillage operations

G. Windbreak tree planting

H. Shelter belt of trees

VI. Water erosion conservation practices (Transparency 7)

A. Mechanical

(Note: Mechanical measures are designed to supplement the cropping program as well as control the movement of large quantities of rainfall on steeper slopes.)

1. Terracing

2. Diversions

3. Grass waterways

4. Land drainage

5. Land preparation

6. Construction of ponds and dams

B. Cropping

(Note: Cropping practices recommended are an attempt to give as much protection to the ground surface as possible while lands are being used, and also to increase the absorption of rainfall.)

1. Subsoiling or chiseling

2. Contour furrowing

3. Contour listing

4. Stubble mulching

5. Strip-cropping

6. Crop rotation

VII. Factors determining cropping system (Transparency 8)

(Note: Efficient use of the land should be the primary consideration of any good farmer. By efficient use is meant the use of land in such a way that maximum income and satisfaction is realized with minimum damage to the land. For example, crops planted on steep land may result in more loss due to damage to the land than is realized from the added income. The farmers should try to use the land in such a way that they will realize income while at the same time protect the land.)

A. Slope

B. Erodibility

C. Drainage

D. Moisture

E. Soil depth

F. Fertility

G. Economics

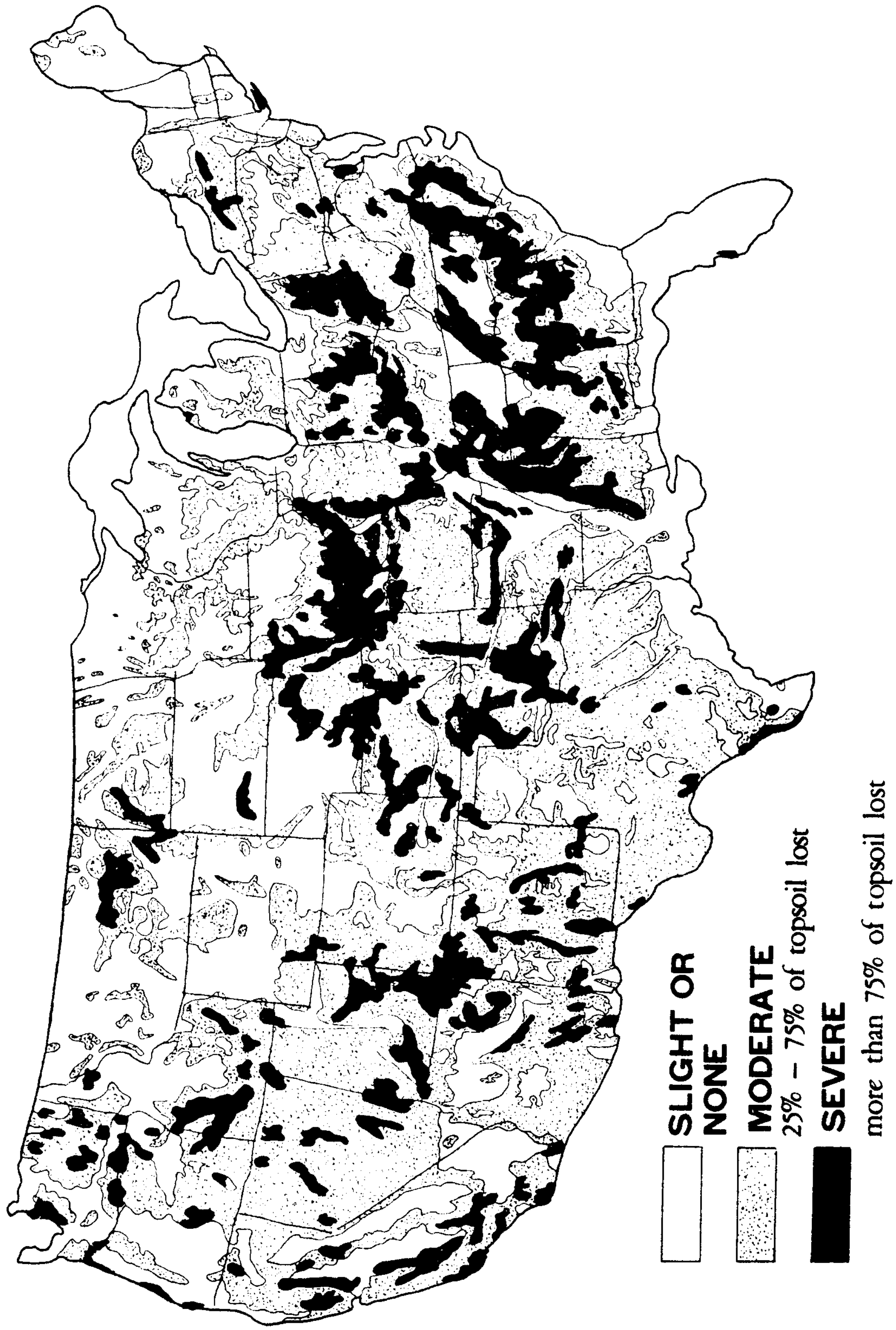
VIII. Organizations involved with soil conservation

A. Soil Conservation Service (SCS)

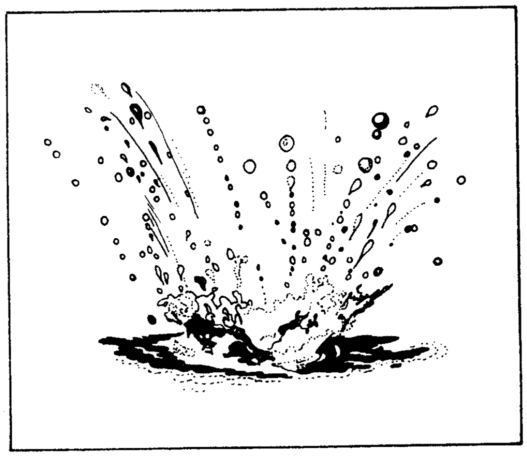
B. Agricultural Stabilization and Conservation Service

C. Local soil and water conservation districts

GENERALIZED SOIL EROSION MAP OF THE UNITED STATES

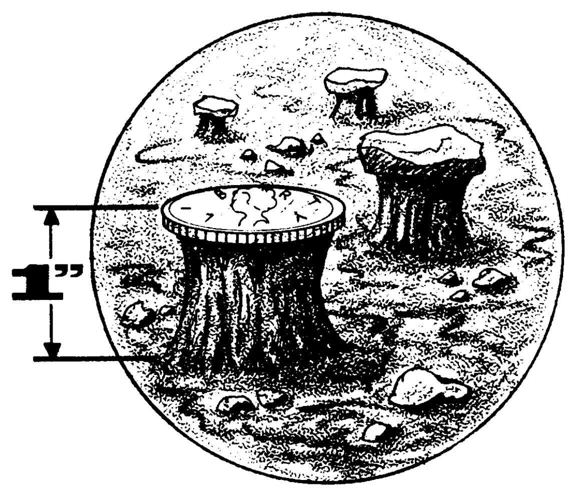


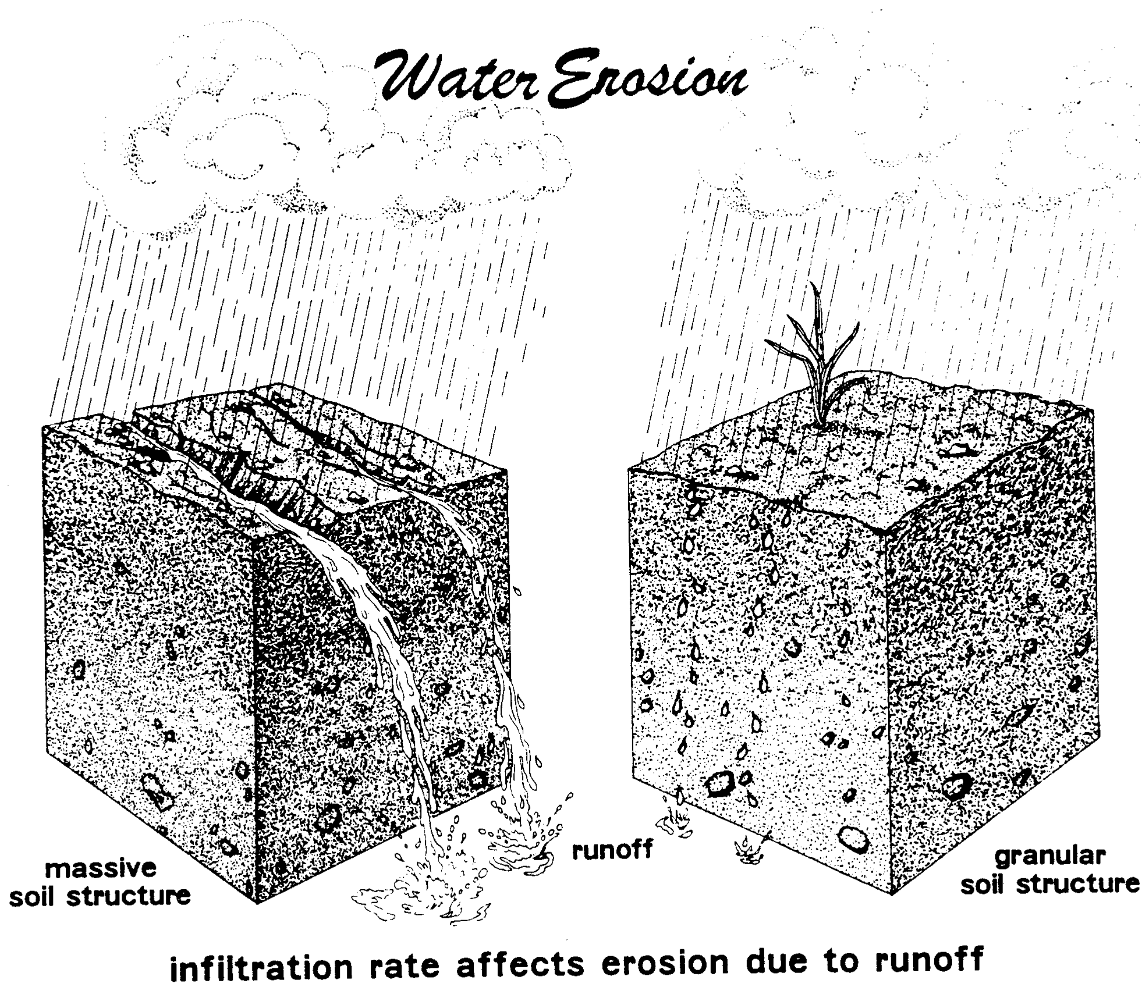
SOIL DETACHMENT BY RAINDROPS



a raindrop may splash soil as far as 5 feet

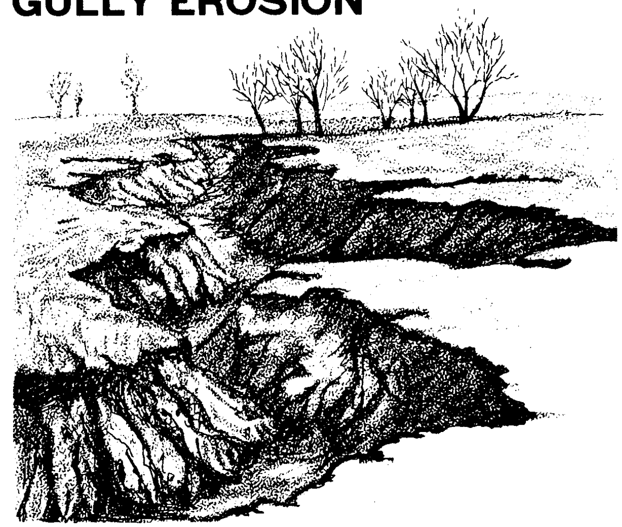
a 1 inch rain may remove 1 inch of soil per acre (150 tons)



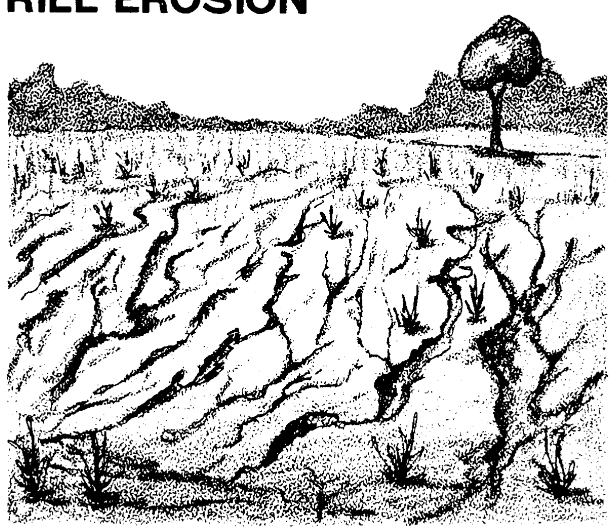

Water Erosion
massive
soil structure
runoff
granular
soil structure
infiltration rate affects erosion due to runoff

EROSION CAUSED BY RUNNING WATER

GULLY EROSION



RILL EROSION



SHEET EROSION

TM 4

Factors Influencing Soil Erosion

A. Nature of the soil
   1. Texture
   2. Structure
   3. Depth of soil
   4. Organic matter content

B. Climate

C. Vegetative cover

D. Slope and horizontal length

E. Management of the soil

WIND EROSION . . . . . .

A. STRIP CROPPING

B. PREVENTION OF BURNING

C. PREVENTION OF GRAZING

D. MOISTURE CONSERVATION

E. EMERGENCY COVER CROPS

F. EMERGENCY TILLAGE OPERATIONS

G. WINDBREAK TREE PLANTING

H. SHELTER BELT OF TREES

. . . . . CONTROL PRACTICES

WATER EROSION CONTROLS

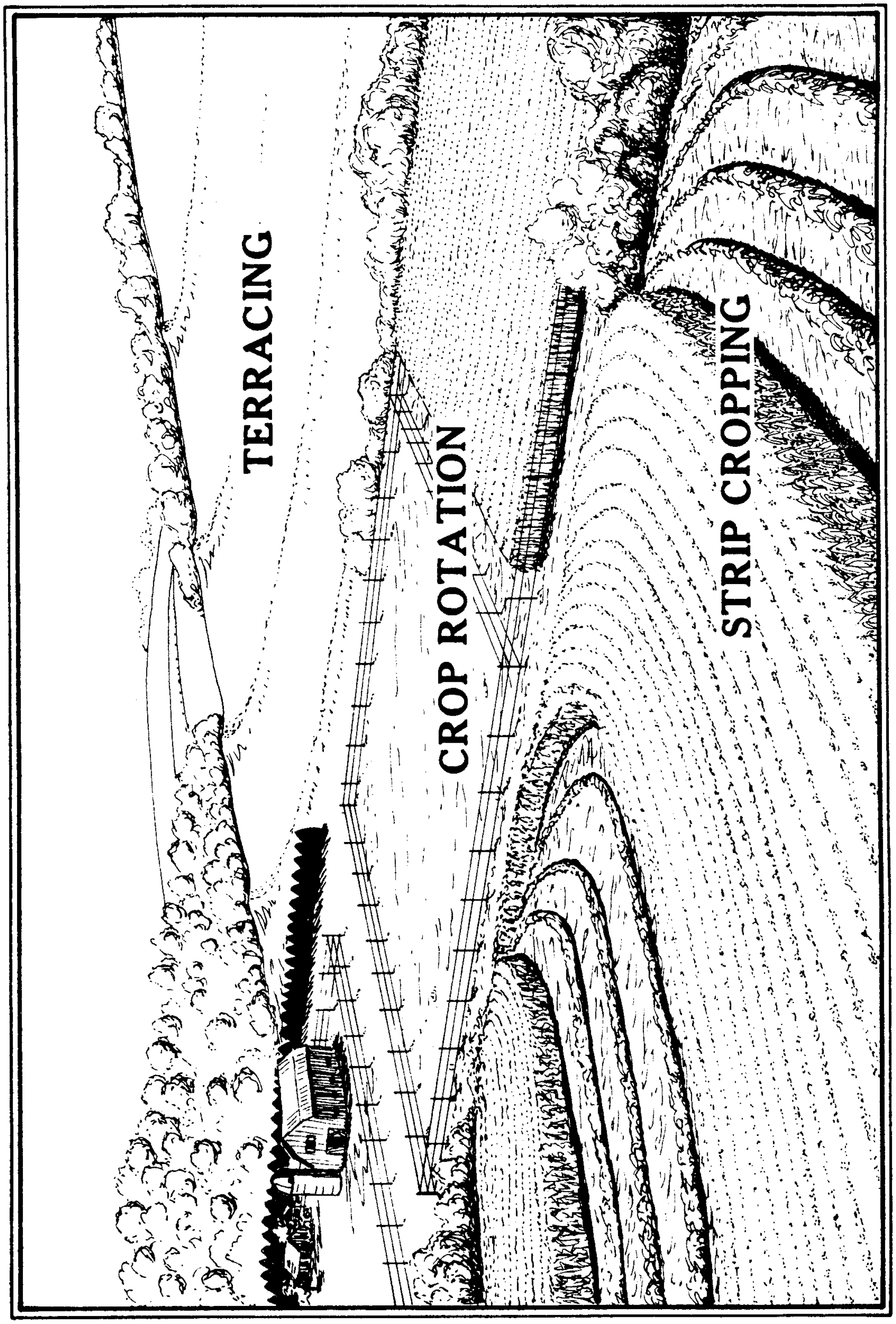
MECHANICAL

TERRACING
DIVERSIONS
GRASSED WATERWAYS
LAND DRAINAGE
LAND PREPARATION (SHAPING, SMOOTHING, LEVELING)
CONSTRUCTION OF PONDS & DAMS

CROPPING

SUBSOILING OR CHISELING
CONTOUR FURROWING
CONTOUR LISTING
STUBBLE MULCHING
STRIP CROPPING

MANAGEMENT PRACTICES USED IN CONTROLLING EROSION



SOIL CONSERVATION

AG 150 - E

ASSIGNMENT SHEET #1--HOW DO YOU RATE AS AN FFA CONSERVATIONIST?

Name ____ Score _______________________

Answer each of the questions below and on the following page. Turn in to the instructor. If the question applies to you or your farming operation, answer YES; if it does not apply to you, answer NO.

		YES	NO
1.	Are droughts on your farm less severe than they used to be?	______	______
2.	Can you cultivate as soon after a rain as you once could?	______	______
3.	Do the rains seem to soak into your soil faster and deeper than they once did?	______	______
4.	Do streams flood less frequently?	______	______
5.	Do your fields drain properly?	______	______
6.	Are your crop yields increasing?	______	______
7.	When you plow, does your soil seem darker in color than it was a few years ago?	______	______
8.	Do you notice fewer clay spots in the fields when you plow?	______	______
9.	Are gullies getting smaller in size and fewer in number?	______	______
10.	Does your soil drift against the fences less now than it once did?	______	______
11.	When you dig post holes, do you find plant roots all the way to the bottom of the holes?	______	______
12.	After a beating rain, does the surface of your soil still appear open and porous like a sponge?	______	______
13.	Is it becoming less difficult to prepare a good seedbed?	______	______
14.	Does your soil crust over less now than it once did?	______	______
15.	Do you spread manure on your land as fast as it is produced?	______	______
16.	Do you grow a soil-building legume at least one year in three?	______	______
17.	Do you plow under or incorporate all crop residues into your soil?	______	______
18.	Do your crops grow better in dry weather than they once did?	______	______

		YES	NO
19.	Does it take less power to plow your fields than it did a few years ago?	______	______
20.	Do you cultivate just often enough to control weeds?	______	______
21.	Do you use a disc and chisel more now than you do a turning plow?	______	______
22.	Do you follow the recommended planting dates for all farm crops?	______	______
23.	Do you follow a recommended crop rotation plan for all fields?	______	______
24.	Do you plant the highest yielding varieties of crops?	______	______
25.	Does your cropping system produce the most possible forage for your livestock?	______	______
26.	Are your yields per acre as high as any in your neighborhood?	______	______
27.	Have you increased the productivity of all of your fields and pastures?	______	______
28.	Do you use as much limestone as any farmer on similar land in the neighborhood?	______	______
29.	Do you fertilize your fields and pastures as much as do any of your neighbors?	______	______
30.	Do you graze the right number of livestock on your range and pasture land?	______	______
31.	Are your livestock healthy?	______	______
32.	Do you have a home garden as good as any in your neighborhood?	______	______
33.	Have you had your soil tested on all gardens, fields and pastures within the past three years?	______	______

Your rating as an FFA conservationist:

Total answers which are YES______ NO ______

I am Good ....(22-33 YES answers)
Fair...............................(11-21 YES answers)
Poor..............................(0-10 YES answers)

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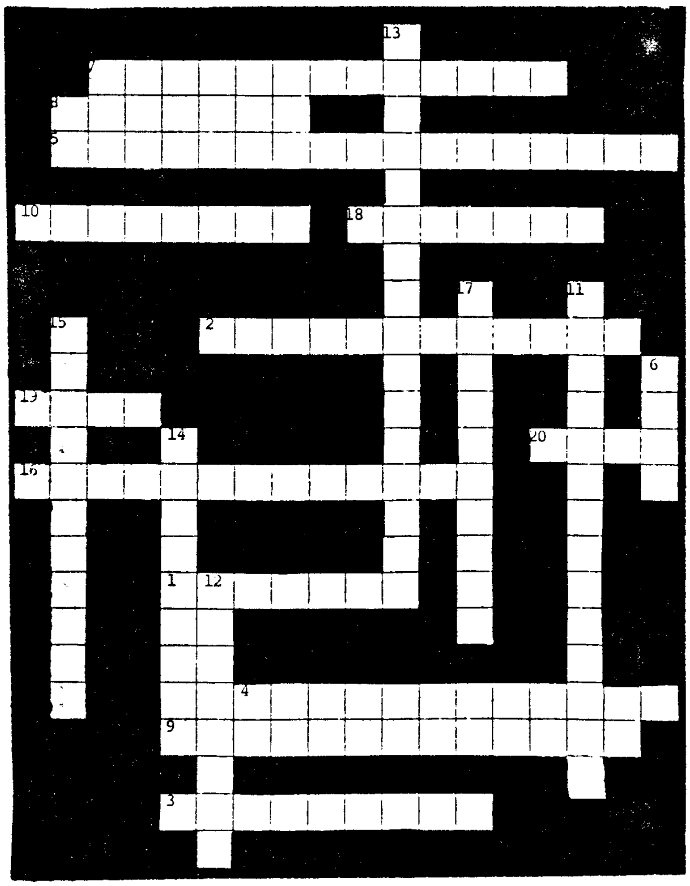
SOIL CONSERVATION

AG 150 - E

ASSIGNMENT SHEET #2--CONSERVING SOIL CROSSWORD PUZZLE

Name ______________________________ Score ________________



DOWN

6. ______ erosion is characterized by many small channels cut in to the soil by running water.
11. Farming around the slopes rather than up and down.
12. Alternating row crops with sod type crops to increase organic matter and reduce annual sod loss.
13. Office will give assistance free of charge for conservation planning.
14. A good ground cover (decreases, increases) water intake.
15. _____ _____ protects the soil's surface during parts of the season that crops are not grown.
17. The shape of the ground surface, as determined by major features such as hills, mountains, or plains.

ACROSS

1. The wearing away of the soil by forces of water and wind.
2. Removal of soil in a uniform layer.
3. A crop grown to cover and protect the soil for a certain part of the year.
4. Advanced stage of rill erosion.
5. The wearing away of the soil by forces which are natural and without interference by man is called____________.
7. Erosion caused by raindrops.
8. Measure to intercept running water and move it around the slope or into a tile line.
9. Practice of planting strips of row crops with strips of meadow, small grains, etc. to slow down water.
10. Grassed ditch-like structure to carry excess water.
16. Soils with high _____ _____ content have increased absorption capacity.
18. _______is usually dark in color.
19. Structure to hold or impound water.
20. The natural medium for the growth of plants. A mixture of minerals, organic matter and reduce annual sod loss.

SOIL CONSERVATION

AG 150 - E

ASSIGNMENT SHEET #3--LOCATING GOOD AND POOR CONSERVATION PRACTICES

Name ____ Score ______________________

Survey your home community and list five examples of good conservation practices.

1.

2.

3.

4.

5.

List five examples of poor conservation practices.

1.

2.

3.

4.

5.

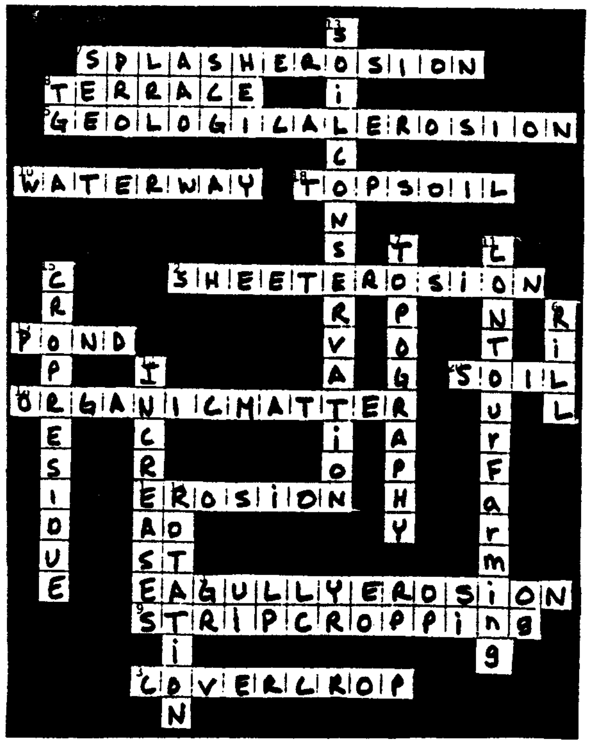
SOIL CONSERVATION

AG 150 - E

ANSWERS TO ASSIGNMENT SHEETS

1. Evaluated to satisfaction of instructor.

2.



3. Evaluated to satisfaction of instructor.

SOIL CONSERVATION

AG 150 - E

UNIT TEST

Name ____ Score _______________________

1. Match terms associated with soil conservation practices to the correct definitions. Write the correct numbers in the blanks.

_____a.	Rotation of crops on a field from one crop to another	1.	Erosion
_____b.	Ditch which prevents erosion by diverting water around a field rather than across	2.	Water outlet
_____c.	Removal of soil by tillage, wind and/or water	3.	Terracing
_____d.	Structure designed to slow down running water and control erosion on sloping land	4.	Crop rotation
_____e.	Crop used to cover the soil surface to decrease erosion	5.	Strip-cropping
_____f.	Practice of growing soil-conserving and soil-depleting crops in alternate strips for the purpose of reducing erosion	6.	Diversion ditch
_____g.	Ditch which carries excess water from farm	7.	Cover crop

2. Name two types of erosion.

a. ____

b. ____

3. Match the categories of water erosion to the correct description. Write the correct numbers in the blanks.

_____a.	Small channels are made by running water over the surface of the soil	1.	Splash
_____b.	The removal of soil in a uniform layer from an entire surface area	2.	Sheet
_____c.	Caused by the effect of falling raindrops	3.	Rill
_____d.	An advanced stage of rill erosion; occurs when rills flow together into larger streams; cannot be crossed by equipment	4.	Gully

4. Select from the following list factors that influence soil erosion. Write an "X" in the blank before each correct answer.

_____a. Soil texture

_____b. Organic matter content

_____c. Slope of field

_____d. Soil depth

_____e. Vegetative cover

_____f. Management practices used

_____g. Frozen soil

_____h. Horizontal length of land

_____i. Root zone

5. Select from the following list conservation practices for reducing wind erosion. Write an "X" in the blank before each correct answer.

_____a. Strip-cropping

_____b. Terracing

_____c. Construction of ponds and dams

_____d. Prevention of overgrazing

_____e. Emergency cover crops

_____f. Prevention of burning

_____g. Crop rotation

_____h. Grass waterways

_____i. Moisture conservation

6. Select from the following list mechanical and cropping practices used in water erosion conservation. Write an "X" in the blank before each correct answer.

_____a. Construction of ponds and dams

_____b. Stubble mulching

_____c. Grass waterways

_____d. Moisture conservation

_____e. Windbreak tree planting

_____f. Strip-cropping

_____g. Terracing

_____h. Crop rotation

_____i. Contour furrowing

_____j. Chiseling

7. Select from the following list factors that determine the type of cropping system to use. Write an "X" in the blank before each correct answer.

_____a. Soil profile

_____b. Erodibility

_____c. Drainage

_____d. Field size

_____e. Moisture

_____f. Soil depth

_____g. Fertility

_____h. Nitrogen content

_____i. Economics

8. Name two organizations involved with soil conservation.

a. ____

b. ____

SOIL CONSERVATION

AG 150 - E

ANSWERS TO TEST

1.
   - a. 4
   - b. 6
   - c. 1
   - d. 3
   - e. 7
   - f. 5
   - g. 2

2. Answer should include two of the following: Water; Wind; Tillage

3. a. 3 b. 2 c. 1 d. 4

4. a, b, c, e, f, g, h

5. a, d, e, f, i

6. a, b, c, f, g, h, i, j

7. b, c, e, f, g, i

8. Answer should include two of the following:

   Soil Conservation Service; Agricultural Stabilization and Conservation Service; Local soil and water conservation districts

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

UNIT OBJECTIVE

After completion of this unit, students should be able to judge land, recommend land treatments and complete the scorecard for land judging or homesite evaluation. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with land judging to the correct definitions.
2. List three reasons for judging land.
3. Select factors considered in determining land capability class.
4. Name the three major groups of soil in relation to texture.
5. Discuss the means of determining soil texture by touch.
6. Match the different variations of permeability, depth, slope, erosion, surface runoff, drainage and climate to the identifying characteristics of each.
7. Match the land capability class to the correct description.
8. Select, when given six land factors, the best land class possible for the specified field.
9. Select the recommended vegetative land treatments when given the land capability class.
10. Select the recommended mechanical land treatments when given the land capability class.
11. Select the correct fertilizer and soil amendments needed from soil test information provided.
12. Select factors considered in homesite evaluation.
13. Match the variations of permeability, slope, erosion, runoff, shrink-swell, water table and flooding to the correct definitions for homesite evaluation.
14. Select, when given land factors, the degree of limitation for foundations without basement; lawns, shrubs and gardens; septic systems; and lagoon sewage systems.
15. Demonstrate the ability to:
    a. Complete a land judging scorecard when given the characteristics of a field.
    b. Complete a homesite evaluation scorecard when given the characteristics of the site.

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

      1. Literature

         a. *Idaho Soils Atlas*, an illustrated manual showing 54 soils throughout the state of Idaho, contact local SCS person for information on obtaining a copy.

         b. *Soil and Land Judging Handbook, Training Guide*, available from Agricultural Communications Center, Ag Publications Building, Building J40, Idaho Street, University of Idaho, Moscow, Idaho 83843-4196; approximate cost $50; order no. MS 52.

         c. *Soils Manual for Land Judging*, a 58-page illustrated manual; available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407; approximate cost $9.15.

      2. Filmstrips, slideshows, etc.

         a. *Land Judging Slides*, set of 72 slides with script; the slides give a complete overview of land judging school and contest rules; available from CIMC, Oklahoma State Department of Voc-Tech Educ., 1500 W. 7th Ave., Stillwater, Oklahoma 74074; approximate cost $22.00.

         b. *Soil and Land Judging Contest Set Up and Procedures*, Program #476, 9 1/2 minutes; shows how to set up and conduct a soil judging contest according to the Idaho land judging program; one available in each University of Idaho District Extension Office.

   B. Make transparencies and necessary copies of materials.

   C. Provide students with objective sheet and discuss.

   D. Provide students with information and assignment sheets and discuss.

   E. Have students conduct laboratory experiments on soil permeability, slope, runoff and erosion.

   F. Conduct field trip to judge a previously prepared land site.

   G. Conduct a county soil-judging contest involving the FFA and 4-H members of the county.

H. Review and give test.

I. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Factors Determining Land Capability Class
2. TM 2--Determining Soil Texture
3. TM 3--Determining Soil Permeability
4. TM 4--Soil Permeability - "B" Horizon (Subsoil)
5. TM 5--Depth of Soil
6. TM 6--Slope
7. TM 7--Water and Wind Erosion
8. TM 8--Surface Runoff
9. TM 9--Land Capability Classes
10. TM 10--Land Capability
11. TM 11--Major Factors That Keep Area Out of Class I
12. TM 12--Land Use According to Capabilities
13. TM 13--Some Recommended Land Treatments: Vegetative
14. TM 14--Some Recommended Land Treatments: Mechanical
15. TM 15--Idaho Land Judging Scorecard
16. TM 16--Selection of Land Use Treatments
17. TM 17--Uses of Land for Agricultural Production
18. TM 18--Homesite Evaluation Land Judging Scorecard

E. Assignment sheets

1. AS 1--Complete Idaho Land Judging Scorecard

2. AS 2--Complete Homesite Evaluation Land Judging Scorecard

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. Donahue, Roy L., Follett, Roy H., Tulloch, Rodney W., *Our Soils and Their Management*, 5th edition, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1983.

B. *Idaho Soil and Land Judging Handbook and Training Guide*, Cooperative Extension Service, University of Idaho, Series No. 52, Moscow, Idaho.

C. *Instructional Materials for Vocational Agriculture*, Teaching Materials Center, Agriculture Education Department, Texas A & M University, College Station, Texas.

D. *Oklahoma Curriculum Guide for Vocational Agriculture*, Oklahoma State Board for Vocational-Technical Education, Curriculum and Instructional Materials Center, Stillwater, Oklahoma.

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

INFORMATION SHEET

I. Terms and definitions

A. Surface texture--Texture of the surface soil or "A" horizon; proportion of sand, silt and clay that makes up the surface soil

B. Sand--(0.05 to 2 mm) The gritty material which you can feel when you rub the soil with your fingers; individual grains can be seen or felt

C. Silt--(0.002 to 0.05 mm) The floury material which you can feel when you rub the soil with your finger; it is not gritty and not sticky when wet

D. Clay--(less than 0.002 mm) Forms lumps or clods when dry and is plastic and sticky when wet; when pinched out between the thumb and finger will form a long flexible "ribbon"

E. Soil pores--Total space not occupied by soil particles in a bulk volume of soil

F. Hard pan--A hardened soil layer in the lower "A" or deeper horizon; not readily penetrated by plant roots or water

G. Bulk density--The weight of dry soil per unit bulk volume, for example: grams per cm^3 or pound per cubic foot

H. Soil structure--Way that individual soil particles are grouped together to form clusters of particles

I. Topsoil or "A" horizon--Surface, dark-colored upper layer of natural soil; zone in which seeds are planted and cultivated; main storehouse for minerals and moisture

J. Subsoil--Layer found just below the topsoil; the "B" horizon; also a storehouse for moisture and minerals

K. Permeability--Rate at which air and water move through the soil

L. Soil depth--Total thickness of soil layers readily penetrated by roots

M. Slope--A measurement of difference in elevation from one point to another; it is generally referred to as a percent--the number of feet difference in elevation for 100 feet of horizontal distance

N. Erosion--Loss of soil by the actions of tillage, wind and/or water

O. Surface runoff--Relative rate water is removed by flow over the soil surface

P. Drainage--The ability of a soil to permit the downward flow of excess water to allow good aeration

Q. Climate--Amount of annual precipitation and the length of the growing season; affects crops that can be grown and crop yields

R. Land capability class--Grouping of different soils according to productive capacity, use, management and conservation treatment required to minimize erosion

S. Soil conserving crops--Crops that prevent or retard erosion and tend to maintain rather than deplete soil organic matter

(Note: Close seeded crops are generally regarded as soil conserving crops.)

T. Soil improving crops--Crops that improve or replenish rather than deplete soil organic matter; improve soil structure and tilth

(Note: Grasses and legumes are such crops.)

II. Reasons for judging land

A. Aids in understanding the importance of basic soil differences as they affect crop production and erosion

B. Helps to determine management practices important to proper use of soil and water

C. Develops understanding of different soil and water conservation practices

D. Aids in understanding the influence of land features on production and land protection

E. Aids in selecting a farm for purchase or making maximum use of land

III. Factors considered in determining land capability class (Transparency 1)

A. Surface texture

B. Permeability

C. Depth of soil

D. Slope

E. Erosion

(Note: This includes wind and water.)

F. Surface runoff

G. Drainage

H. Climate

IV. Major groups of soil in relation to texture

A. Sandy soils--Includes coarse textured, very sandy soils

B. Loamy soils--Includes moderately coarse, medium textured and moderately fine textured soils

C. Clayey soils--Includes fine textured soils

(Note: Refer to textural triangle for specific textural classes that fall into these groups.)

V. Determining soil texture by touch (Transparency 2)

(Note: Soil texture can be determined by touch with the aid of water by working or feeling the soil between fingers and thumb. Refer to AG 150-A--Elementary Study of Soils, Laboratory Exercise #2 for additional information.)

A. Sandy soils--When rubbed between fingers this soil has a rough, gritty feeling; individual grains can be seen or felt

B. Loamy soils--When rubbed between the fingers this soil has a touch of velvet or the feel of wheat flour; it is not gritty and not sticky when wet

C. Clayey soils--Forms very hard lumps or clods when dry and is sticky when wet; when pinched out between the thumb and finger will form a long flexible "ribbon"

VI. Important soil and land characteristics

A. Permeability of subsoil (Transparencies 3, 4)

1. Very slow--Less than 0.06 in/hr; soils that have dense heavy clay or clay pan subsoil

2. Slow--0.06 to 0.2 in/hr; soils that have crumbly, clayey subsoil

3. Moderate--0.2 to 6.0 in/hr; soils that have highly granular, clay loam subsoil

4. Rapid--over 6.0 in/hr; soils that have sandy subsoils

B. Depth of soil (Transparency 5)

(Note: Depth of soil includes the total thickness of the soil layers readily penetrated by plant roots, air and water. A restrictive layer may be dense clay, hardpan or bedrock.)

1. Very shallow--Less than 10 inches deep

2. Shallow--10 to 20 inches deep

3. Moderately deep--20 to 40 inches deep

4. Deep--40 to 60 inches deep

5. Very deep--over 60 inches deep

C. Slope (Transparency 6)

(Note: This is one of the most important factors in land classification. Runoff increases with slope and that in turn increases the erosion hazard for most uses of the land. The two possible slope groupings are for (1) dry cropland and (2) irrigated cropland. For irrigated cropland consider only for surface irrigation. Sprinkler irrigation on cropland reduces the erodibility of a soil due to slope and would need another grouping of percentages to indicate severity of slope. Slope groupings will vary with use, area, soil type, etc.)

		Dry cropland	Irrigated cropland
1.	Nearly level	0 to 3%	0 to 1%
2.	Gently sloping	3 to 8%	1 to 3%
3.	Moderately sloping	8 to 12%	3 to 5%
4.	Strongly sloping	12 to 20%	5 to 8%
5.	Steep	20 to 45%	8 to 12%
6.	Very steep	more than 45%	more than 12%

D. Erosion (Transparency 7)

(Note: Evaluation of the site for land judging will be based on past erosion. Original topsoil depth can be found on the site placard and compared to present depth of topsoil to calculate the percent lost. The present topsoil can be determined by dark color, presence of organic matter and soil structure.)

1. None to slight--Less than 25% of the surface soil is removed with no gullies and/or little deposition by wind and water

2. Moderate--25% to 75% of the surface soil removed with or without gullies and/or moderate deposition by wind and water

3. Severe--More than 75% of the surface soil removed with occasional uncrossable gullies and/or severe accumulation or blowouts by wind

E. Surface runoff (Transparency 8)

(Note: Surface runoff occurs from a combination of natural factors including land slope and water infiltration rate of the soils. Runoff causes erosion--loss of water, loss of soil, loss of nutrients. Lack of runoff causes ponding and excess water in the soil profile.)

1. Rapid--Surface water flows rapidly; fields with slopes of 3% and above (except rapidly permeable soils) would go in this category

2. Moderate--Normal runoff from soils with slopes of 1 to 3% (except rapidly permeable soils)

3. Slow--Surface water flows away slowly; surplus water on clayey soils is an occasional problem; can include nearly level areas (less than 1% slopes) with moderately permeable subsoil

4. Very slow--Surface water flows away very slowly; includes soils on nearly level slopes (less than 1%) with clayey surface texture or sandy texture soils with rapidly permeable subsoil

F. Drainage

(Note: Drainage is the ability of the subsoil to permit the downward flow of excess water to allow good aeration.)

1. Excessive--Excess amounts drain away quickly causing drought conditions; includes only rapidly permeable soils

2. Good--Saturation with water is limited to only a few days; plant roots are not injured

3. Somewhat poor--Saturation with water in root zone is limited to 1 or 2 weeks; this will injure plant roots

4. Poor--Saturation with water in root zone for more than two weeks; this will severely injure plant roots so that crop yield is appreciably reduced or the crop is destroyed

G. Climate

(Note: A short growing season and low natural precipitation are limitations in many parts of Idaho. Low natural precipitation is not a factor when irrigation water is available. Class I land is determined by the ability to produce mature corn for grain.)

1. Good--More than 140 frost-free days along with more than 10 inches of average annual precipitation. If less than 10 inches of annual precipitation occurs, irrigation water must be available

2. Fair--100 to 140 frost-free days along with more than 10 inches of average annual precipitation. If less than 10 inches of average annual precipitation occurs, irrigation water must be available

3. Poor--Less than 100 frost-free days or less than 10 inches of average annual precipitation with irrigation water unavailable

VII. Land capability classes (Transparencies 9, 10, 11, 12)

A. Land suited for cultivation

1. Class I--Soils having few limitations that restrict their use

2. Class II--Soils having some limitations that reduce the choice of plants; require moderate conservation practices

3. Class III--Soils having severe limitations that reduce the choice of plants or require special conservation practices, or both

4. Class IV--Soils having very severe limitations that restrict the choice of plants, require very careful management, special conservation or all of the above

B. Land not suited for cultivation

1. Class V--Soils having little or no erosion hazards, but having other limitations that are impractical to remove that limit their use largely to pasture, range, woodland or wildlife food and cover; these include areas with very poor drainage with wet, poorly drained profiles or frequent flood areas

2. Class VI--Soils having severe limitations that make them generally unsuited for cultivation and limit their use largely to pasture, range, woodland or wildlife food and cover

3. Class VII--Soils having very severe limitations that make them unsuited for cultivation and restrict their use largely to grazing, woodland or wildlife habitat

C. Land not suited for cultivation, grazing or forestry

1. Class VIII--Soils and land forms having limitations that preclude their use for commercial plant production and restrict their use to wildlife, recreation, water supply or scenic purposes

VIII. General guide for selecting land capability class

Soil factor	Best land class possible
A. Surface texture	
Sandy	III
Loamy	I
Clayey	I
B. Permeability	
Rapid	III
Moderate	I
Slow	II
Very slow	III

Soil factor		Best land class possible
C.	Depth--surface and subsoil	
	Very deep	I
	Deep	I
	Moderately deep	II
	Shallow	III
	Very shallow	VII
D.	Slope	
	Nearly level	I
	Gently sloping	II
	Moderately sloping	III
	Strongly sloping	IV
	Steep	VI
	Very steep	VII
E.	Erosion--wind and water	
	None to slight	I
	Moderate	II
	Severe	VI
F.	Surface runoff	
	Rapid	III
	Moderate	I
	Slow	I
	Very slow	II
G.	Drainage	
	Excessive	III
	Good	I
	Somewhat poor	II
	Poor	V
H.	Climate	
	Good	I
	Fair	II
	Poor	III

IX. Vegetative land treatments (Transparency 13)

A. Land suited for cultivation (class I - IV)

1. Use soil conserving and/or improving crops

(Note: Conservation cropping systems include the use of rotations that contain grasses and legumes as well as sequences in which the desired benefits are achieved without use of such crops.)

a. Not necessary--Applicable to class I

b. Every fourth or fifth year--Applicable to class II

c. Every third or fourth year--Applicable to class III

d. Every second or third year--Applicable to class IV

2. Crop residue use

(Note: Use of crop residues left in cultivated fields helps to prevent erosion and improve the soil by adding organic matter; applies to classes I, II, III, IV.)

3. Weed control

(Note: Weed control should be used any time there is an indication of a weed problem. One or more weeds within the boundary of the field will be considered to be a weed problem; could apply to all land classes.)

4. Strip cropping

(Note: Only applies to non-irrigation land classes III and IV.)

5. Brush and tree control

(Note: This practice should not be used when brush material can be controlled by normal farm plowing; applies only to land classes I, II, III, IV.)

B. Land not suited for cultivation (class V - VII)

1. Grasses and legumes

(Note: Used for all class V, VI and VII land except where tree plantings are made.)

2. Pasture, range, hay management

3. Tree planting

4. Woodland harvest cutting

5. Wildlife, recreation and watershed

(Note: Also includes class VIII.)

X. Mechanical land treatments (class I - IV) (Transparency 14)

A. Irrigated land only

1. Land leveling and smoothing

(Note: This does not include simple float, harrow or land plane.)

2. Irrigation water management

3. Water control structures

B. Dryland only

1. Diversion or terrace

2. Grass waterway

3. Contour farming

C. Both irrigated and dryland

1. Subsurface drainage system

(Note: Used on somewhat poorly and poorly drained areas.)

2. Minimum tillage

XI. Fertilizers and soil amendments

(Note: No set limits on lime, gypsum or fertility requirements will fit all areas and all crops. This is to acquaint land judges with present-day terminology and to have some knowledge about soil fertility requirements for Idaho crops and soils. Soil test information will be provided at each site.)

A. Nitrogen--Add when values are less than 40 ppm

B. Phosphorus--Add when values are less than 6 ppm on acid soils, and 10 ppm on alkaline soils

C. Potassium--Add when values are less than 80 ppm on acid soils, and 150 ppm on alkaline soils

D. Micronutrients--Add when zinc levels are below 0.6 ppm

(Note: Zinc is the only micronutrient for which a low level has been established for Idaho soils.)

E. Lime--Add when pH values for a field are less than 6.3

F. Gypsum--Add when pH values for a field are greater than 8.5

G. Organic matter--Add when shown as available

XII. Factors considered in homesite evaluation

A. Surface texture

B. Permeability

C. Soil depth

D. Slope

E. Erosion

F. Surface runoff

G. Shrink-swell (heaviest layer)

H. Water table (permanent or temporary)

I. Flooding

XIII. Important soil and land characteristics for homesite evaluation

(Note: Many of the soil characteristics important to land judging are also important to homesite evaluation. While many of the characteristics are the same, different separations are made within the class, for example: five categories for slope instead of six, etc. Only those classes with different numbers of categories will be covered in this section.)

A. Permeability

1. Slow--Less than 0.2 inches per hour

2. Moderate--0.2 to 6.0 inches per hour

3. Rapid--Greater than 6.0 inches per hour

B. Slope

1. Nearly level--0 to 0.5 percent

2. Gently sloping--0.5 to 5 percent

3. Moderately sloping--5 to 8 percent

4. Strongly sloping--8 to 15 percent

5. Very strongly sloping--Over 15 percent

(Note: Broader and different slope ranges apply to urban use consideration than normally apply to consideration for agricultural land.)

C. Erosion

1. None to slight and moderate--Less than 75% of the surface removed

2. Severe--Greater than 75% of the surface soil removed; require minor modifications

3. Very severe--Greater than 75% of the surface soils removed, usually severely gullied; require extensive modification

D. Surface runoff

1. Slow--Occurs on nearly level areas (less than 0.5%) and deep sands

2. Moderate--Occurs on slopes of 0.5 to 5%

3. Rapid--Occurs on slopes greater than 5%, except on deep sands

E. Shrink-swell

1. Low--Sands, loams and fine sandy loams

2. Moderate--Silt loams, clay loams and silty clay loams

3. High--Silty clay and clays

F. Water table

1. Deep--None evident above 72 inches

2. Moderately deep--Temporary or permanent water table present at depth of 48 to 72 inches

3. Shallow--Temporary or permanent water table at depths less than 48 inches

(Note: Unless obvious, water table depth or seasonal fluctuations are given on a placard at site.)

G. Flooding

1. Slight--No flooding

2. Severe--Occasional flooding; less frequent than one year in five

3. Very severe--Frequent flooding; more frequent than one year in five

XIV. Guide for assigning limitations in homesite evaluation

	Homesite Factors	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
A.	Surface texture				
	Sandy	Moderate	Moderate	Moderate	N/A
	Loamy	Slight	Slight	Slight	N/A
	Clayey	Severe	Severe	Severe	N/A
B.	Permeability				
	Slow	Moderate	Moderate	Severe	Slight
	Moderate	Slight	Slight	Slight	Moderate
	Rapid	Slight	Moderate	Slight	Severe

	Homesite Factors	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
C.	Soil depth				
	Very shallow	Severe	V. Severe	V. Severe	V. Severe
	Shallow	Moderate	Severe	V. Severe	V. Severe
	Moderately deep	Slight	Slight	Severe	Severe
	Deep	Slight	Slight	Moderate	Moderate
	Very deep	Slight	Slight	Slight	Slight
D.	Slope				
	Nearly level	Slight	Moderate	Slight	Slight
	Gently sloping	Slight	Slight	Slight	Slight
	Mod. sloping	Moderate	Moderate	Slight	Moderate
	Strongly sloping	Severe	Severe	Moderate	Severe
	Very strongly sloping	V. Severe	V. Severe	Severe	V. Severe
E.	Erosion				
	None - slight - moderate	Slight	Slight	Slight	Slight
	Severe	Moderate	Moderate	Moderate	Moderate
	Very severe	Severe	Severe	Severe	Severe
F.	Surface runoff				
	Slow & very slow	Severe	Slight	Severe	N/A
	Moderate	Slight	Slight	Slight	N/A
	Rapid	Slight	Severe	Slight	N/A
G.	Shrink-swell				
	Low	Slight	N/A	Slight	Slight
	Moderate	Moderate	N/A	Moderate	Slight
	High	Severe	N/A	Severe	Slight
H.	Water table				
	Deep	Slight	Slight	Slight	Slight
	Moderately deep	Moderate	Moderate	Moderate	Moderate
	Shallow	Severe	Severe	Severe	Severe
I.	Flooding				
	Slight	Slight	Slight	Slight	Slight
	Severe	Moderate	Moderate	Severe	Severe
	Very severe	V. Severe	V. Severe	V. Severe	V. Severe

FACTORS DETERMINING LAND CAPABILITY CLASS

Surface Texture

Permeability

Depth of Soil

Slope

Erosion

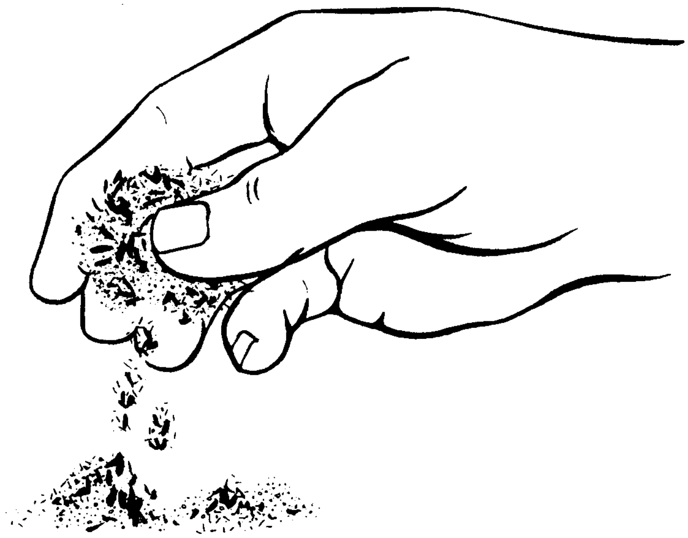
Surface Runoff

Drainage

Climate

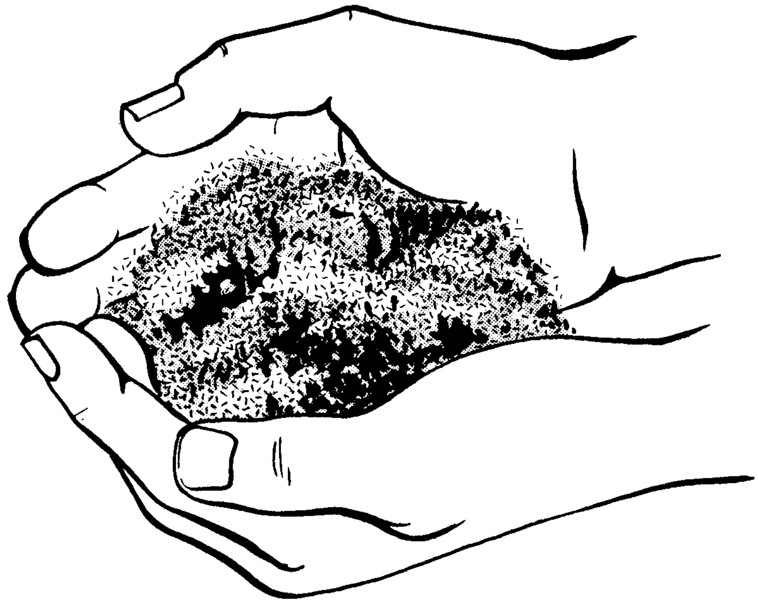
DETERMINING *Soil Texture*

RUB TOPSOIL BETWEEN THUMB AND FINGERS TO FEEL WHETHER IT IS SANDY, LOAMY, OR CLAYEY



SOIL TEXTURE		
SANDY		COARSE-GRITTY FEEL
LOAMY		MEDIUM-SILTY, FLOURY FEEL
CLAYEY		FINE-STICKY WHEN WET

DETERMINING SOIL PERMEABILITY



HANDLE SUBSOIL TO DETERMINE IF SUBSOIL IS LOOSE, CRUMBLY, DENSE OR TIGHT

and

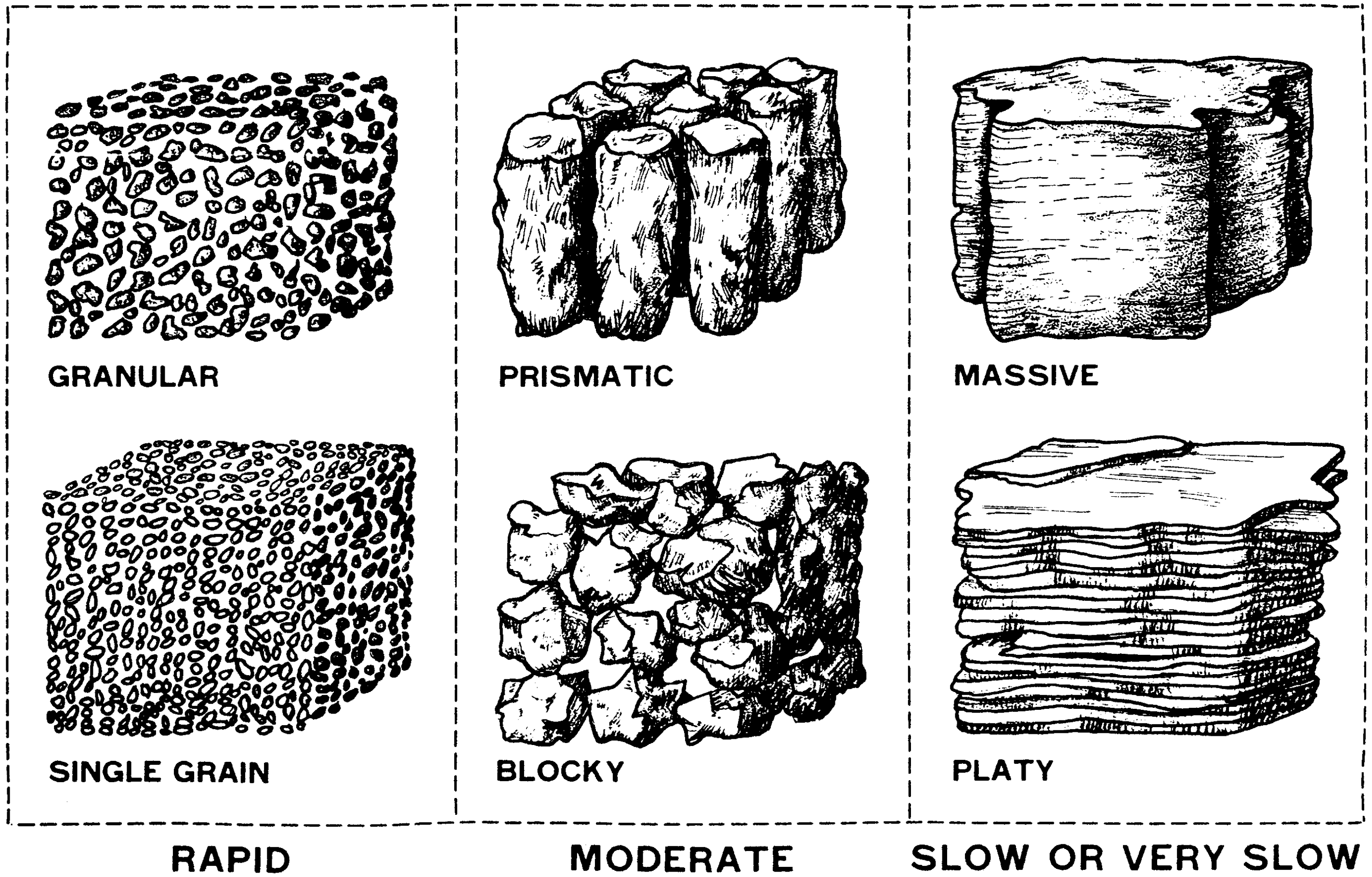
ESTIMATE SOIL PERMEABILITY OR MOVEMENT OF AIR AND WATER IN SUBSOIL

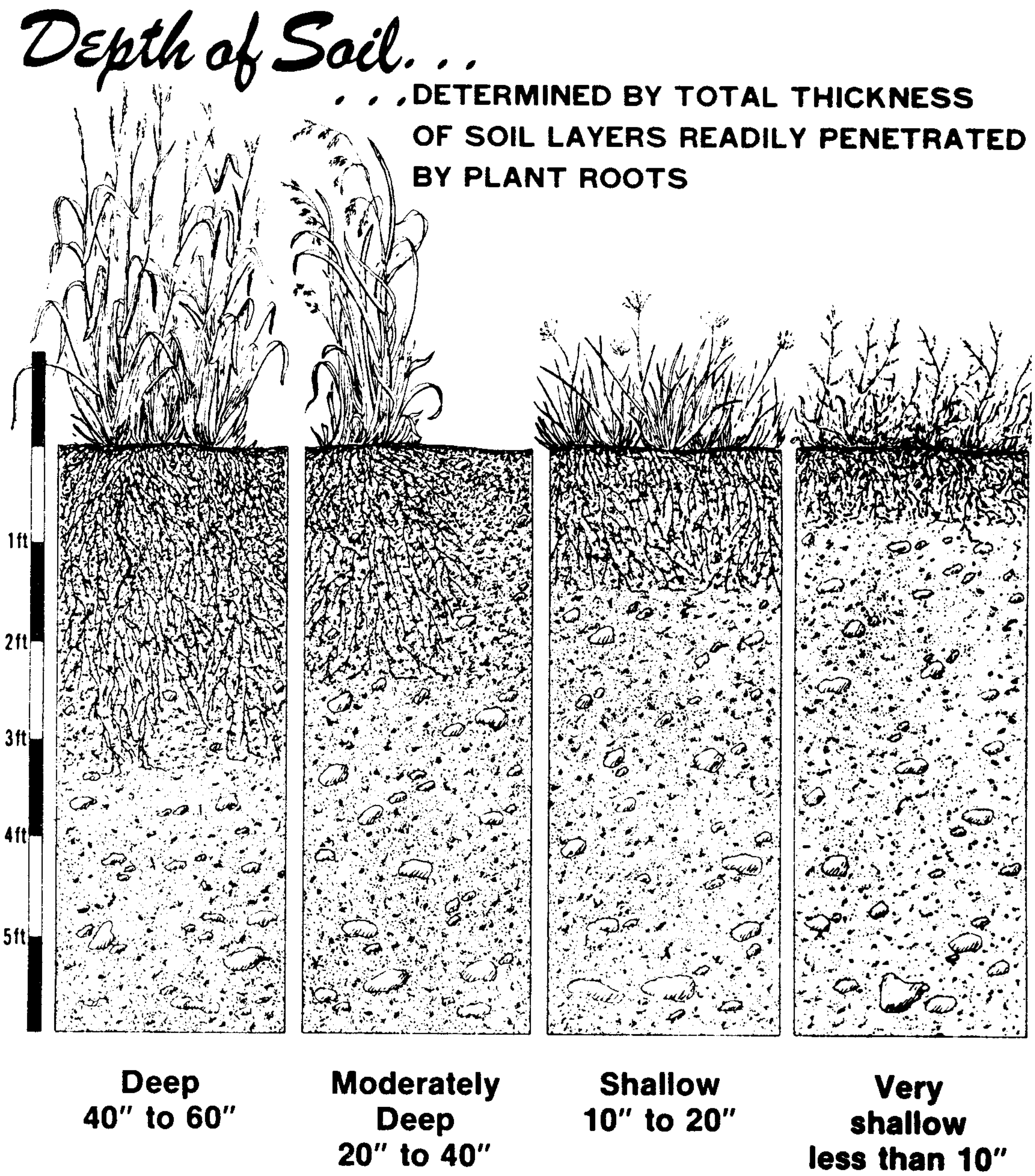
RATE	SOIL TEXTURE
RAPID	LOOSE, SANDY
MODERATE	LOAMY
SLOW	CRUMBLY, CLAYEY
VERY SLOW	DENSE, HEAVY CLAY

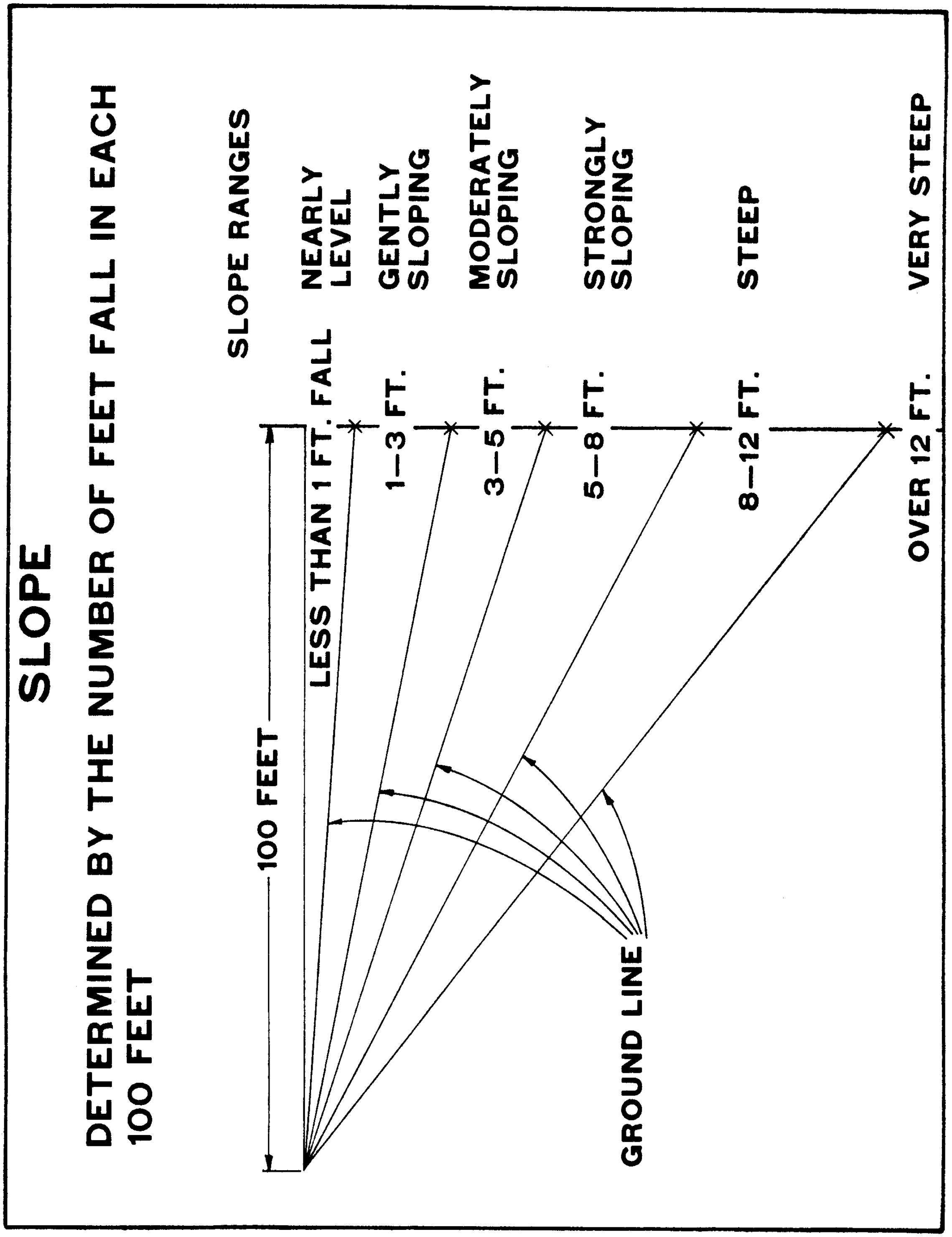
Soil Permeability

"B" HORIZON (SUBSOIL)

FACTORS DETERMINING PERMEABILITY CLASSIFICATION ARE:
SIZE - SHAPE - STRENGTH - ARRANGEMENT OF SOIL AGGREGATES

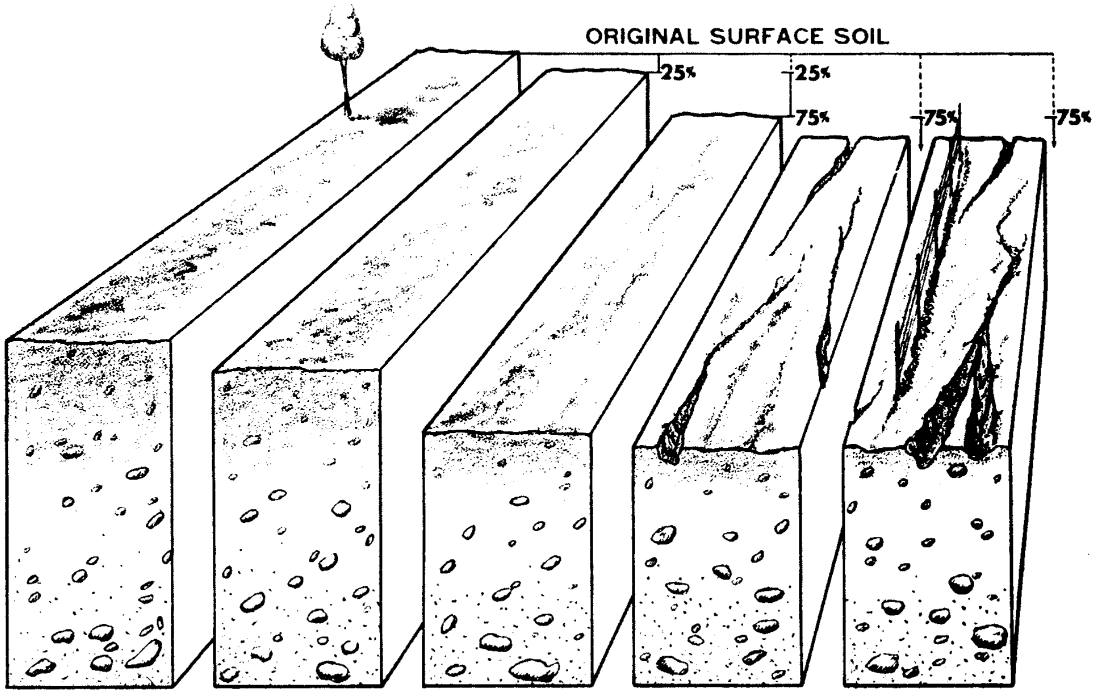



Depth of Soil. . .
. . . DETERMINED BY TOTAL THICKNESS OF SOIL LAYERS READILY PENETRATED BY PLANT ROOTS
1ft
2ft
3ft
4ft
5ft
Deep
40″ to 60″
Moderately Deep
20″ to 40″
Shallow
10″ to 20″
Very shallow
less than 10″


SLOPE
DETERMINED BY THE NUMBER OF FEET FALL IN EACH 100 FEET
100 FEET
SLOPE RANGES
LESS THAN 1 FT. FALL
NEARLY LEVEL
1—3 FT.
GENTLY SLOPING
3—5 FT.
MODERATELY SLOPING
5—8 FT.
STRONGLY SLOPING
8—12 FT.
STEEP
OVER 12 FT.
VERY STEEP
GROUND LINE

Water & Wind Erosion

IN DETERMINING EROSION CLASSIFICATION, OBSERVE THICKNESS OF REMAINING TOPSOIL AND COMPARE WITH ORIGINAL THICKNESS AS FURNISHED FROM INFORMATION SHEET

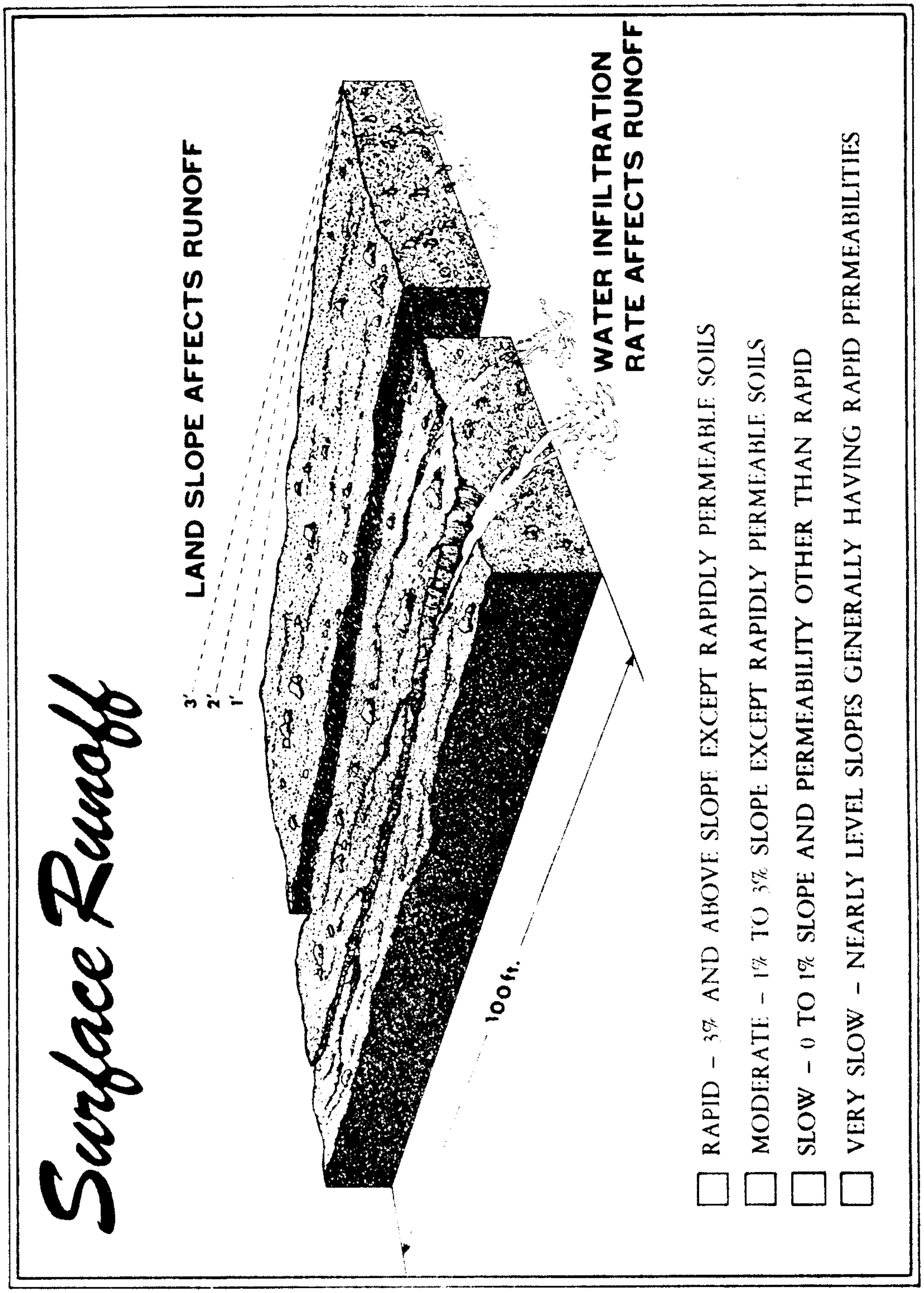


NONE TO SLIGHT — — LESS THAN 25% (WITH NO GULLIES)

MODERATE — — 25% TO 75% (WITHOUT FREQUENT UNCROSSABLE GULLIES)

SEVERE — — 75% OR MORE (WITH OR WITHOUT OCCASIONAL UNCROSSABLE GULLIES)

VERY SEVERE — — 75% OR MORE (WITH FREQUENT UNCROSSABLE GULLIES AND/OR SEVERE ACCUMULATIONS BY WIND)


Surface Runoff
LAND SLOPE AFFECTS RUNOFF
WATER INFILTRATION RATE AFFECTS RUNOFF
3'
2'
1'
100 ft.
☐ RAPID – 3% AND ABOVE SLOPE EXCEPT RAPIDLY PERMEABLE SOILS
☐ MODERATE – 1% TO 3% SLOPE EXCEPT RAPIDLY PERMEABLE SOILS
☐ SLOW – 0 TO 1% SLOPE AND PERMEABILITY OTHER THAN RAPID
☐ VERY SLOW – NEARLY LEVEL SLOPES GENERALLY HAVING RAPID PERMEABILITIES

LAND CAPABILITY CLASSES

SUITABLE FOR CULTIVATION

I REQUIRES GOOD SOIL MANAGEMENT PRACTICES ONLY

II MODERATE CONSERVATION PRACTICES NECESSARY

III INTENSIVE CONSERVATION PRACTICES NECESSARY

IV PERENNIAL VEGETATION - INFREQUENT CULTIVATION

UNSUITABLE FOR CULTIVATION; BUT SUITABLE FOR GRAZING, FORESTRY, AND WILDLIFE FOOD AND COVER

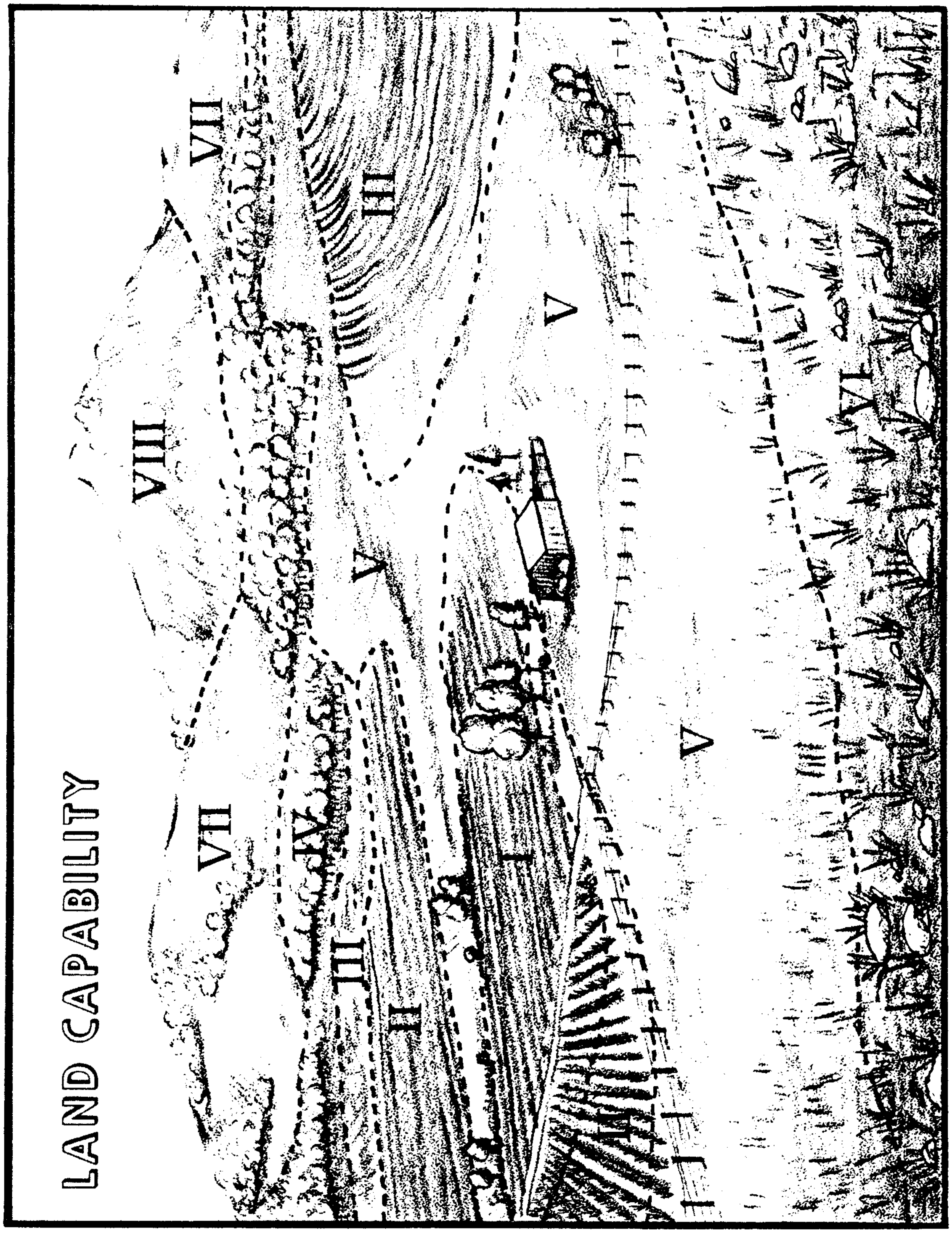
V LIMITED RESTRICTIONS IN USE, USUALLY POORLY DRAINED OR SUBJECT TO OVERFLOW

VI MODERATE RESTRICTIONS IN USE

VII SEVERE RESTRICTIONS

UNSUITABLE FOR CULTIVATION, GRAZING, OR FORESTRY

VIII EXTREME RESTRICTIONS FOR RECREATION, WILDLIFE, WATER SUPPLY, OR AESTHETIC PURPOSES

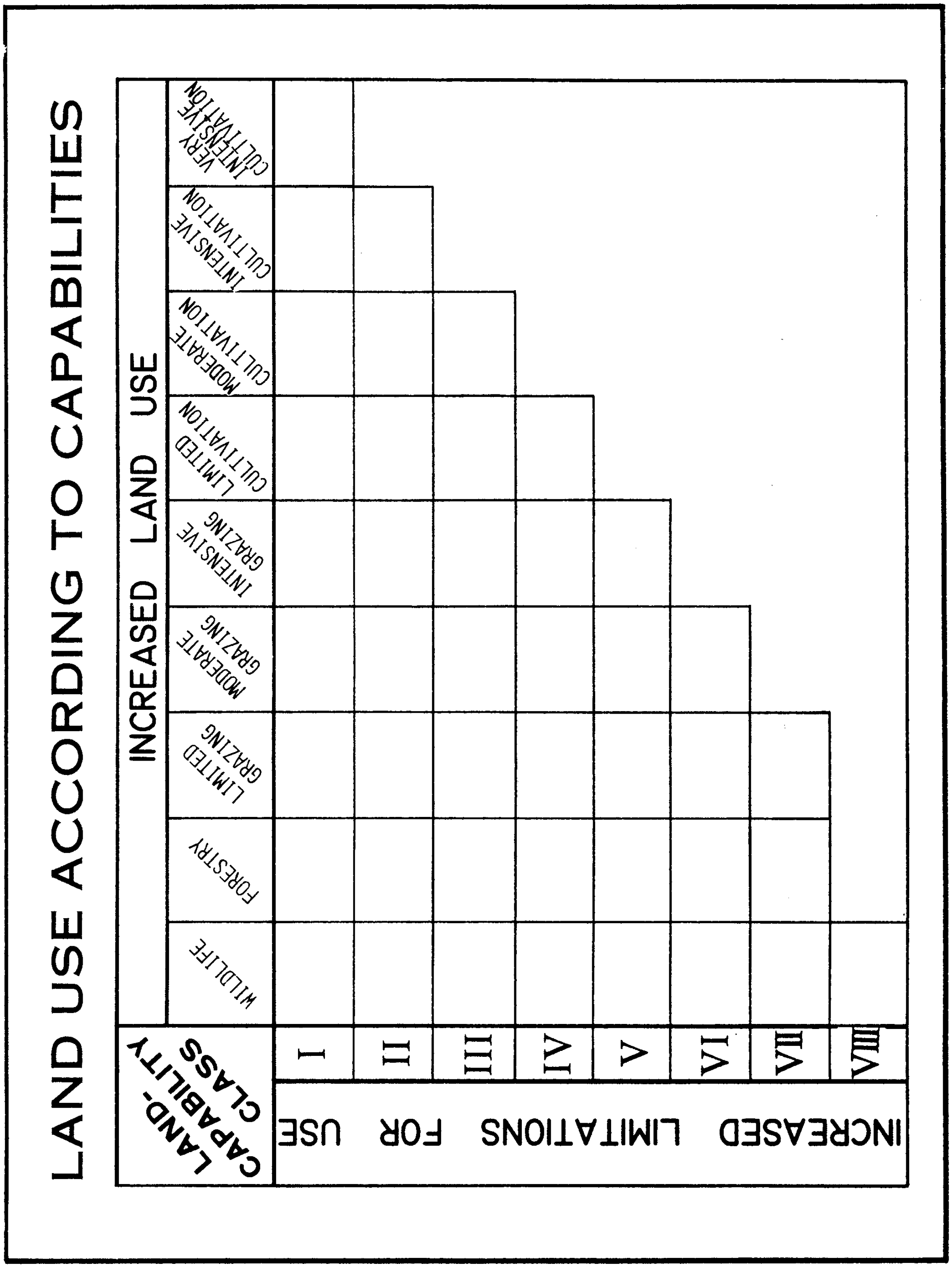

LAND CAPABILITY
VII
VIII
VII
III
V
IV
III
II
I
V
V
VI

Major Factors That Keep Area Out of Class 1

- ☐ 1. Texture
- ☐ 2. Permeability
- ☐ 3. Depth
- ☐ 4. Slope
- ☐ 5. Erosion
- ☐ 6. Runoff
- ☐ 7. Drainage
- ☐ 8. Climate
- ☐ 9. None

(✔) all factors that would prevent
the land area from being class 1

*Class 1 land will not have any factors checked


LAND USE ACCORDING TO CAPABILITIES
INCREASED LAND USE
LAND-CAPABILITY CLASS
WILDLIFE
FORESTRY
LIMITED GRAZING
MODERATE GRAZING
INTENSIVE GRAZING
LIMITED CULTIVATION
MODERATE CULTIVATION
INTENSIVE CULTIVATION
VERY INTENSIVE CULTIVATION
I
II
III
IV
V
VI
VII
VIII
INCREASED LIMITATIONS FOR USE

SOME RECOMMENDED LAND TREATMENTS

VEGETATIVE

USE SOIL IMPROVING/CONSERVING CROPS

CROP RESIDUE

WEED CONTROL

STRIP CROPPING

BRUSH AND TREE CONTROL

GRASSES AND LEGUMES

PASTURE, RANGE, HAY MANAGEMENT

TREE PLANTING

WOODLAND HARVEST CUTTING

WILDLIFE, RECREATION AND WATERSHED

SOME RECOMMENDED LAND TREATMENTS

MECHANICAL

IRRIGATED ONLY

LAND LEVELING AND SMOOTHING

IRRIGATION WATER MANAGEMENT

WATER CONTROL STRUCTURES

DRYLAND ONLY

DIVERSION OR TERRACE

CONTOUR FARMING

GRASS WATERWAYS

BOTH DRYLAND AND IRRIGATED

SUBSURFACE DRAINAGE SYSTEM

MINIMUM TILLAGE

Idaho Land Judging Scorecard

Contestant No. ______________

Name ______________________

Field No. __________________

(Indicate answer by an X in the box)

PART I — LAND CLASS FACTORS

A. SURFACE TEXTURE
- ☐ 1. Sandy soils
- ☐ 2. Loamy soils
- ☐ 3. Clayey soils

B. PERMEABILITY
- ☐ 1. Very slow
- ☐ 2. Slow
- ☐ 3. Moderate
- ☐ 4. Rapid

C. DEPTH, SURFACE AND SUBSOIL
- ☐ 1. Very shallow — less than 10"
- ☐ 2. Shallow — 10 to 20"
- ☐ 3. Moderately deep — 20 to 40"
- ☐ 4. Deep — 40 to 60"
- ☐ 5. Very deep — over 60"

D. SLOPE	**Dry**	**Irrigated**
☐ 1. Nearly level	0 to 3%	0 to 1%
☐ 2. Gently sloping	3 to 8%	1 to 3%
☐ 3. Moderately sloping	8 to 12%	3 to 5%
☐ 4. Strongly sloping	12 to 20%	5 to 8%
☐ 5. Steep	20 to 45%	8 to 12%
☐ 6. Very steep	over 45%	over 12%

E. EROSION — WIND AND WATER
- ☐ 1. None to slight — less than 25% lost
- ☐ 2. Moderate — 25 to 75% lost
- ☐ 3. Severe — over 75% lost

F. SURFACE RUNOFF
- ☐ 1. Rapid
- ☐ 2. Moderate
- ☐ 3. Slow
- ☐ 4. Very slow

G. DRAINAGE
- ☐ 1. Excessive
- ☐ 2. Good
- ☐ 3. Somewhat poor
- ☐ 4. Poor

H. CLIMATE
- ☐ 1. Good
- ☐ 2. Fair
- ☐ 3. Poor

I. MAJOR FACTORS

Any which keep area out of Class I
- ☐ 1. Texture
- ☐ 2. Permeability
- ☐ 3. Depth
- ☐ 4. Slope
- ☐ 5. Erosion
- ☐ 6. Surface runoff
- ☐ 7. Drainage
- ☐ 8. Climate
- ☐ 9. None

J. LAND CAPABILITY CLASS
- ☐ 1. Class I
- ☐ 2. Class II
- ☐ 3. Class III
- ☐ 4. Class IV
- ☐ 5. Class V
- ☐ 6. Class VI
- ☐ 7. Class VII
- ☐ 8. Class VIII

PART II — RECOMMENDED LAND TREATMENTS

Needed for different land capability classes

K. VEGETATIVE

Use soil conserving and/or improving crops:
- ☐ 1. Not necessary — Class I
- ☐ 2. Every 4-5th year — Class II
- ☐ 3. Every 3-4th year — Class III
- ☐ 4. Every 2-3rd year — Class IV
- ☐ 5. Crop residue use
- ☐ 6. Weed control
- ☐ 7. Strip cropping
- ☐ 8. Brush and tree control
- ☐ 9. Grasses and legumes
- ☐ 10. Pasture, range, hay management
- ☐ 11. Tree planting
- ☐ 12. Woodland harvest cutting
- ☐ 13. Wildlife, recreation and watershed

L. MECHANICAL

Irrigated Only
- ☐ 14. Land leveling and smoothing
- ☐ 15. Irrigation water management
- ☐ 16. Water control structures

Dryland Only
- ☐ 17. Diversion or terrace
- ☐ 18. Contour farming
- ☐ 19. Grass waterway

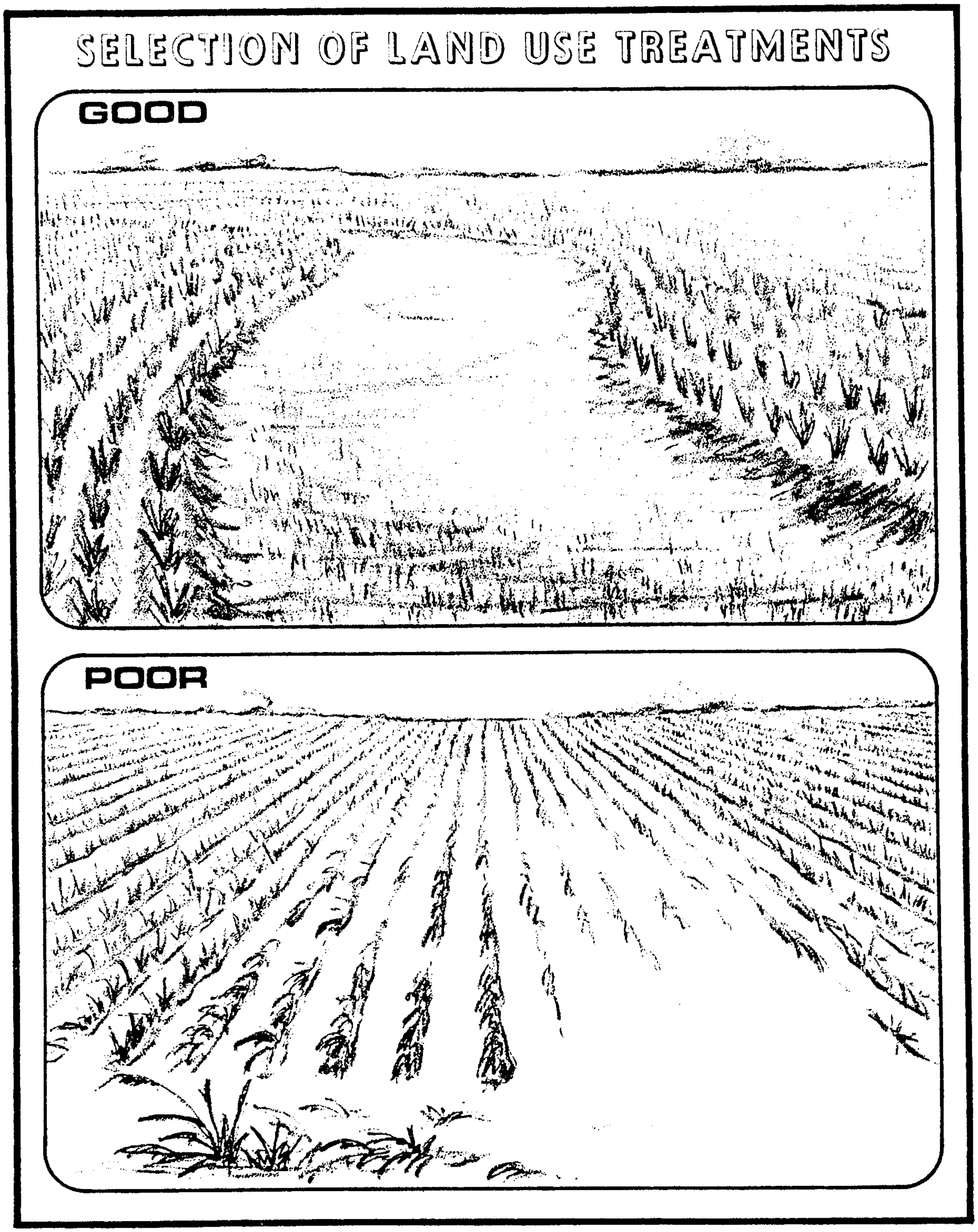
Both Dryland and Irrigated
- ☐ 20. Subsurface drainage system
- ☐ 21. Minimum tillage

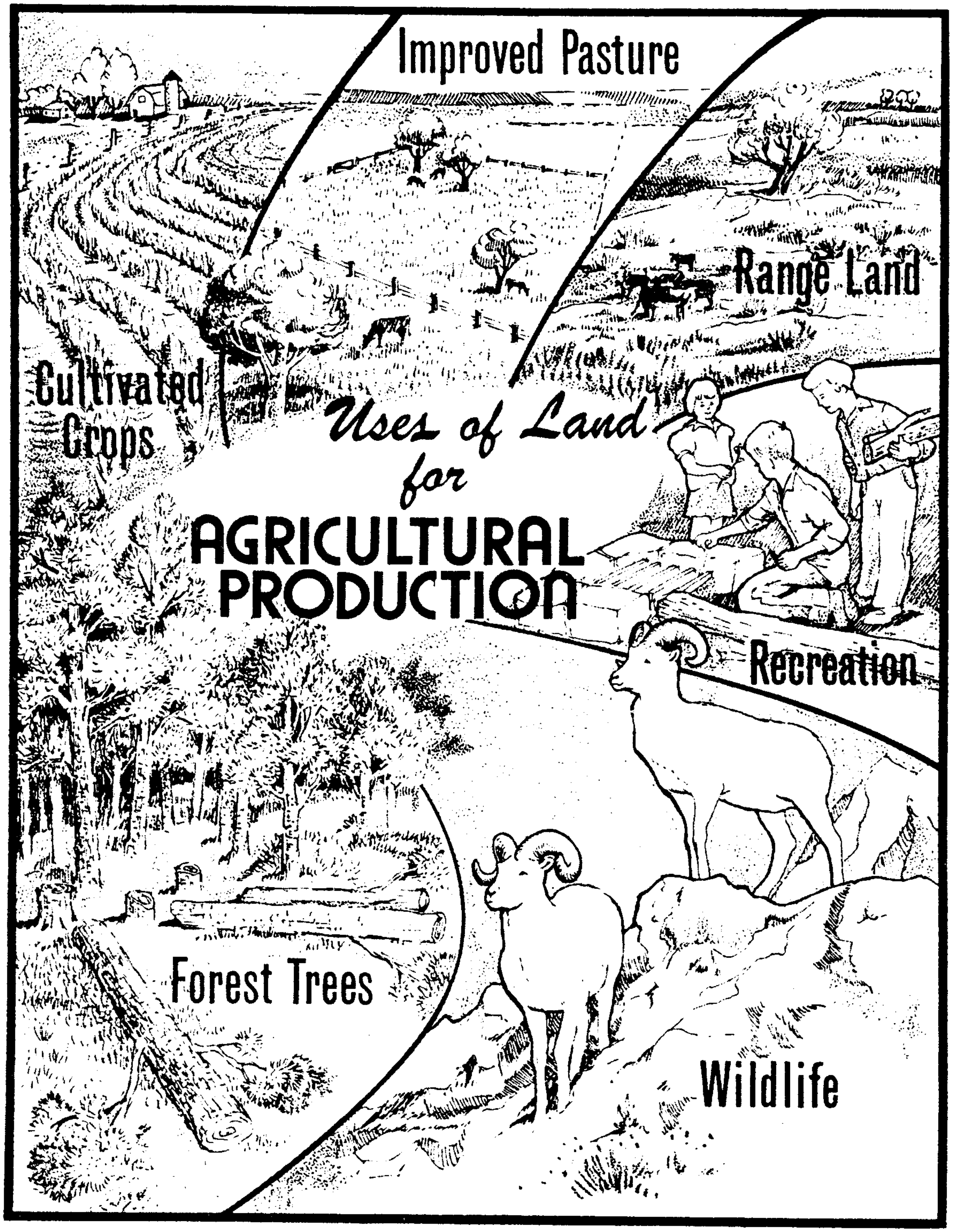
M. FERTILIZERS AND SOIL AMENDMENTS
- ☐ 22. Nitrogen (N)
- ☐ 23. Phosphorus (P)
- ☐ 24. Potassium (K)
- ☐ 25. Micronutrients
- ☐ 26. Lime
- ☐ 27. Gypsum
- ☐ 28. Organic matter
- ☐ 29. Fertilizer or amendments not needed

______________ SCORE PART I (Possible 40)

______________ SCORE PART II (Possible 30)

______________ SCORE (TOTAL) (Possible 70)


SELECTION OF LAND USE TREATMENTS
GOOD
POOR


Improved Pasture
Range Land
Cultivated Crops
Uses of Land for
AGRICULTURAL PRODUCTION
Recreation
Forest Trees
Wildlife

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Homesite Evaluation Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

PART I Land Factors Features of the Site Being Considered	PART II Planned Use — One Family Dwelling Without Basement. Interpretations of Limitations in Terms of: Degree of limitation	Dwelling site Foundations w/o basement	 Lawns, shrubs and gardens	 Septic system	 Lagoon sewage
A. TEXTURE — SURFACE ☐ Sandy ☐ Loamy ☐ Clayey	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
B. PERMEABILITY ☐ Slow — less than 0.2"/hr ☐ Moderate — 0.2 to 6.0"/hr. ☐ Rapid — over 6.0"/hr.	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
C. SOIL DEPTH ☐ Very shallow — less than 10" ☐ Shallow — 10 to 20" ☐ Moderately deep — 20 to 40" ☐ Deep — 40 to 60" ☐ Very deep — over 60"	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
D. SLOPE ☐ Nearly level — 0 to 0.5% ☐ Gently sloping — 0.5 to 5.0% ☐ Moderately sloping — 5.0 to 8% ☐ Strongly sloping — 8.0 to 15% ☐ Very strongly sloping — over 15.0%	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
E. EROSION ☐ None — Slight — Moderate ☐ Severe ☐ Very severe	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
F. SURFACE RUNOFF ☐ Slow — nearly level areas and deep sands ☐ Moderate — slopes 0.5 to 5% ☐ Rapid — slopes over 5%	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
G. SHRINK — SWELL (heaviest layer) ☐ Low ☐ Moderate ☐ High	Slight Moderate Severe	☐ ☐ ☐		☐ ☐ ☐	☐ ☐ ☐
H. WATER TABLE (permanent or temporary) ☐ Deep — none evident above 72" ☐ Moderately deep — 48 to 72" ☐ Shallow — less than 48"	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
I. FLOODING ☐ Slight ☐ Severe — less than 1 year in 5 ☐ Very severe — more than 1 year in 5	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
FINAL EVALUATION ☐ All factors none to slight ☐ One or more factors moderate; none severe ☐ One or more factors severe; none very severe ☐ One or more factors very severe	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐

SCORE PART I ____________
(possible 20)

SCORE PART II ________ ________ ________ ________
(possible 20 for each use)

PART I AND II — TOTAL SCORE ____________________
(possible 100)

TM 18

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

ASSIGNMENT SHEET #1--COMPLETE IDAHO LAND JUDGING SCORECARD

Name ______________________________ Score ________________________

Apply the following land class factors and field conditions to the judging scorecard:

1. Texture--Feel of wheat flour
2. Permeability--Granular, clay loam
3. Depth--26 inches
4. Slope--3 1/2 foot fall in each 100 feet
5. Erosion--30% of topsoil removed, no gullies
6. Drainage--Root zone saturated with water limited to 1 week
7. Climate--120 days, irrigation water available
8. Soil test results
   a. pH--6.0
   b. N--25 ppm
   c. P--8 ppm
   d. K--250 ppm
   e. Zn--0.8 ppm

Idaho Land Judging Scorecard

Contestant No. ____________

Name ____________________

Field No. ______________

(Indicate answer by an X in the box)

PART I — LAND CLASS FACTORS

A. SURFACE TEXTURE
- ☐ 1. Sandy soils
- ☐ 2. Loamy soils
- ☐ 3. Clayey soils

B. PERMEABILITY
- ☐ 1. Very slow
- ☐ 2. Slow
- ☐ 3. Moderate
- ☐ 4. Rapid

C. DEPTH, SURFACE AND SUBSOIL
- ☐ 1. Very shallow — less than 10"
- ☐ 2. Shallow — 10 to 20"
- ☐ 3. Moderately deep — 20 to 40"
- ☐ 4. Deep — 40 to 60"
- ☐ 5. Very deep — over 60"

D. SLOPE	**Dry**	**Irrigated**
☐ 1. Nearly level	0 to 3%	0 to 1%
☐ 2. Gently sloping	3 to 8%	1 to 3%
☐ 3. Moderately sloping	8 to 12%	3 to 5%
☐ 4. Strongly sloping	12 to 20%	5 to 8%
☐ 5. Steep	20 to 45%	8 to 12%
☐ 6. Very steep	over 45%	over 12%

E. EROSION — WIND AND WATER
- ☐ 1. None to slight — less than 25% lost
- ☐ 2. Moderate — 25 to 75% lost
- ☐ 3. Severe — over 75% lost

F. SURFACE RUNOFF
- ☐ 1. Rapid
- ☐ 2. Moderate
- ☐ 3. Slow
- ☐ 4. Very slow

G. DRAINAGE
- ☐ 1. Excessive
- ☐ 2. Good
- ☐ 3. Somewhat poor
- ☐ 4. Poor

H. CLIMATE
- ☐ 1. Good
- ☐ 2. Fair
- ☐ 3. Poor

I. MAJOR FACTORS

Any which keep area out of Class I
- ☐ 1. Texture
- ☐ 2. Permeability
- ☐ 3. Depth
- ☐ 4. Slope
- ☐ 5. Erosion
- ☐ 6. Surface runoff
- ☐ 7. Drainage
- ☐ 8. Climate
- ☐ 9. None

J. LAND CAPABILITY CLASS
- ☐ 1. Class I
- ☐ 2. Class II
- ☐ 3. Class III
- ☐ 4. Class IV
- ☐ 5. Class V
- ☐ 6. Class VI
- ☐ 7. Class VII
- ☐ 8. Class VIII

PART II — RECOMMENDED LAND TREATMENTS

Needed for different land capability classes

K. VEGETATIVE

Use soil conserving and/or improving crops:
- ☐ 1. Not necessary — Class I
- ☐ 2. Every 4-5th year — Class II
- ☐ 3. Every 3-4th year — Class III
- ☐ 4. Every 2-3rd year — Class IV
- ☐ 5. Crop residue use
- ☐ 6. Weed control
- ☐ 7. Strip cropping
- ☐ 8. Brush and tree control
- ☐ 9. Grasses and legumes
- ☐ 10. Pasture, range, hay management
- ☐ 11. Tree planting
- ☐ 12. Woodland harvest cutting
- ☐ 13. Wildlife, recreation and watershed

L. MECHANICAL

Irrigated Only
- ☐ 14. Land leveling and smoothing
- ☐ 15. Irrigation water management
- ☐ 16. Water control structures

Dryland Only
- ☐ 17. Diversion or terrace
- ☐ 18. Contour farming
- ☐ 19. Grass waterway

Both Dryland and Irrigated
- ☐ 20. Subsurface drainage system
- ☐ 21. Minimum tillage

M. FERTILIZERS AND SOIL AMENDMENTS
- ☐ 22. Nitrogen (N)
- ☐ 23. Phosphorus (P)
- ☐ 24. Potassium (K)
- ☐ 25. Micronutrients
- ☐ 26. Lime
- ☐ 27. Gypsum
- ☐ 28. Organic matter
- ☐ 29. Fertilizer or amendments not needed

____________ SCORE PART I (Possible 40)

____________ SCORE PART II (Possible 30)

____________ SCORE (TOTAL) (Possible 70)

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

ASSIGNMENT SHEET #2--COMPLETE IDAHO HOMESITE EVALUATION
LAND JUDGING SCORECARD

Name ______________________ Score ______________________

Apply the following homesite soil factors and conditions to the judging scorecard:

1. Texture--Moderately gritty

2. Permeability--Soft blocky, sandy loam

3. Soil depth--55 inches

4. Slope--2 foot fall in each 100 feet

5. Erosion--60% of topsoil removed, no gullies

6. Water table--None evident above 72 inches

7. Flooding--No flooding

Homesite Evaluation Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

PART I Land Factors

PART II Planned Use — One Family Dwelling Without Basement. Interpretations of Limitations in Terms of: Dwelling site

Features of the Site Being Considered	Degree of limitation	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
A. TEXTURE — SURFACE ☐ Sandy ☐ Loamy ☐ Clayey	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
B. PERMEABILITY ☐ Slow — less than 0.2"/hr ☐ Moderate — 0.2 to 6.0"/hr. ☐ Rapid — over 6.0"/hr.	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
C. SOIL DEPTH ☐ Very shallow — less than 10" ☐ Shallow — 10 to 20" ☐ Moderately deep — 20 to 40" ☐ Deep — 40 to 60" ☐ Very deep — over 60"	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
D. SLOPE ☐ Nearly level — 0 to 0.5% ☐ Gently sloping — 0.5 to 5.0% ☐ Moderately sloping — 5.0 to 8% ☐ Strongly sloping — 8.0 to 15% ☐ Very strongly sloping — over 15.0%	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
E. EROSION ☐ None — Slight — Moderate ☐ Severe ☐ Very severe	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
F. SURFACE RUNOFF ☐ Slow — nearly level areas and deep sands ☐ Moderate — slopes 0.5 to 5% ☐ Rapid — slopes over 5%	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
G. SHRINK — SWELL (heaviest layer) ☐ Low ☐ Moderate ☐ High	Slight Moderate Severe	☐ ☐ ☐		☐ ☐ ☐	☐ ☐ ☐
H. WATER TABLE (permanent or temporary) ☐ Deep — none evident above 72" ☐ Moderately deep — 48 to 72" ☐ Shallow — less than 48"	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
I. FLOODING ☐ Slight ☐ Severe — less than 1 year in 5 ☐ Very severe — more than 1 year in 5	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
FINAL EVALUATION ☐ All factors none to slight ☐ One or more factors moderate; none severe ☐ One or more factors severe; none very severe ☐ One or more factors very severe	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐

SCORE PART I ____________
(possible 20)

SCORE PART II ________ ________ ________ ________
(possible 20 for each use)

PART I AND II — TOTAL SCORE ____________
(possible 100)

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Idaho Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

(Indicate answer by an X in the box)

PART I — LAND CLASS FACTORS

A. SURFACE TEXTURE
- ☐ 1. Sandy soils
- ☒ 2. Loamy soils
- ☐ 3. Clayey soils

B. PERMEABILITY
- ☐ 1. Very slow
- ☐ 2. Slow
- ☒ 3. Moderate
- ☐ 4. Rapid

C. DEPTH, SURFACE AND SUBSOIL
- ☐ 1. Very shallow — less than 10"
- ☐ 2. Shallow — 10 to 20"
- ☒ 3. Moderately deep — 20 to 40"
- ☐ 4. Deep — 40 to 60"
- ☐ 5. Very deep — over 60"

D. SLOPE

	Dry	Irrigated
☐ 1. Nearly level	0 to 3%	0 to 1%
☐ 2. Gently sloping	3 to 8%	1 to 3%
☒ 3. Moderately sloping	8 to 12%	3 to 5%
☐ 4. Strongly sloping	12 to 20%	5 to 8%
☐ 5. Steep	20 to 45%	8 to 12%
☐ 6. Very steep	over 45%	over 12%

E. EROSION — WIND AND WATER
- ☐ 1. None to slight — less than 25% lost
- ☒ 2. Moderate — 25 to 75% lost
- ☐ 3. Severe — over 75% lost

F. SURFACE RUNOFF
- ☒ 1. Rapid
- ☐ 2. Moderate
- ☐ 3. Slow
- ☐ 4. Very slow

G. DRAINAGE
- ☐ 1. Excessive
- ☐ 2. Good
- ☒ 3. Somewhat poor
- ☐ 4. Poor

H. CLIMATE
- ☐ 1. Good
- ☒ 2. Fair
- ☐ 3. Poor

I. MAJOR FACTORS

Any which keep area out of Class I
- ☐ 1. Texture
- ☐ 2. Permeability
- ☒ 3. Depth
- ☒ 4. Slope
- ☒ 5. Erosion
- ☒ 6. Surface runoff
- ☒ 7. Drainage
- ☒ 8. Climate
- ☐ 9. None

J. LAND CAPABILITY CLASS
- ☐ 1. Class I
- ☐ 2. Class II
- ☒ 3. Class III
- ☐ 4. Class IV
- ☐ 5. Class V
- ☐ 6. Class VI
- ☐ 7. Class VII
- ☐ 8. Class VIII

PART II — RECOMMENDED LAND TREATMENTS

Needed for different land capability classes

K. VEGETATIVE

Use soil conserving and/or improving crops:
- ☐ 1. Not necessary — Class I
- ☐ 2. Every 4-5th year — Class II
- ☒ 3. Every 3-4th year — Class III
- ☐ 4. Every 2-3rd year — Class IV
- ☒ 5. Crop residue use
- ☐ 6. Weed control
- ☒ 7. Strip cropping
- ☐ 8. Brush and tree control
- ☐ 9. Grasses and legumes
- ☐ 10. Pasture, range, hay management
- ☐ 11. Tree planting
- ☐ 12. Woodland harvest cutting
- ☐ 13. Wildlife, recreation and watershed

L. MECHANICAL

Irrigated Only
- ☐ 14. Land leveling and smoothing
- ☒ 15. Irrigation water management
- ☒ 16. Water control structures

Dryland Only
- ☐ 17. Diversion or terrace
- ☐ 18. Contour farming
- ☐ 19. Grass waterway

Both Dryland and Irrigated
- ☒ 20. Subsurface drainage system
- ☒ 21. Minimum tillage

M. FERTILIZERS AND SOIL AMENDMENTS
- ☒ 22. Nitrogen (N)
- ☐ 23. Phosphorus (P)
- ☐ 24. Potassium (K)
- ☐ 25. Micronutrients
- ☒ 26. Lime
- ☐ 27. Gypsum
- ☒ 28. Organic matter
- ☐ 29. Fertilizer or amendments not needed

____________ SCORE PART I (Possible 40)

____________ SCORE PART II (Possible 30)

____________ SCORE (TOTAL) (Possible 70)

Assignment Sheet #2

Homesite Evaluation Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

PART I Land Factors — Features of the Site Being Considered		PART II Planned Use — One Family Dwelling Without Basement. Interpretations of Limitations in Terms of: Dwelling site — Degree of limitation	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
A. TEXTURE — SURFACE						
☒ Sandy		Slight	☐	☐	☐	
☐ Loamy		Moderate	☒	☒	☒	
☐ Clayey		Severe	☐	☐	☐	
B. PERMEABILITY						
☐ Slow	less than 0.2"/hr	Slight	☒	☒	☒	☐
☒ Moderate	0.2 to 6.0"/hr.	Moderate	☐	☐	☐	☒
☐ Rapid	over 6.0"/hr.	Severe	☐	☐	☐	☐
C. SOIL DEPTH						
☐ Very shallow	less than 10"	Slight	☒	☒	☐	☐
☐ Shallow	10 to 20"	Moderate	☐	☐	☒	☒
☐ Moderately deep	20 to 40"	Severe	☐	☐	☐	☐
☒ Deep	40 to 60"	Very Severe	☐	☐	☐	☐
☐ Very deep	over 60"					
D. SLOPE						
☐ Nearly level	0 to 0.5%	Slight	☒	☒	☒	☒
☒ Gently sloping	0.5 to 5.0%	Moderate	☐	☐	☐	☐
☐ Moderately sloping	5.0 to 8%	Severe	☐	☐	☐	☐
☐ Strongly sloping	8.0 to 15%	Very Severe	☐	☐	☐	☐
☐ Very strongly sloping	over 15.0%					
E. EROSION						
☒ None — Slight — Moderate		Slight	☒	☒	☒	☒
☐ Severe		Moderate	☐	☐	☐	☐
☐ Very severe		Severe	☐	☐	☐	☐
F. SURFACE RUNOFF						
☐ Slow — nearly level areas and deep sands		Slight	☒	☒	☒	
☒ Moderate — slopes 0.5 to 5%		Moderate	☐	☐	☐	
☐ Rapid — slopes over 5%		Severe	☐	☐	☐	
G. SHRINK — SWELL (heaviest layer)						
☒ Low		Slight	☒		☒	☒
☐ Moderate		Moderate	☐		☐	☐
☐ High		Severe	☐		☐	☐
H. WATER TABLE (permanent or temporary)						
☒ Deep — none evident above 72"		Slight	☒	☒	☒	☒
☐ Moderately deep — 48 to 72"		Moderate	☐	☐	☐	☐
☐ Shallow — less than 48"		Severe	☐	☐	☐	☐
I. FLOODING						
☒ Slight		Slight	☒	☒	☒	☒
☐ Severe	less than 1 year in 5	Moderate	☐	☐	☐	☐
☐ Very severe	more than 1 year in 5	Severe	☐	☐	☐	☐
		Very Severe	☐	☐	☐	☐
FINAL EVALUATION						
☐ All factors none to slight		Slight	☒	☒	☐	☐
☒ One or more factors moderate; none severe		Moderate	☐	☐	☒	☒
☐ One or more factors severe; none very severe		Severe	☐	☐	☐	☐
☐ One or more factors very severe		Very Severe	☐	☐	☐	☐

SCORE PART I ____________ (possible 20)

SCORE PART II ________ ________ ________ ________ (possible 20 for each use)

PART I AND II — TOTAL SCORE ____________ (possible 100)

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

UNIT TEST

Name ______________________________________ Score ______________________________

1. Match terms associated with land judging to the correct definition. Write the correct numbers in the blanks.

_____a. Relative rate water is removed by flow over the soil surface

_____b. Total thickness of soil layers readily penetrated by roots

_____c. Crops that prevent or retard erosion and tend to maintain rather than deplete soil organic matter

_____d. The number of feet difference in elevation for 100 feet of horizontal distance

_____e. Grouping of different soils according to productive capacity, use, management and conservation treatment necessary to minimize erosion

_____f. Crops that improve or replenish rather than deplete soil organic matter

_____g. Rate at which air and water move through the soil

_____h. Surface, dark-colored upper layer of natural soil; "A" horizon

_____i. Layer found just below the topsoil; "B" horizon

_____j. Loss of soil by actions of tillage, wind and/or water

_____k. Way that individual soil particles are grouped together to form clusters of particles

_____l. Proportion of sand, silt and clay that makes up the surface soil

_____m. Forms lumps or clods when dry and is plastic and sticky when wet

_____n. A hardened soil layer not readily penetrated by plant roots or water

1. Surface texture
2. Sand
3. Silt
4. Clay
5. Soil pores
6. Hard pan
7. Bulk density
8. Soil structure
9. Topsoil
10. Subsoil
11. Permeability
12. Soil depth
13. Slope
14. Erosion
15. Surface runoff
16. Drainage
17. Climate
18. Land capability class
19. Soil conserving crops
20. Soil improving crops

_____o. Amount of annual precipitation and the length of the growing season; affects crops that can be grown and crop yields

_____p. The gritty material which you can feel when you rub the soil with your fingers

_____q. The ability of a soil to permit the downward flow of excess water to allow good aeration

_____r. Total space not occupied by soil particles in a bulk volume of soil

_____s. The floury material which you can feel when you rub the soil with your finger; it is not gritty and not sticky when wet

2. List three reasons for judging land.

a. ____

b. ____

c. ____

3. Select from the following list factors used in determining land capability class. Write an "X" in the blank before each correct answer.

_____a. Surface texture

_____b. Soil profile

_____c. Climate

_____d. Depth of soil

_____e. Previous crop

_____f. Slope

_____g. Permeability

_____h. Erosion

_____i. Cover crops

_____j. Surface runoff

_____k. Drainage

_____l. Shrink-swell

4. Name the three major groups of soil in relation to texture.

a. ______________________________

b. ______________________________

c. ______________________________

5. Discuss in a short paragraph the means of determining soil texture by touch.

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6. Match the different variations of permeability, depth, slope, erosion, surface runoff, drainage and climate to the correct definition. Write the correct numbers in the blanks.

Permeability

_____a.	Soils that have sandy subsoil	1.	Very slow
_____b.	Soils that have highly granular, clay loam subsoil	2.	Slow
		3.	Moderate
_____c.	Soils that have dense heavy clay or clay pan subsoil	4.	Rapid
_____d.	Soils that have crumbly, clayey subsoil		

Depth of soil

_____a.	10 to 20 inches deep	1.	Very shallow
_____b.	More than 60 inches deep	2.	Shallow
_____c.	Less than 10 inches deep	3.	Moderately deep

_____d.	40 to 60 inches deep	4.	Deep
_____e.	20 to 40 inches deep	5.	Very deep

Slope (irrigated land)

_____a.	3 to 5 feet fall in each 100 feet	1.	Nearly level
_____b.	More than 12 feet fall in each 100 feet	2.	Gently sloping
_____c.	8 to 12 feet fall in each 100 feet	3.	Moderately sloping
_____d.	5 to 8 feet fall in each 100 feet	4.	Strongly sloping
_____e.	Less than 1 foot fall in each 100 feet	5.	Steep
_____f.	1 to 3 feet fall in each 100 feet	6.	Very steep

Erosion

_____a.	25 to 75 percent of surface soil removed with or without gullies	1.	None to slight
		2.	Moderate
_____b.	More than 75 percent of the surface soil removed with occasional uncrossable gullies	3.	Severe
_____c.	Less than 25 percent surface soil removed with no gullies		

Surface runoff

_____a.	Normal runoff from soils with slopes of 1 to 3% (except rapidly permeable soils)	1.	Rapid
		2.	Moderate
_____b.	Surface water flows rapidly; fields with slopes of 3% and above (except rapidly permeable soils)	3.	Slow
		4.	Very slow
_____c.	Surface water flows away slowly; fields with slope of less than 1% with moderately permeable subsoil		
_____d.	Surface water flows away very slowly; fields with slope of less than 1% with rapidly permeable subsoil		

Drainage

_____a.	Excess amounts drain away quickly causing drought conditions; rapidly permeable soils	1.	Excessive
_____b.	Saturation with water in root zone limited to 1 or 2 weeks; will injure plant roots	2.	Good
_____c.	Saturation with water in root zone for more than 2 weeks; severely injure plant roots so that yield is greatly reduced	3.	Somewhat poor
_____d.	Saturation with water in root zone limited to a few days; plant roots are not injured	4.	Poor

Climate

_____a.	Less than 100 frost-free days or less than 10 inches of average annual precipitation with irrigation water unavailable	1.	Good
_____b.	More than 140 frost-free days with more than 10 inches of average annual precipitation or irrigation water available	2.	Fair
_____c.	100 to 140 frost-free days along with more than 10 inches of average annual precipitation or irrigation water available	3.	Poor

7. Match the land capability class to the correct description. Write the correct numbers in the blanks.

_____a.	Soils having very severe limitations that make them unsuited for cultivation and restrict their use to grazing, woodland or wildlife habitat	1.	Class I
_____b.	Soils having few limitations that restrict their use	2.	Class II
_____c.	Soils having severe limitations that reduce the choice of plants or require special conservation practices, or both	3.	Class III
_____d.	Soil and land forms having limitations that preclude their use for commercial plant production and restrict their use to wildlife, recreation, water supply or scenic purposes	4.	Class IV
		5.	Class V
		6.	Class VI
		7.	Class VII
		8.	Class VIII

_____e. Soils having little or no erosion hazards, but having other limitations that are impractical to remove, largely limited to pasture, range, woodland or wildlife food and cover

_____f. Soils having some limitations that reduce the choice of plants; require moderate conservation practices

_____g. Soils having very severe limitations that restrict the choice of plants, require careful management, special conservation or all of the above

_____h. Soils having severe limitations that make them generally unsuited for cultivation and limit their use to pasture, range, woodland or wildlife food and cover

8. Write the best land capability class possible for each of the following land class factors. Write the correct numbers in the blanks. (Land capability classes are I, II, III, IV, V, VI, VII, VIII)

_____a. Loamy soil

_____b. Shallow depth

_____c. Slow permeability

_____d. Strongly sloping

_____e. Severe erosion

_____f. Very slow surface runoff

9. Select the recommended vegetative land treatments for non-irrigated Class III land that has a moderate erosion problem. Write an "X" in the blank before each correct treatment.

_____a. Soil conserving and/or improving crops not necessary

_____b. Use soil conserving and/or improving crops every 4th-5th year

_____c. Use soil conserving and/or improving crops every 3rd-4th year

_____d. Use soil conserving and/or improving crops every 2nd-3rd year

_____e. Crop residue use

_____f. Weed control

_____g. Strip cropping

_____h. Brush and tree control

_____i. Grasses and legumes

_____j. Pasture, range, hay management

_____k. Tree planting

_____l. Woodland harvest cutting

_____m. Wildlife, recreation and watershed

10. Select the recommended mechanical land treatments for irrigated Class II with an excessive surface runoff problem. Write an "X" in the blank before each correct treatment.

_____a. Land leveling and smoothing

_____b. Irrigation water management

_____c. Water control structure

_____d. Diversion or terrace

_____e. Contour farming

_____f. Grass waterway

_____g. Subsurface drainage system

_____h. Minimum tillage

11. Using the information on the following placard, select the correct fertilizer and soil amendments needed. Write an "X" in the blank before each correct treatment.

1. Field number 1

2. Original depth of topsoil 12 inches

3. Climate
   a. Annual precipitation 8 inches
   b. Frost-free days 125

4. Soil Analysis
   a. pH 7.5
   b. Nitrogen (NO_3) 30 ppm
   c. Phosphorus (P) 9 ppm
   d. Potassium (K) 300 ppm
   e. Zinc (Zn) 1.5 ppm
   f. Manure available
   g. Irrigation water available

_____a. Nitrogen (N)

_____b. Phosphorus (P)

_____c. Potassium (K)

_____d. Micronutrients

_____e. Lime

_____f. Gypsum

_____g. Organic matter

_____h. Fertilizer or amendments not needed

12. Select from the following list factors considered in homesite evaluation. Write an "X" in the blank before each correct answer.

_____a. Surface texture

_____b. Permeability

_____c. Climate

_____d. Depth of soil

_____e. Slope

_____f. Erosion

_____g. Drainage

_____h. Surface runoff

_____i. Shrink-swell

_____j. Soil profile

_____k. Water table

_____l. Flooding

_____m. Land capability class

13. Match the variations of permeability, slope, erosion, runoff, shrink-swell, water table and flooding to the correct definitions for homesite evaluation. Write the correct numbers in the blanks.

Permeability

_____a.	Soils that have sandy subsoil; greater than 6.0 inches per hour	1.	Slow
		2.	Moderate
_____b.	Soils that have dense, heavy clay or crumbly, clayey subsoil; 0.2 to 6.0 inches per hour	3.	Rapid
_____c.	Soils that have highly granular, clay loam or silt loam subsoil; less than 0.2 inches per hour		

Slope (irrigated land)

_____a.	5 to 8 feet fall in each 100 feet	1.	Nearly level
_____b.	More than 15 feet fall in each 100 feet	2.	Gently sloping
_____c.	Less than 0.5 feet fall in each 100 feet	3.	Moderately sloping

_____d.	8 to 15 feet fall in each 100 feet	4.	Strongly sloping
_____e.	0.5 to 5 foot fall in each 100 feet	5.	Very strongly sloping

Erosion

_____a.	75 percent or more of surface soil removed and with severe gullies that will require extensive modification	1.	None to slight moderate
		2.	Severe
_____b.	75 percent or more of the surface soil removed with occasional gullies that may require minor modification	3.	Very severe
_____c.	Less than 75 percent surface soil removed		

Surface runoff

_____a.	Occurs on slopes of 0.5 to 5.0 percent	1.	Slow
_____b.	Occurs on slopes greater than 5 percent, except on deep sands	2.	Moderate
		3.	Rapid
_____c.	Occurs on nearly level areas of less than 0.5 percent and on deep sands		

Shrink-swell

_____a.	Sands, loams and fine sandy loams	1.	Low
_____b.	Silt loams, clay loams and silty clay loams	2.	Moderate
		3.	Shallow
_____c.	Silty clay and clays		

Water table

_____a.	None evident above 72 inches	1.	Deep
_____b.	Evidence of water table between 48 to 72 inches	2.	Moderately deep
		3.	Shallow
_____c.	Evidence of water table at less than 48 inches		

Flooding

_____a.	Less frequent than one year in five	1.	Slight
_____b.	More frequent than one year in five	2.	Severe
_____c.	No flooding occurs	3.	Very severe

14. Select the degree of limitation for foundations without basement; lawns, shrubs and gardens; septic systems and lagoon sewage systems for each homesite land factors. Write the correct answers in the blanks.

Features of homesite	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	sewage Lagoon
a. Surface texture: Sandy		Moderate		N/A
b. Permeability: Rapid	Slight	________	Slight	________
c. Soil depth: Mod. Deep	________	Slight	________	________
d. Slope: Gently sloping	Slight	________	________	________
e. Erosion: Severe	________	________	________	Moderate
f. Surface runoff: Slow	Severe	________	________	N/A
g. Shrink-swell: Low	________	N/A	________	Slight
h. Water table: Deep	Slight	________	________	________
i. Flooding: Severe	Moderate	________	________	Severe

15. Apply the following land class factors, field conditions and placard information to the Idaho Land Judging Scorecard on page 150F-52.

a. Texture--When rubbed between the fingers, the soil feels sticky and stains your fingers

b. Permeability--Blocky, clayey subsoil

c. Depth--18 inches

d. Slope--6 inch fall in each 100 feet

e. Erosion--No gullies

f. Drainage--Root zone saturated with water limited to two weeks

(Note: See site placard on the following page.)

Site Placard

1. Field number 2

2. Original depth of topsoil 36 inches

3. Climate
   a. Annual precipitation 10 inches
   b. Frost-free days 120

4. Soil Analysis
   a. pH 7.5
   b. Nitrogen (NO_3) 20 ppm
   c. Phosphorus (P) 8 ppm
   d. Potassium (K) 200 ppm
   e. Zinc (Zn) 2.0 ppm
   f. Manure available
   g. Irrigation water available

16. Apply the following homesite land factors, conditions and placard information to the Homesite Evaluation Land Judging Scorecard on page 150F-53.

    a. Texture--When rubbed between the fingers, the soil feels smooth but not sticky, and stains your fingers

    b. Permeability--Granular, sandy loam subsoil

    c. Soil depth--36 inches

    d. Slope--3 feet fall in each 100 feet

Site Placard

1. Field number 3

2. Original depth of topsoil 60 inches

3. Climate
   a. Annual precipitation 16 inches
   b. Frost-free days 140

4. Soil Analysis
   a. pH 7.2
   b. Other factors
      1) Flooding--Once every six years
      2) Water table--None evident above 72 inches

Idaho Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

(Indicate answer by an X in the box)

PART I — LAND CLASS FACTORS

A. SURFACE TEXTURE
- ☐ 1. Sandy soils
- ☐ 2. Loamy soils
- ☐ 3. Clayey soils

B. PERMEABILITY
- ☐ 1. Very slow
- ☐ 2. Slow
- ☐ 3. Moderate
- ☐ 4. Rapid

C. DEPTH, SURFACE AND SUBSOIL
- ☐ 1. Very shallow — less than 10"
- ☐ 2. Shallow — 10 to 20"
- ☐ 3. Moderately deep — 20 to 40"
- ☐ 4. Deep — 40 to 60"
- ☐ 5. Very deep — over 60"

D. SLOPE

	Dry	Irrigated
☐ 1. Nearly level	0 to 3%	0 to 1%
☐ 2. Gently sloping	3 to 8%	1 to 3%
☐ 3. Moderately sloping	8 to 12%	3 to 5%
☐ 4. Strongly sloping	12 to 20%	5 to 8%
☐ 5. Steep	20 to 45%	8 to 12%
☐ 6. Very steep	over 45%	over 12%

E. EROSION — WIND AND WATER
- ☐ 1. None to slight — less than 25% lost
- ☐ 2. Moderate — 25 to 75% lost
- ☐ 3. Severe — over 75% lost

F. SURFACE RUNOFF
- ☐ 1. Rapid
- ☐ 2. Moderate
- ☐ 3. Slow
- ☐ 4. Very slow

G. DRAINAGE
- ☐ 1. Excessive
- ☐ 2. Good
- ☐ 3. Somewhat poor
- ☐ 4. Poor

H. CLIMATE
- ☐ 1. Good
- ☐ 2. Fair
- ☐ 3. Poor

I. MAJOR FACTORS

Any which keep area out of Class I
- ☐ 1. Texture
- ☐ 2. Permeability
- ☐ 3. Depth
- ☐ 4. Slope
- ☐ 5. Erosion
- ☐ 6. Surface runoff
- ☐ 7. Drainage
- ☐ 8. Climate
- ☐ 9. None

J. LAND CAPABILITY CLASS
- ☐ 1. Class I
- ☐ 2. Class II
- ☐ 3. Class III
- ☐ 4. Class IV
- ☐ 5. Class V
- ☐ 6. Class VI
- ☐ 7. Class VII
- ☐ 8. Class VIII

PART II — RECOMMENDED LAND TREATMENTS

Needed for different land capability classes

K. VEGETATIVE

Use soil conserving and/or improving crops:
- ☐ 1. Not necessary — Class I
- ☐ 2. Every 4-5th year — Class II
- ☐ 3. Every 3-4th year — Class III
- ☐ 4. Every 2-3rd year — Class IV
- ☐ 5. Crop residue use
- ☐ 6. Weed control
- ☐ 7. Strip cropping
- ☐ 8. Brush and tree control
- ☐ 9. Grasses and legumes
- ☐ 10. Pasture, range, hay management
- ☐ 11. Tree planting
- ☐ 12. Woodland harvest cutting
- ☐ 13. Wildlife, recreation and watershed

L. MECHANICAL

Irrigated Only
- ☐ 14. Land leveling and smoothing
- ☐ 15. Irrigation water management
- ☐ 16. Water control structures

Dryland Only
- ☐ 17. Diversion or terrace
- ☐ 18. Contour farming
- ☐ 19. Grass waterway

Both Dryland and Irrigated
- ☐ 20. Subsurface drainage system
- ☐ 21. Minimum tillage

M. FERTILIZERS AND SOIL AMENDMENTS
- ☐ 22. Nitrogen (N)
- ☐ 23. Phosphorus (P)
- ☐ 24. Potassium (K)
- ☐ 25. Micronutrients
- ☐ 26. Lime
- ☐ 27. Gypsum
- ☐ 28. Organic matter
- ☐ 29. Fertilizer or amendments not needed

____________ SCORE PART I (Possible 40)

____________ SCORE PART II (Possible 30)

____________ SCORE (TOTAL) (Possible 70)

Homesite Evaluation Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

PART I Land Factors	PART II Planned Use — One Family Dwelling Without Basement. Interpretations of Limitations in Terms of:				
	Dwelling site				
Features of the Site Being Considered	Degree of limitation	Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
A. TEXTURE — SURFACE ☐ Sandy ☐ Loamy ☐ Clayey	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
B. PERMEABILITY ☐ Slow less than 0.2"/hr ☐ Moderate 0.2 to 6.0"/hr. ☐ Rapid over 6.0"/hr.	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
C. SOIL DEPTH ☐ Very shallow less than 10" ☐ Shallow 10 to 20" ☐ Moderately deep 20 to 40" ☐ Deep 40 to 60" ☐ Very deep over 60"	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
D. SLOPE ☐ Nearly level 0 to 0.5% ☐ Gently sloping 0.5 to 5.0% ☐ Moderately sloping 5.0 to 8% ☐ Strongly sloping 8.0 to 15% ☐ Very strongly sloping over 15.0%	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
E. EROSION ☐ None — Slight — Moderate ☐ Severe ☐ Very severe	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
F. SURFACE RUNOFF ☐ Slow — nearly level areas and deep sands ☐ Moderate — slopes 0.5 to 5% ☐ Rapid — slopes over 5%	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
G. SHRINK — SWELL (heaviest layer) ☐ Low ☐ Moderate ☐ High	Slight Moderate Severe	☐ ☐ ☐		☐ ☐ ☐	☐ ☐ ☐
H. WATER TABLE (permanent or temporary) ☐ Deep — none evident above 72" ☐ Moderately deep — 48 to 72" ☐ Shallow — less than 48"	Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
I. FLOODING ☐ Slight ☐ Severe less than 1 year in 5 ☐ Very severe more than 1 year in 5	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
FINAL EVALUATION ☐ All factors none to slight ☐ One or more factors moderate; none severe ☐ One or more factors severe; none very severe ☐ One or more factors very severe	Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐

SCORE PART I ____________
(possible 20)

SCORE PART II ________ ________ ________ ________
(possible 20 for each use)

PART I AND II — TOTAL SCORE ____________
(possible 100)

LAND EVALUATION AND USE CLASSIFICATION

AG 150 - F

ANSWERS TO TEST

1.

a.	15	f.	20	k.	8	p.	2
b.	12	g.	11	l.	1	q.	16
c.	19	h.	9	m.	4	r.	5
d.	13	i.	10	n.	6	s.	3
e.	18	j.	14	o.	17		

2. Answer should include three of the following:

   Aids in understanding the importance of basic soil differences as they affect crop production and erosion; Helps to determine management practices important to proper use of soil and water; Develops understanding of different soil and water conservation practices; Aids in understanding the influence of land features on production and land protection; Aids in selecting a farm for purchase or making maximum use of land

3. a, c, d, f, g, h, j, k

4. Sandy; Loamy; Clayey

5. <u>Sandy soils</u>--When rubbed between fingers this soil has a rough, gritty feeling; individual grains can be seen or felt; <u>Loamy soils</u>--When rubbed between the fingers this soil has a touch of velvet or the feel of wheat flour; it is not gritty and not sticky when wet; <u>Clayey soils</u>--Forms very hard lumps or clods when dry and is sticky when wet; when pinched out between the thumb and finger will form a long flexible "ribbon"

6.

Permeability	a. 4	b. 3	c. 1	d. 2		
Depth	a 2	b. 5	c. 1	d. 4	e. 3	
Slope	a. 3	b. 6	c. 5	d. 4	e. 1	f. 2
Erosion	a. 2	b. 3	c. 1			
Surface runoff	a. 2	b. 1	c. 3	d. 4		
Drainage	a. 1	b. 3	c. 4	d. 2		
Climate	a. 3	b. 1	c. 2			

7.

a.	7	e.	5
b.	1	f.	2
c.	3	g.	4
d.	8	h.	6

8.

a.	I	d.	IV
b.	III	e.	VI
c.	II	f.	II

9. c, e, g

10. b, c, h

11. a, b, g

12. a, b, d, e, f, h, i, k, l

13.

Permeability	a. 3	b. 2	c. 1		
Slope	a. 3	b. 5	c. 1	d. 4	e. 2
Erosion	a. 3	b. 2	c. 1		
Surface runoff	a. 2	b. 3	c. 1		
Shrink-swell	a. 1	b. 2	c. 3		
Water table	a. 1	b. 2	c. 3		
Flooding	a. 2	b. 3	c. 1		

14.
   a. Moderate; Moderate
   b. Moderate; Severe
   c. Slight; Severe; Severe
   d. Slight; Slight; Slight
   e. Moderate; Moderate; Moderate
   f. Slight; Severe
   g. Slight; Slight
   h. Slight; Slight; Slight
   i. Moderate; Severe

15. Completed scorecard on page 150F-56

16. Completed scorecard on page 150F-57

Idaho Land Judging Scorecard

Contestant No. ____________

Name ____________

Field No. ____________

(Indicate answer by an X in the box)

PART I — LAND CLASS FACTORS

A. SURFACE TEXTURE
- [ ] 1. Sandy soils
- [ ] 2. Loamy soils
- [x] 3. Clayey soils

B. PERMEABILITY
- [ ] 1. Very slow
- [x] 2. Slow
- [ ] 3. Moderate
- [ ] 4. Rapid

C. DEPTH, SURFACE AND SUBSOIL
- [ ] 1. Very shallow — less than 10"
- [x] 2. Shallow — 10 to 20"
- [ ] 3. Moderately deep — 20 to 40"
- [ ] 4. Deep — 40 to 60"
- [ ] 5. Very deep — over 60"

D. SLOPE

	Dry	Irrigated
[x] 1. Nearly level	0 to 3%	0 to 1%
[ ] 2. Gently sloping	3 to 8%	1 to 3%
[ ] 3. Moderately sloping	8 to 12%	3 to 5%
[ ] 4. Strongly sloping	12 to 20%	5 to 8%
[ ] 5. Steep	20 to 45%	8 to 12%
[ ] 6. Very steep	over 45%	over 12%

E. EROSION — WIND AND WATER
- [ ] 1. None to slight — less than 25% lost
- [x] 2. Moderate — 25 to 75% lost
- [ ] 3. Severe — over 75% lost

F. SURFACE RUNOFF
- [ ] 1. Rapid
- [ ] 2. Moderate
- [ ] 3. Slow
- [x] 4. Very slow

G. DRAINAGE
- [ ] 1. Excessive
- [ ] 2. Good
- [x] 3. Somewhat poor
- [ ] 4. Poor

H. CLIMATE
- [ ] 1. Good
- [x] 2. Fair
- [ ] 3. Poor

I. MAJOR FACTORS

Any which keep area out of Class I
- [ ] 1. Texture
- [x] 2. Permeability
- [x] 3. Depth
- [ ] 4. Slope
- [x] 5. Erosion
- [x] 6. Surface runoff
- [x] 7. Drainage
- [x] 8. Climate
- [ ] 9. None

J. LAND CAPABILITY CLASS
- [ ] 1. Class I
- [ ] 2. Class II
- [x] 3. Class III
- [ ] 4. Class IV
- [ ] 5. Class V
- [ ] 6. Class VI
- [ ] 7. Class VII
- [ ] 8. Class VIII

PART II — RECOMMENDED LAND TREATMENTS

Needed for different land capability classes

K. VEGETATIVE

Use soil conserving and/or improving crops:
- [ ] 1. Not necessary — Class I
- [ ] 2. Every 4-5th year — Class II
- [x] 3. Every 3-4th year — Class III
- [ ] 4. Every 2-3rd year — Class IV
- [x] 5. Crop residue use
- [ ] 6. Weed control
- [ ] 7. Strip cropping
- [ ] 8. Brush and tree control
- [ ] 9. Grasses and legumes
- [ ] 10. Pasture, range, hay management
- [ ] 11. Tree planting
- [ ] 12. Woodland harvest cutting
- [ ] 13. Wildlife, recreation and watershed

L. MECHANICAL

Irrigated Only
- [ ] 14. Land leveling and smoothing
- [x] 15. Irrigation water management
- [x] 16. Water control structures

Dryland Only
- [ ] 17. Diversion or terrace
- [ ] 18. Contour farming
- [ ] 19. Grass waterway

Both Dryland and Irrigated
- [x] 20. Subsurface drainage system
- [ ] 21. Minimum tillage

M. FERTILIZERS AND SOIL AMENDMENTS
- [x] 22. Nitrogen (N)
- [x] 23. Phosphorus (P)
- [ ] 24. Potassium (K)
- [ ] 25. Micronutrients
- [ ] 26. Lime
- [ ] 27. Gypsum
- [x] 28. Organic matter
- [ ] 29. Fertilizer or amendments not needed

____________ SCORE PART I (Possible 40)

____________ SCORE PART II (Possible 30)

____________ SCORE (TOTAL) (Possible 70)

Homesite Evaluation Land Judging Scorecard

Contestant No. ____________

Name ____________________

Field No. ________________

PART I Land Factors Features of the Site Being Considered	PART II Planned Use — One Family Dwelling Without Basement. Interpretations of Limitations in Terms of: Degree of limitation	Dwelling site Foundations w/o basement	Lawns, shrubs and gardens	Septic system	Lagoon sewage
A. TEXTURE — SURFACE ☐ Sandy ☒ Loamy ☐ Clayey	Slight Moderate Severe	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	
B. PERMEABILITY ☐ Slow — less than 0.2"/hr ☒ Moderate — 0.2 to 6.0"/hr. ☐ Rapid — over 6.0"/hr.	Slight Moderate Severe	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	☐ ☒ ☐
C. SOIL DEPTH ☐ Very shallow — less than 10" ☐ Shallow — 10 to 20" ☒ Moderately deep — 20 to 40" ☐ Deep — 40 to 60" ☐ Very deep — over 60"	Slight Moderate Severe Very Severe	☒ ☐ ☐ ☐	☒ ☐ ☐ ☐	☐ ☐ ☒ ☐	☐ ☐ ☒ ☐
D. SLOPE ☐ Nearly level — 0 to 0.5% ☒ Gently sloping — 0.5 to 5.0% ☐ Moderately sloping — 5.0 to 8% ☐ Strongly sloping — 8.0 to 15% ☐ Very strongly sloping — over 15.0%	Slight Moderate Severe Very Severe	☒ ☐ ☐ ☐	☒ ☐ ☐ ☐	☒ ☐ ☐ ☐	☒ ☐ ☐ ☐
E. EROSION ☒ None — Slight — Moderate ☐ Severe ☐ Very severe	Slight Moderate Severe	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐
F. SURFACE RUNOFF ☐ Slow — nearly level areas and deep sands ☒ Moderate — slopes 0.5 to 5% ☐ Rapid — slopes over 5%	Slight Moderate Severe	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	
G. SHRINK — SWELL (heaviest layer) ☒ Low ☐ Moderate ☐ High	Slight Moderate Severe	☒ ☐ ☐		☒ ☐ ☐	☒ ☐ ☐
H. WATER TABLE (permanent or temporary) ☒ Deep — none evident above 72" ☐ Moderately deep — 48 to 72" ☐ Shallow — less than 48"	Slight Moderate Severe	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐	☒ ☐ ☐
I. FLOODING ☐ Slight ☒ Severe — less than 1 year in 5 ☐ Very severe — more than 1 year in 5	Slight Moderate Severe Very Severe	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☐ ☒ ☐	☐ ☐ ☒ ☐
FINAL EVALUATION ☐ All factors none to slight ☐ One or more factors moderate; none severe ☒ One or more factors severe; none very severe ☐ One or more factors very severe	Slight Moderate Severe Very Severe	☐ ☒ ☐ ☐	☐ ☒ ☐ ☐	☐ ☐ ☒ ☐	☐ ☐ ☒ ☐

SCORE PART I ____________
(possible 20)

SCORE PART II ________ ________ ________ ________
(possible 20 for each use)

PART I AND II — TOTAL SCORE ____________________
(possible 100)

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0INTRODUCTION TO CROP SCIENCE

AG 150 - G

UNIT OBJECTIVE

After completion of this unit, students should be able to discuss the importance of plants and crop production. Students should also be able to list the major crops of Idaho and the United States, classify plants and discuss factors affecting crop production. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with crop science to the correct definitions.

2. Select necessities that are furnished by plants.

3. Select crops of Idaho that rank in the top three in production in the United States.

4. Name five major crops grown in the U.S.

5. Classify plants by matching them with the correct class.

6. Match common crops of Idaho with their average yields.

7. List four factors that affect the amount of crop that can be produced.

8. State the purpose of the Idaho Crop Improvement Association.

9. Discuss the information put together by the Idaho Agricultural Statistics Service and the people who use this information.

INTRODUCTION TO CROP SCIENCE

AG 150 - G

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

      1. Literature

         a. *Idaho Agricultural Statistics*; available from Idaho Agricultural Statistics Service, Boise, Idaho; cost $5.00.

         b. *Summary of Findings and Recommendations of the Governor's Task Force on Idaho Agricultural Policy*, 1980.

   B. Make transparencies and necessary copies of materials.

   C. Provide students with objective sheet and discuss.

   D. Provide students with information sheet and discuss.

   E. Construct and administer pretest on crop science.

   F. Invite someone to speak on careers in crop science.

   G. Review and give test.

   H. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Good Things We Get From Plants

      2. TM 2--Idaho Crop-Reporting Districts

      3. TM 3--Major Crops of Idaho

   E. Test

   F. Answers to test

III. Unit references

A. *1989 Agricultural Statistics*, Idaho Agricultural Statistics Service, Boise, Idaho.

B. *Careers*, National Agricultural Statistics Service, United States Department of Agriculture, 1989.

C. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

D. Delorit, R.J., et al., *Crop Production*, 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

E. Hartmann, H.T., et al., *Plant Science - Growth, Development, and Utilization of Cultivated Plants*, 2nd edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1988.

F. *In Small Grains, Let's Aim For Quality*, Idaho Crop Improvement Association, Boise, Idaho.

G. Janick, J., et al., *Plant Science*, 2nd edition, W.H. Freeman and Co., San Francisco, California, 1974.

H. *Summary of Findings and Recommendations of the Governor's Task Force on Idaho Agricultural Policy*, Boise, Idaho, 1980.

INTRODUCTION TO CROP SCIENCE

AG 150 - G

INFORMATION SHEET

I. Terms and definitions

A. Agronomy--Science of crop production and soil management

B. Arable land--Land, which is capable in its present condition of producing, crops requiring tillage

C. Arid climate--Climate in which the annual rainfall is less than 10 inches

D. Cereal--Grass grown to be used for feed or seed

E. Forage--Livestock feed, such as pasture, hay or silage

F. Legume--Soil improving plant, which manufactures nitrogen

G. Pulse--Leguminous plants or their seeds; this includes chiefly those plants with large seeds used for food

H. Range--Extensive area of natural pastureland

I. Weed--Undesirable plant growing with a crop

J. Native plant--Plant originating in North America

K. Introduced plant--Plant brought in from countries outside the United States

L. Cwt--Hundred weight, 100 pounds

M. Bushel--Thirty-two dry quarts; a common measurement for small grains

N. Ton--Two thousand pounds; a common measurement for forage, sugar beets and sweet corn

II. Plants furnish the following necessities (Transparency 1)

A. Oxygen for man and animals to breathe

B. Fuel for heating and transportation

C. Building materials

D. Medicine and drugs

E. Food for man and animal nutrition

F. Fabric for clothing and other purposes

G. Paper

H. Cover against wind and water

I. Habitat for animals

(Note: Plants furnish most of the necessities of life for man either directly or indirectly. If plant life suddenly disappeared, man and animal would also disappear. Plants are the basis of all food we eat and all the oxygen we breathe.)

III. Major agronomic crops grown in Idaho (1988) (Transparencies 2, 3)

	Crop	Rank Among States	Production	Unit	Percent of U.S.
1.	Potatoes	1	99,320,000	Cwt	32.3
2.	Barley	1	51,000,000	Bu	17.6
3.	Wrinkled peas for seed	1	653,000	Cwt	74.0
4.	Lentils	2	414,000	Cwt	21.2
5.	Dry edible peas	2	860,000	Cwt	37.6
6.	Alfalfa seed	2	16,150,000	Lbs	14.0
7.	Kentucky Bluegrass seed	3	14,955,000	Lbs	25.7
8.	Sugar beets	3	4,067,000	Ton	16.4
9.	Hops	3	3,920,000	Lbs	7.2
10.	All mint	3	974,000	Lbs	13.7
11.	Onions (summer storage)	3	4,028,000	Cwt	16.5
12.	Prunes and plums (fresh)	4	6,500	Ton	12.5
13.	Dry edible beans	5	2,249,000	Cwt	11.7
14.	Sweet corn for processing	5	163,800	Ton	6.9
15.	Sweet cherries	6	2,300	Ton	1.2
16.	Alfalfa hay	6	3,496,000	Ton	5.0
17.	All wheat	8	75,520,000	Bu	4.2
18.	Apples	10	135,000,000	Lbs	1.5
19.	All hay	15	3,881,000	Ton	3.1

IV. Major crops of the United States

A. Corn

B. Wheat (winter and spring)

C. Oats

D. Barley

E. Rye

F. Grain sorghum

G. Cotton

H. Tobacco

I. Rice

J. Sugar crops

K. Alfalfa

L. Soybeans

M. Peanuts

V. Classes of plants

A. Cereals

1. Barley

2. Wheat

3. Corn

4. Oats

5. Rice

B. Root crops

1. Potatoes

2. Sugar beets

C. Tree crops

1. Prunes and plums

2. Apples

3. Sweet cherries

D. Pulses

1. Peas

2. Lentils

3. Beans

E. Oil seed crops

1. Sunflower

2. Soybean

3. Peanut
4. Cotton seed

F. Forage crops

1. Alfalfa hay
2. Field corn
3. Most grasses

VI. How much crop can be produced per acre?

A. Average yields in Idaho for 1988 include:

1.	Barley	60 bu/acre
2.	Corn for grain	130 bu/acre
3.	Dry beans, combined	18.9 cwt/acre
4.	Alfalfa hay	3.8 ton/acre
5.	Lentils	13 cwt/acre
6.	Potatoes	286 cwt/acre
7.	Sugar beets	24.5 ton/acre
8.	Wheat	65.7 bu/acre

B. Record yields recorded

1.	Potatoes	1,000 cwt/acre
2.	Dry land wheat	208 bu/acre

VII. Factors that affect amount of crop produced

A. Crop being raised

(Note: This is dictated by area and will be related to the presence or absence of other factors such as length of growing season, soil type, pests, etc.)

B. Climate

1. Annual precipitation
2. Temperature
3. Length of growing season

4. Methods of modifying climate available

   a. Irrigation

   b. Frost protection

   c. Variety selection

   d. Seedbed preparation

   e. Field choice, for example: North Slope vs. South Slope

C. Pests

1. Resistant varieties

2. Pesticides

3. Plant dates

D. Soil features

1. Seedbed preparation

2. Cultivation

E. Economics

(Note: This is the least controllable of all factors. The goal of crop production is to get the highest amount of yield with the fewest inputs. The maximum yield is not always the same as the maximum profit point. The crop can cost you money by (1) decreased yields or (2) money for added inputs. Manage to reach the point of maximum profit.)

VIII. Purpose of Idaho Crop Improvement Association--To maintain and make available to the public a maximum amount of high quality seeds of superior plant varieties at a reasonable price

IX. Idaho Agricultural Statistics Service

A. The "fact finders" for Idaho agriculture

1. Prospective production and supplies of food and fiber

2. Prices paid and received by farmers

3. Farm labor and wages

4. Storage holding of commodities

5. Numbers and sizes of farms

6. Weekly weather and crop bulletins

B. Information users include:

1. Farmers and ranchers--Decisions on how much to plant, how many cattle to raise or when to sell

2. Manufacturers--Help predict demand

3. Business persons

4. Economists

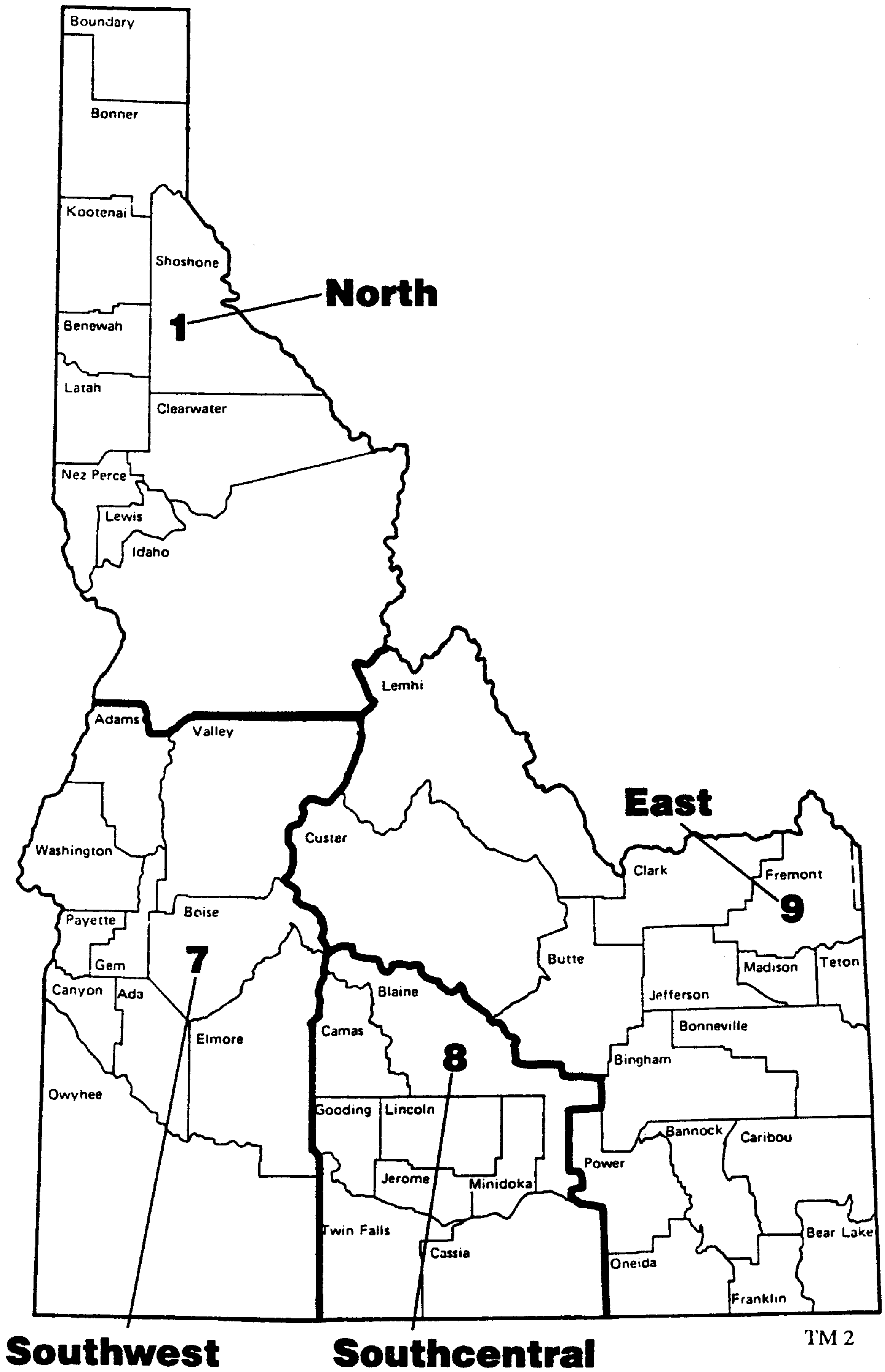
5. State and federal officials

6. Members of Congress

Good Things We Get From Plants

1. Oxygen for man and animal to breath
2. Fuel for heating and transportation
3. Building materials
4. Medicines and drugs
5. Food for man and animal nutrition
6. Fabric for clothing and other purposes
7. Paper
8. Cover against wind and water
9. Habitat for animals

Idaho Crop-Reporting Districts



TM 2

MAJOR CROPS OF IDAHO

	Crop	Rank Among States	Production	Unit	Percent of U.S.
1.	Potatoes	1	99,320,000	Cwt	32.3
2.	Barley	1	51,000,000	Bu	17.6
3.	Wrinkled peas for seed	1	653,000	Cwt	74.0
4.	Lentils	2	414,000	Cwt	21.2
5.	Dry edible peas	2	860,000	Cwt	37.6
6.	Alfalfa seed	2	16,150,000	Lbs	14.0
7.	Kentucky Bluegrass seed	3	14,955,000	Lbs	25.7
8.	Sugarbeets	3	4,067,000	Ton	16.4
9.	Hops	3	3,920,000	Lbs	7.2
10.	All mint	3	974,000	Lbs	13.7
11.	Onions (summer storage)	3	4,028,000	Cwt	16.5
12.	Prunes and plums (fresh)	4	6,500	Ton	12.5
13.	Dry edible beans	5	2,249,000	Cwt	11.7
14.	Sweet corn for processing	5	163,800	Ton	6.9
15.	Sweet cherries	6	2,300	Ton	1.2
16.	Alfalfa hay	6	3,496,000	Ton	5.0
17.	All wheat	8	75,520,000	Bu	4.2
18.	Apples	10	135,000,000	Lbs	1.5
19.	All hay	15	3,881,000	Ton	3.1

INTRODUCTION TO CROP SCIENCE

AG 150 - G

UNIT TEST

Name ____ Score _______________________

1. Match terms associated with crop science to the correct definitions. Write the correct numbers in the blanks.

_____a.	Extensive area of natural pasture land	1.	Agronomy
_____b.	100 pounds	2.	Arable land
_____c.	Grass grown to be used for feed or seed	3.	Arid climate
_____d.	Plant originating in North America	4.	Cereal
_____e.	Undesirable plant growing with a crop	5.	Forage
_____f.	Livestock feed, such as pasture, hay or silage	6.	Legume
_____g.	Land which is capable in its present condition of producing crops requiring tillage	7.	Pulse
		8.	Range
_____h.	Soil improving plant which manufactures nitrogen	9.	Weed
_____i.	Science of crop production and soil management	10.	Native plant
_____j.	Plant brought in from countries outside the United States	11.	Introduced plant
_____k.	Thirty-two dry quarts; a common measurement for small grains	12.	Cwt
		13.	Bushel
_____l.	Leguminous plants or their seeds; this includes chiefly those plants with large seeds used for food	14.	Ton
_____m.	2,000 pounds; a common measurement for forage, sugar beets and sweet corn		
_____n.	Climate in which the annual rainfall is less than 10 inches		

2. Select from the following list necessities that are furnished by plants. Write an "X" in the blank before each correct answer.

_____a. Food

_____b. Synthetic plastic products

_____c. Medicine and drugs

_____d. Paper

_____e. Water

_____f. Building materials

_____g. Fuel for heating

_____h. Oxygen

_____i. Diseases

_____j. Fabric for clothing and other purposes

3. Select from the following list crops of Idaho that rank in the top three in production in the United States. Write an "X" in the blank before each correct answer.

_____a. Wheat

_____b. Corn grain

_____c. Potatoes

_____d. Barley

_____e. Peas

_____f. Lentils

_____g. Apples

_____h. Alfalfa seed

_____i. Sugar beets

_____j. Sweet corn

4. Name five major crops grown in the United States.

a. ____

b. ____

c. ____

d.____

e.____

5. Classify the following plants as a cereal (C), root crop (R), tree crop (T), pulse (P), oil seed (O) or forage crop (F). Write the correct letters in the blanks.

_____a. Potatoes

_____b. Soybeans

_____c. Wheat

_____d. Field corn

_____e. Lentils

_____f. Sweet cherries

_____g. Alfalfa hay

_____h. Oats

_____i. Beans

_____j. Cotton seed

6. Match common crops of Idaho with the correct average yield. Write the correct numbers in the blanks.

		1.	286 bu/acre
_____a.	Potatoes	2.	60 bu/acre
_____b.	Lentils	3.	130 bu/acre
_____c.	Corn for grain	4.	18.9 cwt/acre
_____d.	Barley	5.	3.8 ton/acre
_____e.	Wheat	6.	3.8 bu/acre
_____f.	Sugar beets	7.	13 cwt/acre
_____g.	Dry beans	8.	286 cwt/acre
_____h.	Alfalfa hay	9.	24.5 ton/acre
		10.	65.7 bu/acre

7. List four factors that affect the amount of crop that can be produced.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

8. State the purpose of the Idaho Crop Improvement Association.

9. Discuss the information put together by the Idaho Agricultural Statistics Service and the people who use this information.

INTRODUCTION TO CROP SCIENCE

AG 150 - G

ANSWERS TO TEST

1.

a.	8	e.	9	i.	1	m.	14
b.	12	f.	5	j.	11	n.	3
c.	4	g.	2	k.	13		
d.	10	h.	6	l.	7		

2. a, c, d, f, g, h, j

3. c, d, e, f, h, i

4. Answer should include five of the following:

   Corn; Wheat; Oats; Barley; Rye; Grain sorghum; Cotton; Tobacco; Rice; Sugar crops; Alfalfa; Soybeans; Peanuts

5.

a.	R	f.	T
b.	O	g.	F
c.	C	h.	C
d.	F	i.	P
e.	P	j.	O

6.

a.	8	e.	10
b.	7	f.	9
c.	3	g.	4
d.	2	h.	5

7. Answer should include four of the following:

   Crop being raised; Climate; Pests; Soil features; Economics

8. To maintain and make available to the public a maximum amount of high quality seeds of superior plant varieties at a reasonable price

9. Answer should include information from the following:

   The "fact finders" for Idaho agriculture; Prospective production and supplies of food and fiber; Prices paid and received by farmers; Farm labor and wages; Storage holding of commodities; Numbers and sizes of farms; Weekly weather and crop bulletins; Farmers and ranchers--Decisions on how much to plant, how many cattle to raise or when to sell; Manufacturers--Help predict demand; Business persons; Economists; State and federal officials; Members of Congress

BASIC PLANT PROCESSES

AG 150 - H

UNIT OBJECTIVE

After completion of this unit, students should be able to list the important plant processes, illustrate the process of photosynthesis and select factors that affect photosynthetic rate. Students should also be able to briefly explain the processes of absorption and transpiration. This knowledge will be demonstrated by completing the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with basic plant processes to the correct definitions.
2. Name the four important plant processes in food manufacture and growth.
3. Select reasons photosynthesis is the most important process in the world.
4. Explain the process of photosynthesis.
5. Select factors that affect photosynthetic rate.
6. Explain the process of respiration.
7. Classify characteristics as that of photosynthesis or respiration.
8. Explain the process of absorption by plant roots.
9. Explain the process of transpiration.
10. Select factors affecting water loss by transpiration.
11. Study the effect of light on dry weight.
12. Measure loss from transpiration.

BASIC PLANT PROCESSES

AG 150 - H

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

   B. Make transparencies and necessary copies of materials.

   C. Provide students with objective sheet and discuss.

   D. Provide students with information and assignment sheets, and laboratory exercise.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss procedures outlined in laboratory exercise.

   G. Review and give test.

   H. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Important Plant Processes

      2. TM 2--Importance of Photosynthesis

      3. TM 3--Photosynthesis

      4. TM 4--Photosynthesis and Respiration in Relation to Dry Weight

      5. TM 5--Transpiration

      6. TM 6--Root Hairs, Soil Particles and Moisture

      7. TM 7--How a Water Solution From the Soil Moves Within a Root

   E. Assignment sheet

      1. AS 1--Effect of Light on Dry Weight

F. Answers to assignment sheet

G. Laboratory exercise

1. LE 1--Measuring Loss From Transpiration

H. Test

I. Answers to test

III. Unit references

A. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

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D. Hartmann, Hudson T., et al., *Plant Science - Growth, Development, and Utilization of Cultivated Plants*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1988.

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BASIC PLANT PROCESSES

AG 150 - H

INFORMATION SHEET

I. Terms and definitions

A. Photosynthesis--The process of making sugars in green plants from water and carbon dioxide in the presence of sunlight

B. Respiration--The process of using the stored foods of a plant in which energy is obtained or released

C. Transpiration--The evaporation of water vapor from the stoma on the leaves of a plant

D. Absorption--The taking in of water and mineral nutrients through the roots of a plant

E. Stoma--A small opening in the epidermis of leaves and stems through which gases pass

F. Mesophyll--The photosynthetic tissue of a leaf, located between the layers of epidermis

G. Chlorophyll--The green pigment of plant cells; necessary for photosynthesis

H. Chloroplast--A cellular organelle in which chlorophyll is contained; site of photosynthesis

I. Phloem--Food conducting tissue of plants

J. Root hairs--Outgrowths of the epidermal cells of the root; greatly increase absorption area of the root system

K. Permeable membrane--A membrane through which liquid substances may diffuse, such as the plasma membrane of root hair cells

L. Epidermis--The outermost layer of cells of the leaf and of young stems and roots

M. Cortex--Cells of a stem or root bound externally by the epidermis and internally by the vascular system

N. Xylem--Tissue through which most of the water and minerals of a plant are conducted

O. Osmosis--The diffusion of water through a selectively permeable membrane

II. Important plant processes in food manufacture and growth (Transparency 1)

A. Photosynthesis

B. Respiration

C. Transpiration

D. Absorption

III. Reasons photosynthesis is the most important process in world (Transparency 2)

A. Plants produce food by photosynthesis

B. Plants produce food used directly by man

C. Plants produce food used indirectly by man through meat and milk produced by livestock

(Note: Green plants, through the process of photosynthesis, are the basic factories of the world on which all life is dependent. A corn plant produces about 5 grams of sugar during 14 hours of sunlight. During a 100-day period, a 20-acre field of corn with 20,000 plants per acre could produce two and one-half tons of sugar. An estimated 150 billion tons of sugar are produced by plants each year by photosynthesis. This would be a pile of sugar 40 miles square at the base and 2 miles high at the peak.)

IV. Process of photosynthesis (Transparency 3)

A. Carbon dioxide (CO_2) enters the leaf from the surrounding air through the stoma

(Note: After CO_2 enters the stoma, it enters the intercellular spaces of the mesophyll tissue. Here it comes in contact with the wet walls of the mesophyll cells. The CO_2 dissolves in the water of the mesophyll cells.)

B. Water moves from the soil into the root, stems and leaves through the xylem tissue

C. The molecules of water (H_2O) and carbon dioxide (CO_2) are synthesized (put together) in the chlorophyll of a plant with energy from sunlight

D. The end result is the formation of sugar, which is transported by the phloem tissue to the part of the plant where it is used

(Note: The process can be illustrated by the chemical equation which is written: 6 parts carbon dioxide (6 CO_2) + 6 parts water (6 H_2O) + 672 K cal of radiant energy (sunlight) in the presence of chlorophyll of plants = sugar ($C_6H_{12}O_6$) retained by the plant + oxygen (6 O_2) given off into the atmosphere.)

V. Factors that affect photosynthetic rate

A. Water supply

B. Temperature

C. Light quality

D. Light intensity

E. Deficiency of certain plant nutrients

VI. Process of respiration

(Note: As with all living things, plants require energy to carry out their growth and development process. This energy comes from a very complex process called respiration. In a sense, respiration in plants is the reverse of photosynthesis as sugar is broken down to produce energy.)

A. Sugar is broken down to produce energy for essential plant functions

B. Respiration consumes oxygen (O_2) and glucose ($C_6H_{12}O_6$)

C. Respiration gives off carbon dioxide (CO_2) and water (H_20)

(Note: The process can be illustrated by the chemical equation which is written: Sugar ($C_6H_{12}O_6$) + 6 parts oxygen (6 O_2) = 6 parts carbon dioxide (6 CO_2) + 6 parts water (6 H_2O).)

VII. Relationship between photosynthesis and respiration (Transparency 4)

Photosynthesis	Respiration
1. A building process (+)	1. A destruction process (-)
2. Sugars manufactured	2. Sugars consumed
3. CO_2 is consumed	3. CO_2 is given off
4. Oxygen is given off	4. Oxygen is consumed
5. Requires light	5. Goes on day and night
6. Only takes place in cells containing chlorophyll	6. Carried on in all cells
7. Sugar ($C_6H_{12}O_6$) is the end product	7. Energy produced for plant functions is end product

(Note: A green plant grown in the dark loses in weight because its stored foods are respired and nothing is added through photosynthesis.)

VIII. The process of absorption

A. The soil solution enters the root hairs by the process of osmosis

(Note: The soil solution is composed of water and minerals in solution.)

B. After the soil solution is absorbed by the root hairs, it moves through the epidermal cells, cortex and phloem to the xylem

C. The xylem conducts the solution to other parts of the plant

IX. The process of transpiration (Transparencies 5, 6, 7)

A. Water enters plant through root hairs

B. Water passes to xylem and up the stem to the leaves

C. A small amount of water is used in photosynthesis

D. The remainder is lost by transpiration

(Note: Water loss occurs mainly through the stoma on the leaves. When stoma are open, water vapor, which is low in carbon dioxide, escapes from the leaf and is replaced by dry air higher in carbon dioxide.)

X. Factors affecting water loss by transpiration

A. Climatic conditions

B. The number of stoma on the leaves

C. Availability of soil moisture to the plant

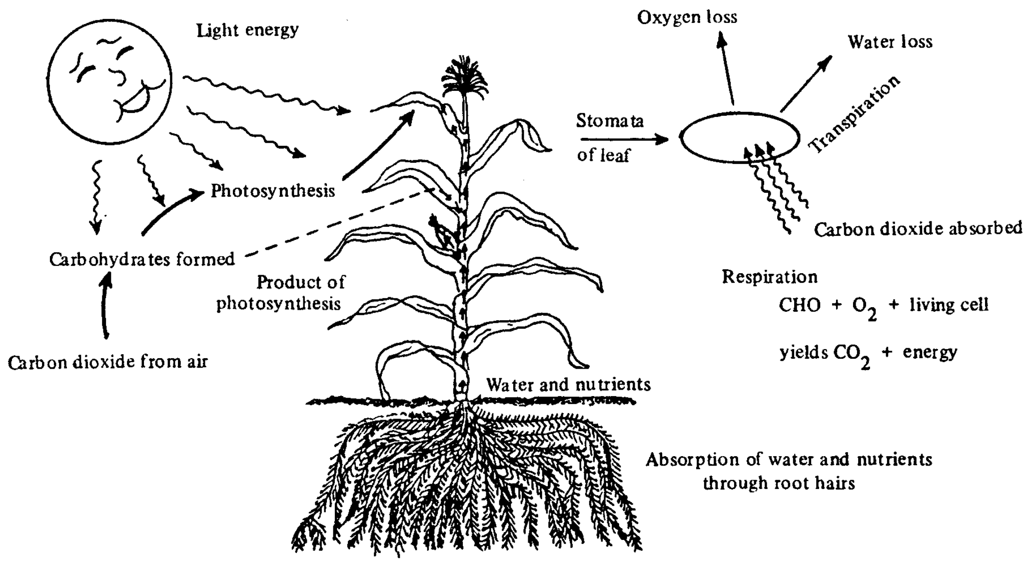
D. General plant structure

(Note: Some plants have a waxy covering called a cuticle which inhibits evaporation of water. Some plants have stoma only on lower side of leaf where temperatures are cooler.)

E. Soil fertility

(Note: Transpiration is greater for plants in fertile soils than poor soils; therefore, the plant uses more water on fertile soils than poor soils.)

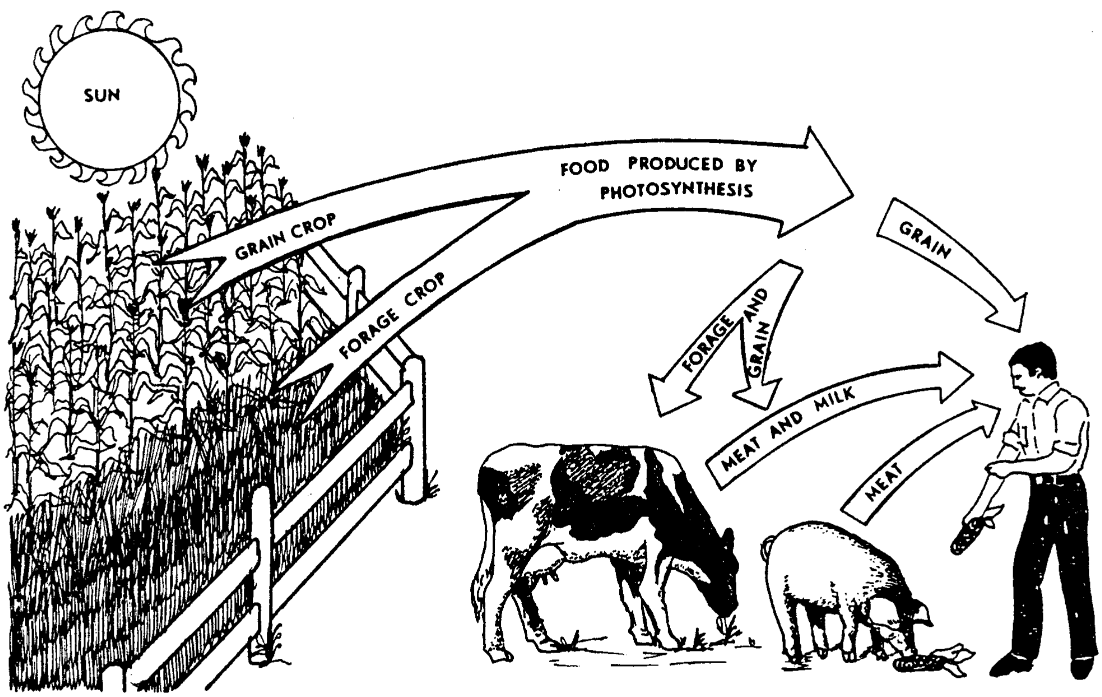
Important Plant Processes



A series of events must take place for plant growth to occur. Important ones are:

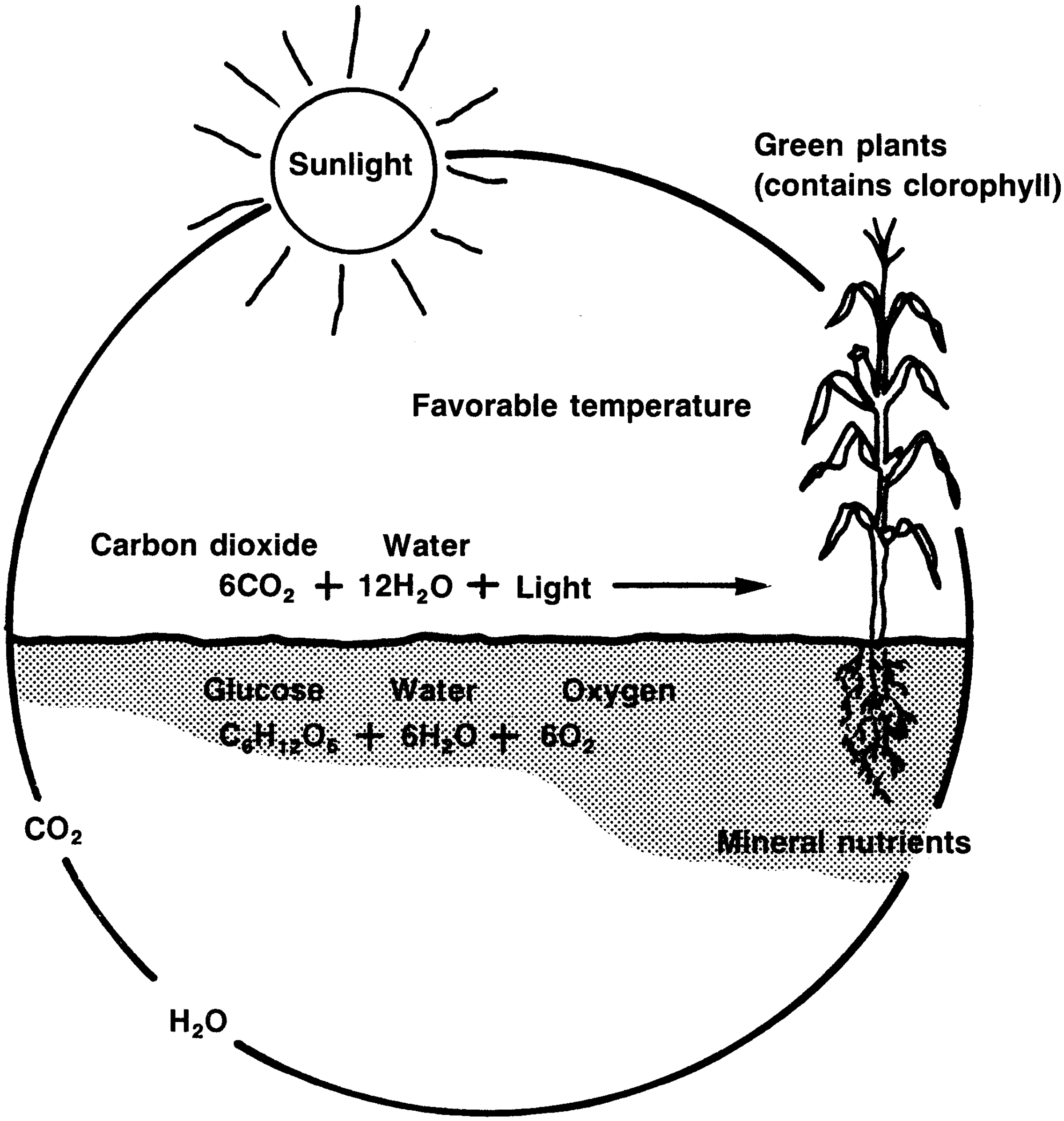
- **Photosynthesis**
- **Respiration**
- **Transpiration**
- **Absorption**

Importance of Photosynthesis

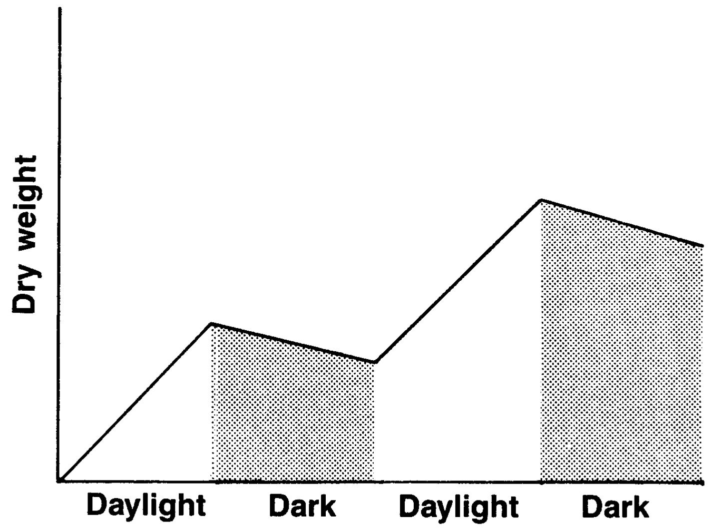


Through the process of photosynthesis, crop plants produce food. This plant-produced food is used directly by man or indirectly through meat and milk produced by livestock.

Photosynthesis



Photosynthesis and Respiration in Relation to Dry Weight



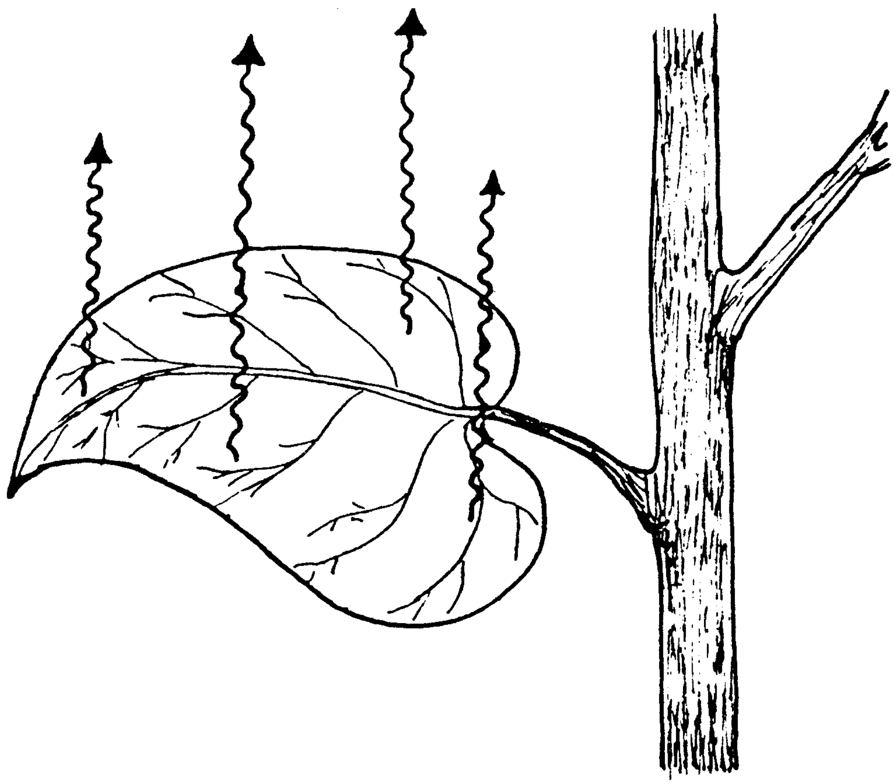
Daylight hours

- The sugar produced by photosynthesis is greater than the sugar used by respiration.
- Result is increase in dry weight.

Dark hours

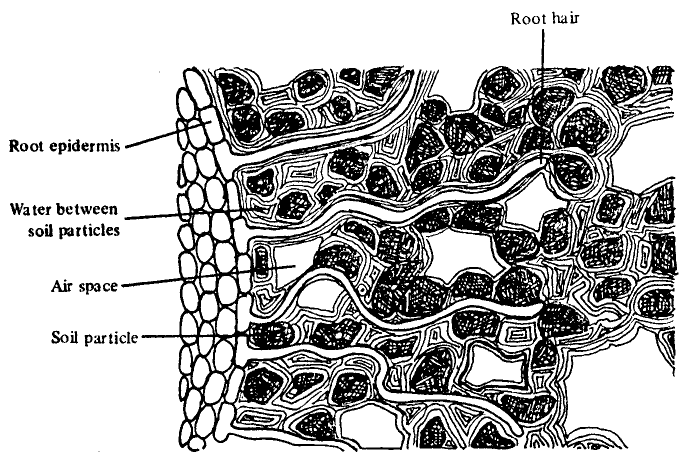
- No sugar is produced by photosynthesis.
- Sugar is used by respiration.
- Result is decrease in dry weight.

Transpiration



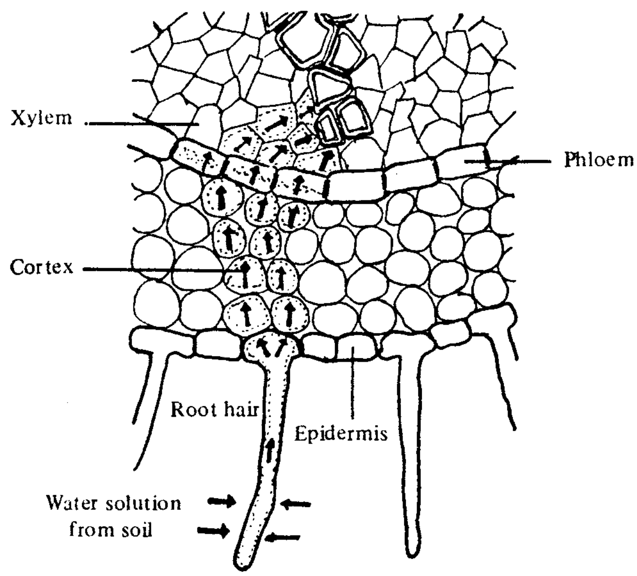
Is the loss of water from plants by evaporation

Root Hairs, Soil Particles and Moisture



1. **Root hairs increase the absorption area of the root system 3 to 5 times.**
2. **Water and minerals in solution enter the plant mainly through the root hairs.**

How a Water Solution From the Soil Moves Within the Root



1. **Solution enters the root hair by osmosis.**
2. **Solution moves through the epidermal cells, the cortex and the phloem to the xylem tissue.**
3. **Solution is transported by the xylem to other parts of the plant.**

BASIC PLANT PROCESSES

AG 150 - H

ASSIGNMENT SHEET #1--EFFECT OF LIGHT ON DRY WEIGHT

Name ____ Score _______________________

Part I

Three hundred bean seeds were divided into three lots of 100 each. One lot of 100 seeds was used to measure the percent moisture in the seeds, from which it was possible to calculate the dry weight of the other two lots. A second lot of seeds was sown in sand in a suitable box and kept in a dark room. The third lot was likewise sown in sand in a suitable box and kept under a daily cycle of 15 hours of light and 9 hours of dark. These two lots of seeds were kept at a temperature of 75^{o}F. Four weeks after planting, each lot of resulting seedlings was harvested and the dry weight of each was measured. The resulting data are tabulated.

Environmental Condition	Calculated Dry Weight of Seeds Planted	Dry Weight of Seedlings at End of Four Weeks	Difference Between Dry Weight of Seed-lings and Dry Weight of Seeds Planted
Seedlings in light	57.9 g	82.2 g	+24.3 g
Seedlings in dark	57.9 g	23.4 g	-34.5 g

Part II

a. What one environmental factor was varied in this experiment?

b. How do you account for the increase in dry weight of the seedlings in light as compared with the dry weight of the seeds, which were planted in darkness?

c. Why do the seedlings that developed in the dark not gain in dry weight?

d. Why do the seedlings that developed in the dark actually decrease in dry weight?

e. Is light necessary for the utilization of food in the growth of plants?

BASIC PLANT PROCESSES

AG 150 - H

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

a. Light

b. Photosynthesis is greater than respiration

c. Respiration is greater than photosynthesis

d. Sugars are utilized by respiration for basic functions of the plant without being replenished by photosynthesis

e. Yes

BASIC PLANT PROCESSES

AG 150 - H

LABORATORY EXERCISE #1--MEASURING LOSS FROM TRANSPIRATION

Name ____ Score ____________________

I. Materials needed

A. A growing plant in a pot, bucket or other container or a plant growing in a convenient location

B. Plastic bag or sheet of clear plastic that will cover the plant or a branch of the plant containing 10 to 12 leaves

C. String, rubber bands or other suitable tie materials

D. Stake to support the weight of the plastic

E. Plastic straw or other suitable tubing for a drain

F. Measuring cup or beaker

II. Procedure (Figure 1)

A. Be sure plant has been watered

B. Cover the entire vegetative portion of the plant or a section with plastic material

C. Locate tubing at bottom of plastic covering to serve as a water drain

D. Place plant in sunny location for an entire day; measure the water collected; empty container

E. Measure water collected during dark period of the day

F. Compare differences in the amount of water collected

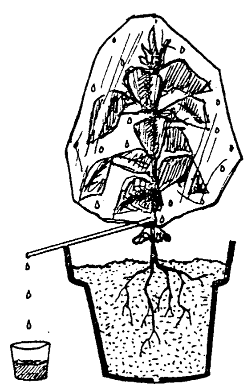


Figure 1

III.Questions

a. Which period produced the most water in the container? Why?

b. Does temperature have an effect on transpiration rates? Does light? Air humidity?

BASIC PLANT PROCESSES

AG 150 - H

ANSWERS TO LABORATORY EXERCISES

Lab # 1

Part III:

a. Most water into container during the daylight period
Why? Stomata are open during the day, allowing water to escape

b. Temperature - as temperature increases, transpiration increases
Light - light increases temperature, which increases transpiration
Air humidity - as humidity increases, it lowers transpiration

BASIC PLANT PROCESSES

AG 150 - H

UNIT TEST

Name ____ Score _______________________

1. Match terms associated with basic plant processes to the correct definitions. Write the correct numbers in the blanks.

_____a.	A small opening in the epidermis of leaves and stems through which gases must pass		1.	Photosynthesis
			2.	Respiration
_____b.	The green pigment of plant cells; necessary for photosynthesis		3.	Osmosis
_____c.	The process of making sugars in green plants from water and carbon dioxide in the presence of sunlight		4.	Absorption
			5.	Stoma
_____d.	Food conducting tissue of plants		6.	Mesophyll
_____e.	The outermost layer of cells of the leaf and of young stems and roots		7.	Chlorophyll
_____f.	The evaporation of water vapor from the stoma on the leaves of a plant		8.	Chloroplast
			9.	Phloem
_____g.	A cellular organelle in which chlorophyll is contained; site of photosynthesis		10.	Root hairs
_____h.	Tissue through which most of the water and minerals of a plant are conducted		11.	Permeable membrane
_____i.	The photosynthetic tissue of a leaf; located between the layers of epidermis		12.	Epidermis
			13.	Cortex
_____j.	The process of using the stored foods of a plant in which energy is obtained or released		14.	Xylem
_____k.	A membrane through which liquid substances may diffuse		15.	Transpiration
_____l.	The taking in of water and mineral nutrients through the roots of a plant			
_____m.	Cells of a stem or root bound externally by the epidermis and internally by the vascular system			
_____n.	Outgrowths of the epidermal cells of the root; greatly increase absorption area of the root system			
_____o.	The diffusion of water through a selectively permeable membrane			

2. Name the four important plant processes in food manufacture and growth.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

3. Select from the following list reasons photosynthesis is the most important process in the world. Write an "X" in the blank before each correct answer.

   _____a. Produces food used directly by man

   _____b. Releases carbon dioxide

   _____c. It warms the soil

   _____d. Produces food used indirectly by man

   _____e. All life is dependent on photosynthesis

   _____f. Releases moisture into the atmosphere

4. Explain the process of photosynthesis.

   ____

   ____

   ____

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   ____

5. Select from the following list factors that affect photosynthetic rate. Write an "X" in the blank before each correct answer.

   _____a. Nutrient deficiency

   _____b. Energy produced

   _____c. Water supply

_____d. Absorption rate

_____e. Quality of light

_____f. Temperature

_____g. Intensity of light

6. Explain the process of respiration.

____

____

____

____

____

7. Classify the following characteristics as that of photosynthesis (X) or respiration (O). Write the correct letter in the blank before each statement.

_____a. Sugar is the end product

_____b. Carbon dioxide is given off

_____c. Requires light

_____d. A destruction process

_____e. Goes on day and night

_____f. A building process

_____g. Only takes place in cells containing chlorophyll

_____h. Carried on in all cells

_____i. Oxygen is given off

_____j. Sugars consumed

8. Explain the process of absorption by plant roots.

____

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____

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____

9. Explain the process of transpiration.

____

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____

10. Select from the following list factors affecting water loss by transpiration. Write an "X" in the blank before each correct answer.

_____a. Amount of available water

_____b. Number of root hairs

_____c. Presence of cuticle on leaf

_____d. Number of stoma on leaf

_____e. Soil fertility

_____f. Type of root structure

_____g. Climatic conditions

_____h. Amount of sunlight

BASIC PLANT PROCESSES

AG 150 - H

ANSWERS TO TEST

1.

a.	5	f.	15	k.	11
b.	7	g.	8	l.	4
c.	1	h.	14	m.	13
d.	9	i.	6	n.	10
e.	12	j.	2	o.	3

2. Photosynthesis; Respiration; Transpiration; Absorption

3. a, d, e

4. Carbon dioxide (CO_2) enters the leaf from the surrounding air through the stoma; Water moves from the soil into the root, stems and leaves through the xylem tissue; The molecules of water (H_2O) and carbon dioxide (CO_2) are synthesized (put together) in the chlorophyll of a plant with energy from sunlight; The end result is the formation of sugar which is transported by the phloem tissue to the part of the plant where it is used

5. a, c, e, f, g

6. Sugar is broken down to produce energy for essential plant functions; Respiration consumes oxygen (O_2) and glucose ($C_6H_{12}O_6$); Respiration gives off carbon dioxide (CO_2) and water (H_20)

7.

a.	X	e.	O	i.	X
b.	O	f.	X	j.	O
c.	X	g.	X		
d.	O	h.	O		

8. The soil solution enters the root hairs by the process of osmosis; After the soil solution is absorbed by the root hairs, it moves through the epidermal cells, cortex and phloem to the xylem; The xylem conducts the solution to other parts of the plant

9. Water enters plant through root hairs; Water passes to xylem and up the stem to the leaves; A small amount of water is used in photosynthesis; The remainder is lost by transpiration

10. a, c, d, e, g

PLANT GROWTH AND DEVELOPMENT

AG 150 - I

UNIT OBJECTIVE

After completion of this unit, students should be able to match terms and definitions, identify the parts of a plant and match functions and plant parts. Students should also be able to list requirements for good seed germination and select factors that cause poor germination. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with plant growth and development to the correct definitions.
2. Name the three stages of plant growth and development.
3. Name three requirements for good seed germination.
4. Select factors that cause poor seed germination.
5. Label a drawing showing the four primary parts of a plant.
6. Match functions of plant parts to the correct part.
7. Name two types of root systems.
8. Label a drawing showing the parts of a stem.
9. Match stem modifications with the correct description.
10. Select conditions affecting the vegetative growth of crop plants.
11. Name two means of reproduction by plants.
12. Label a drawing showing the parts of a complete flower.
13. Match the type of flower to the correct description.
14. Match the types of pollination to the correct description.

PLANT GROWTH AND DEVELOPMENT

AG 150 - I

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

      1. Literature

         a. *Agronomy Curriculum Materials Packet*, 232 pages; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $10.00; order no. 214.

         b. *Crop Production*, 15 transparency masters; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $2.25; order no. 517.

      2. Filmstrips, slideshows, etc.

         a. *Agronomy*, computer program; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $15.00; order no. 902.

   B. Make transparencies and necessary copies of materials.

   C. Provide students with objective sheet and discuss.

   D. Provide students with information sheets and discuss.

   E. Review and give test.

   F. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Transparency masters

      1. TM 1--Primary Parts of a Plant

      2. TM 2--Functions of Leaves, Stems, Roots and Flowers

      3. TM 3--Types of Root Systems

      4. TM 4--Parts of the Stem

5. TM 5--Above Ground Stem Modifications

6. TM 6--Below Ground Stem Modifications

7. TM 7--Conditions Affecting the Vegetative Growth of Crop Plants

8. TM 8--Comparison of Utilization of Sunlight by Crop Plants

9. TM 9--Plant Growth Variance With Temperature Change

10. TM 10--Rate of Photosynthesis and Respiration as Affected by Temperature

11. TM 11--Approximate Pounds of Water Required to Produce One Pound of Dry Matter

12. TM 12--Parts of a Complete Flower

13. TM 13--Self-pollination and Cross-pollination

E. Test

F. Answers to test

III. Unit references

A. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

B. Delorit, R.J., et al., *Crop Production,* 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

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PLANT GROWTH AND DEVELOPMENT

AG 150 - I

INFORMATION SHEET

I. Terms and definitions

A. Node--The part of a stem where a leaf is attached

B. Internode--The part of a stem between two nodes

C. Bud--An embryonic shoot of a plant

D. Leaf scar--A scar left on the stem when a leaf falls

E. Vascular bundle scar--A spot within a leaf scar left by the vascular bundles when a leaf falls

F. Monocot--Plant having one seed leaf (cotyledon) as in cereals and corn

G. Dicot--Plant having two seed leaves (cotyledons) as in beans and peas

H. Vascular bundle--A strand of tissue containing xylem and phloem enclosed by a sheath of cells

I. Xylem--Vascular tissue that transports water and minerals from the root system to the leaves

J. Phloem--Vascular tissue that conducts food from the leaves to regions of growth or storage

K. Pistil--Seed bearing organ of a flower, composed of the ovary, style and stigma

L. Stamen--Part of the flower which produces the pollen; composed of the filament and anther

M. Fertilization--Union of the male (pollen) nucleus with the female (egg) cell

N. Pollination--Transfer of pollen from the anther to the stigma

O. Embryo--The young plantlet within the seed; the germ

P. Radicle--The embryonic root

Q. Hypocotyl--The part of an embryo between the cotyledons and the radicle

R. Epicotyl--The part of the embryo above the cotyledons and below the next leaves

II. Stages of plant growth and development

- A. Seed germination and seedling growth
- B. Vegetative
- C. Reproduction

III. Requirements for good seed germination

- A. Proper temperature

  (Note: This requirement varies for different crops. Cereals will show some germination at 32oF, while corn will not show any germination until 48oF.)

- B. Sufficient moisture

  (Note: This requirement varies for different crops. Cereals will germinate when their moisture content is about 50%. Soybeans will not germinate until their moisture content is about 75%. The range is 26% to 75% for most agronomic crops.)

- C. Ample supply of oxygen

  (Note: Germination will not occur if oxygen is not available for crops like small grains and peas. Rice seed can germinate in the absence of oxygen.)

IV. Factors that cause poor seed germination

- A. Mechanical injury to seed (cracked grain)
- B. Disease
- C. Storage conditions

  (Note: Temperature and humidity are important considerations for storage of crop seeds.)

- D. Age of seed

  (Note: Germination percentages will decrease as the age of the seed increases.)

- E. Soil temperature too cold
- F. Hard seed coat

  (Note: Some plants (hard-seeded legumes) produce seeds with a hard seed coat. The seed coat will not allow moisture and oxygen to enter the seed and bring about germination.)

- G. Soil moisture insufficient
- H. Planting too deep

I. Chemical damage

(Note: Reduced germination percentages may result if seeds come in contact with chemicals such as fertilizers.)

J. Crusting of soil

V. Primary parts of a plant (Transparency 1)

A. Roots

B. Stem

C. Leaves

D. Flowers

VI. Functions of plant parts (Transparency 2)

A. Roots

1. Absorb water and nutrients

(Note: Most of absorption takes place through root hairs. The rate at which water is absorbed depends on (1) the rate at which water is lost from leaves (transpiration), (2) the amount of water in the soil, and (3) the amount of root surface in contact with soil particles.)

2. Anchor and support plants

(Note: The roots must anchor the plant to the extent that wind, etc., cannot knock it down.)

3. Store food

(Note: Some plants store foods they have manufactured in the roots. Examples are radishes, carrots, sweet potatoes and sugar beets.)

B. Stem

1. Supports leaves, flowers, fruit and seeds

2. Conducts water, nutrients and food

(Note: The stem conducts water and minerals in solution from the root system through the xylem tissue to the leaves. It also conducts food made in the leaves through the phloem tissue to the parts of the plant where it is growing or food is being stored.)

3. Stores food

(Note: Examples of plants that store food in the stem include potatoes and asparagus.)

C. Leaves

1. Manufacture food for the plant

(Note: Photosynthesis is the process by which leaves make food from carbon dioxide and water in the presence of sunlight.)

2. Necessary for transpiration

3. Store food

(Note: Examples of plants that store food in the leaves include lettuce, cabbage, celery, rhubarb and onions.)

D. Flowers

1. Serve as site of reproduction

2. Store food

(Note: Examples of plants that store food in flowers include grains, fruits, nuts, berries, broccoli and cauliflower.)

VII. Types of root systems (Transparency 3)

A. Tap root system

(Note: In this system, one root is larger than the rest. Examples of plants with tap root systems include alfalfa, sugar beets, beans, carrots and radishes.)

B. Fibrous root system

(Note: In this system, all roots are approximately the same size. Examples of plants with fibrous root systems include all the grasses and cereal grains.)

VIII. Parts of the stem (Transparency 4)

A. Node

B. Internode

C. Terminal bud

D. Lateral bud

E. Leaf scar

F. Vascular bundle scar

IX. Stem modifications (Transparency 5)

A. Above ground

1. Crown--Appears just above or just below ground level from which modified stems grow. This type of growth is common in small grains

2. Stolon--Runners that grow along top of soil surface. This type of growth is common in strawberry plants and clover

3. Spur--Modified stem growth that appears laterally on branches of fruit trees and bears fruit

B. Below ground (Transparency 6)

1. Rhizome--Underground stems that grow horizontally below soil surface. This type of growth is common to bluegrass, brome grass, quack grass and canada thistle

2. Tuber--Enlarged fleshy parts found at the tip of a rhizome. This type of growth is common to potatoes

3. Corm--Fleshy, short underground stems with very few buds. This type of growth is common to timothy and gladiolus

4. Bulb--Short disc-shaped stem surrounded by leaf-like scale structures. This type of growth is common to onion and garlic

X. Conditions affecting the vegetative growth of crop plants (Transparency 7)

A. Climate

1. Sunlight (Transparency 8)

(Note: Sunlight is the energy source for photosynthesis. More efficient use of sunlight by a crop plant will result in higher yields, if other factors are not limiting.)

2. Temperature (Transparencies 9, 10)

(Note: The temperature of both air and soil affects the rates at which the different plant processes take place. Air temperature affects the rate of photosynthesis, respiration and transpiration. Soil temperature has an effect on respiration and absorption by the roots.)

3. Water (Transparency 11)

(Note: Water can be a severe limiting factor in the growth of crop plants. The availability of water, either by precipitation or irrigation, influences crop yield more than any other factor. Water is a requirement for food manufacture, a solvent for mineral nutrients and a part of the transpiration process.)

B. Soil features

1. Nutrient availability

2. Moisture storage

3. Soil compaction

a. Reduced water infiltration

b. Reduced root penetration

4. Amount of erosion

C. Crop pests

1. Disease

2. Insects

3. Weeds

D. Crop being produced

E. Economics

(Note: Economics is the least controllable of all variables affecting crop production. In many cases the point of maximum yield is not the same as maximum profit point. Crops should be managed to reach the point of maximum profit.)

XI. Sexual reproduction in plants

A. Reproduction by seed

1. Involves the combination of two different sets of genes to create offspring with a new genetic makeup

2. Often the most efficient and economical method for reproducing annual bedding plants and some biennials and perennials

3. The function of the seed is to produce a new plant

a. A seed is produced by the combination of nuclear material in the process of fertilization

b. Results in zygote formation

B. Sexual reproduction usually used for annuals and on plants which grow quickly from seed and produce a plant similar to the parents

(Note: The end result of sexual reproduction in plants is the seed. Seeds are of importance in production of a new crop and as food for both people and livestock.)

XII. Asexual reproduction

A. Reproduction by vegetative propagation

1. Uses plant parts such as leaves, roots and stems to start new plants

2. No new genetic material introduced--the offspring will be identical to parents

B. Methods

1. Cuttings

a. Stem cuttings using a tip (straight) cutting

b. Leaf cuttings using a leaf section, leaf petiole or by cutting the veins

c. Root cuttings using a cutting of the root and planting it

2. Layering--Rooting a stem at the node

(Note: Grape layering to replace a vine or strawberries' natural runners are examples of layering.)

3. Separation--Removing corms or bulbets from the parent bulb plant (for example: an iris)

4. Division--The removal of new shoots with some root from below

(Note: This is used on dahlias.)

5. Grafting--Involves the transfer of wood with buds from one plant and matching up its cambium layer to another plant. The ends then grow together, resulting in a plant having desirable qualities of both parent plants

XIII. Parts of a complete flower (Transparency 12)

A. Pistil--Female part where egg cell originates

1. Stigma--Upper part of pistil that catches pollen

2. Style--Supports stigma

3. Ovary--Produces ovules which develop into seeds

B. Stamen--Male part of flower

1. Filament--Supports anther

2. Anther--Bears the pollen

C. Accessory organs

1. Corolla--Petals of the flower

2. Calyx--Sepals of the flower

3. Pedicel--Stalk of an individual flower

XIV. Types of flowers

A. Complete--Has stamens, pistils, petals and sepals on same flower; common to dicots

B. Incomplete--Has stamens and pistils, but no petals or sepals; common to monocots

C. Perfect flower--Has both stamens and pistils on the same flower

D. Imperfect flower--Has either stamens or pistils, but not both on the same flower

E. Staminate--Has only male flower parts

F. Pistillate--Has only female flower parts

G. Monoecious--Staminate and pistillate flowers found on the same plant

(Examples: Corn, cucumbers, squash, melons and pumpkins)

H. Dioecious--Staminate and pistillate flowers found on separate plants

(Examples: Holly, date, palm, spinach and asparagus)

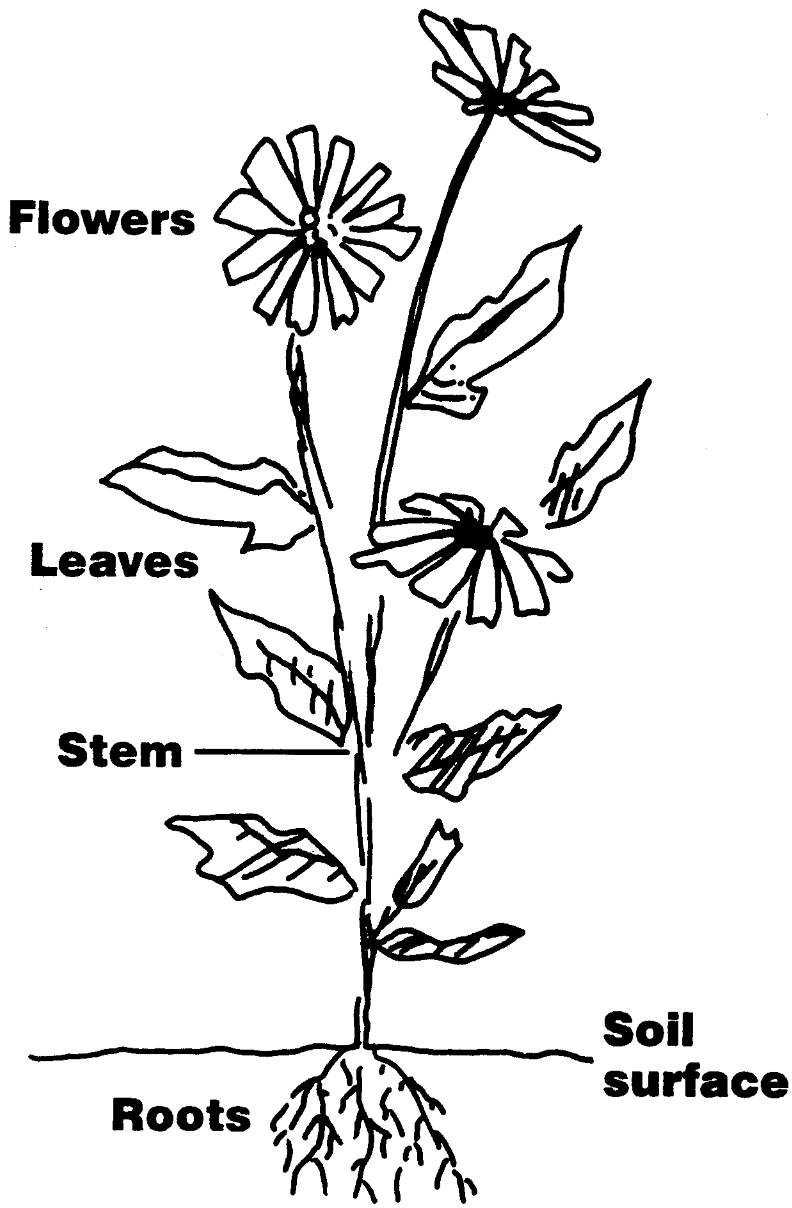
XV. Types of pollination (Transparency 13)

A. Self-pollination--Transfer of pollen from the anthers to the stigma of the same flower on the same plant

B. Cross-pollination--Transfer of pollen from the anthers of one plant to the stigmas of another plant

(Note: Cross-pollination usually requires an insect or bee to transfer the pollen from one plant to the other.)

Primary Parts of a Plant



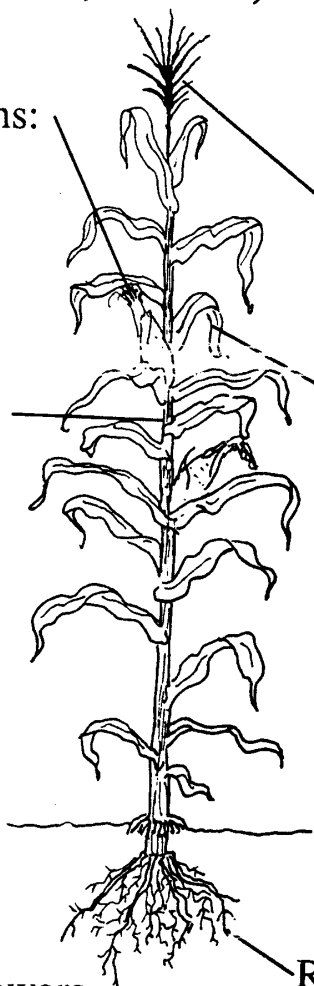
Functions of Leaves, Stems, Roots, and Flowers

Female Flower Functions:

a. Reproduction
b. Store food - in seeds and fruits

Stem Tissue Functions:

a. Conducts water and raw minerals from soil to leaves
b. Conducts manufactured food from leaves to other plant parts
c. Produces leaves and displays them to light
d. Supports leaves, flowers, and fruit
e. Stores food reserves in some plants - Irish potato, asparagus, cabbage hearts, etc.



Male Flower Function:

a. Pollination

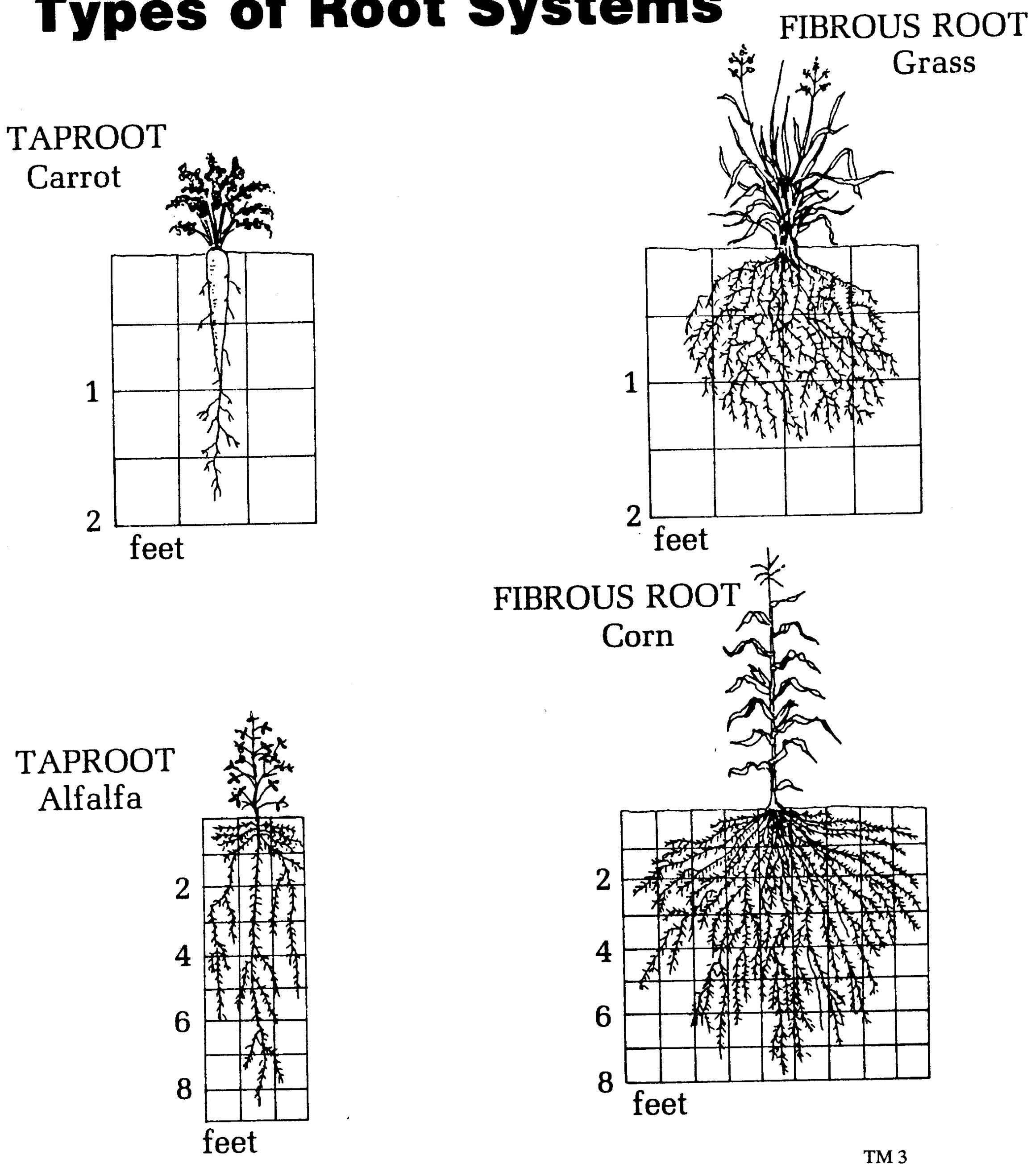
Leaf Functions:

a. Photosynthesis
b. Transpiration
c. Food storage in some crops, i.e. lettuce, cabbage

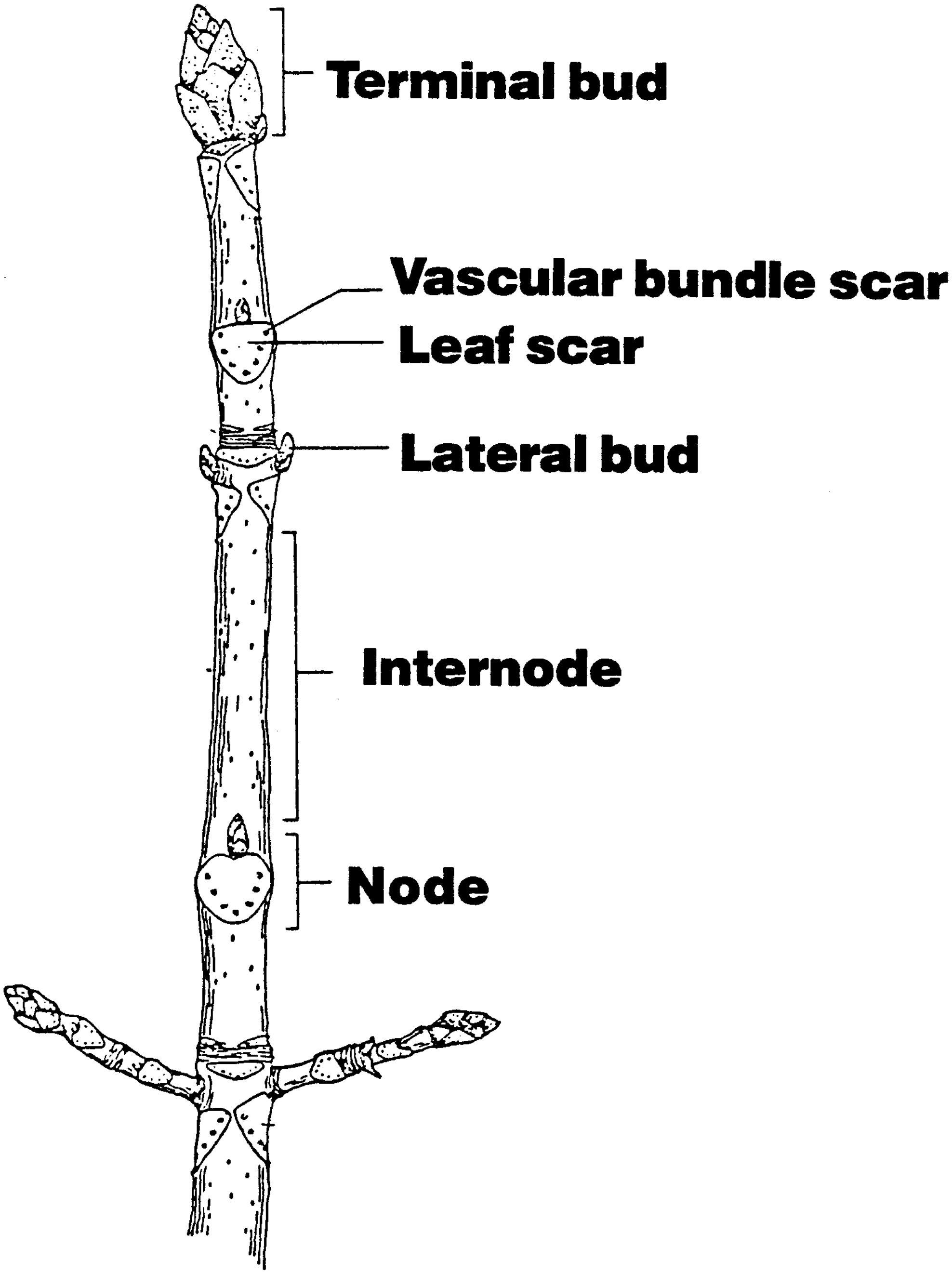
Root Functions:

a. Absorb water and raw minerals
b. Anchor plant
c. Store food reserves - in some crops carrots, beets, turnips

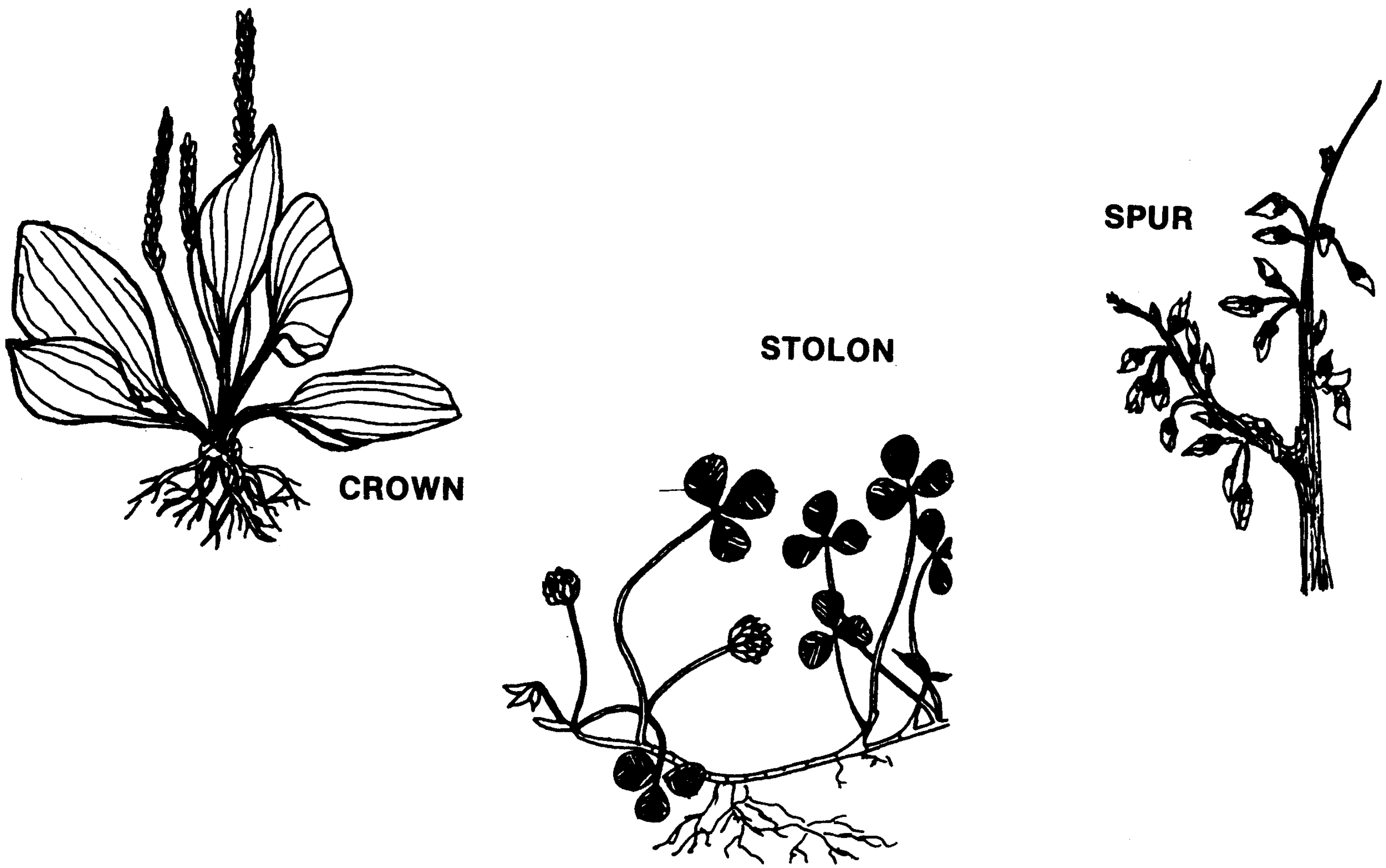
Types of Root Systems



Parts of the Stem

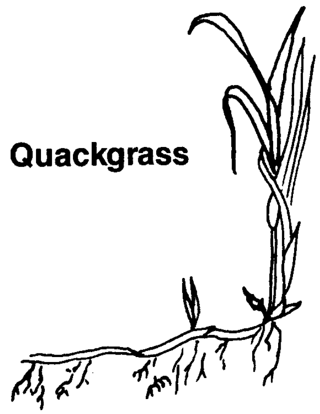


ABOVE GROUND STEM MODIFICATIONS



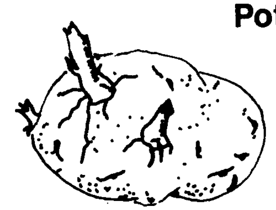
Below Ground Stem Modifications

Quackgrass



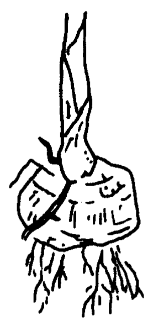
Rhizomes

Potato



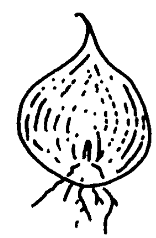
Tuber

Gladiolus



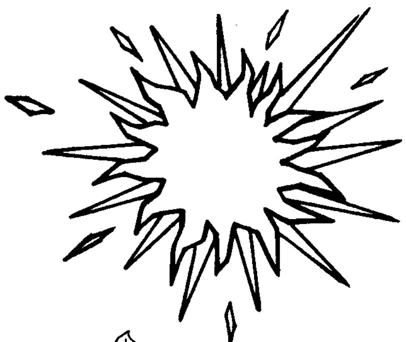
Corm

Onion



Bulbs

Conditions Affecting the Vegetative Growth of Crop Plants

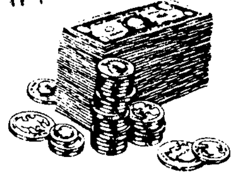


1. Climate

2. Soil features

3. Crop pests

4. Crop being produced



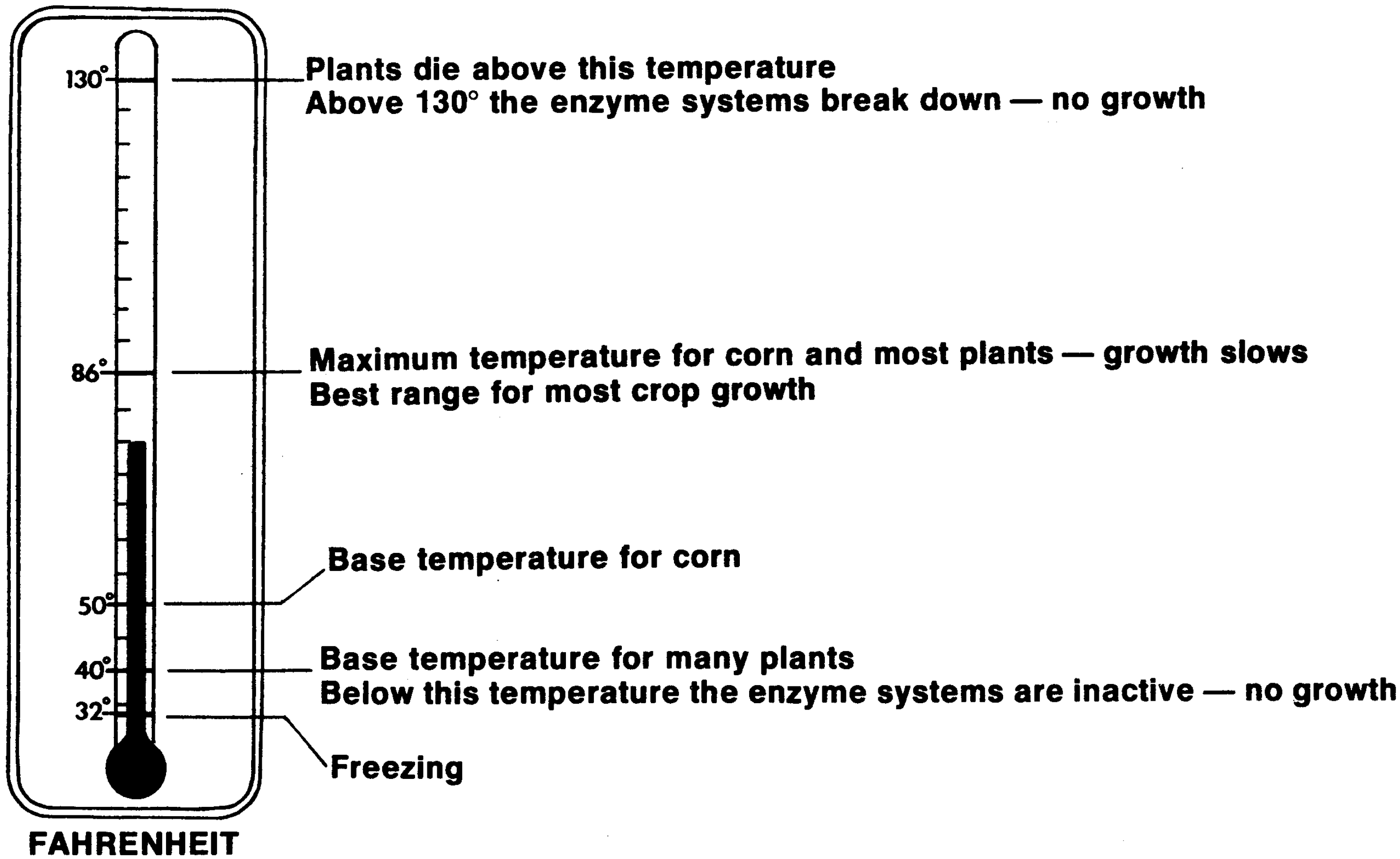
5. Economics

Comparison of Utilization of Sunlight by Crop Plants.*

Crop	Yield	Total Dry Matter
Corn	150 bu.	19,500
Soybeans	45 bu.	5,700
Wheat	50 bu.	6,000
Oats	80 bu.	6,560
Alfalfa	6 tons	12,000
Red Clover	3 tons	6,000
Mixed hay (50% legume)	5 tons	10,000
Pasture	—	6,000

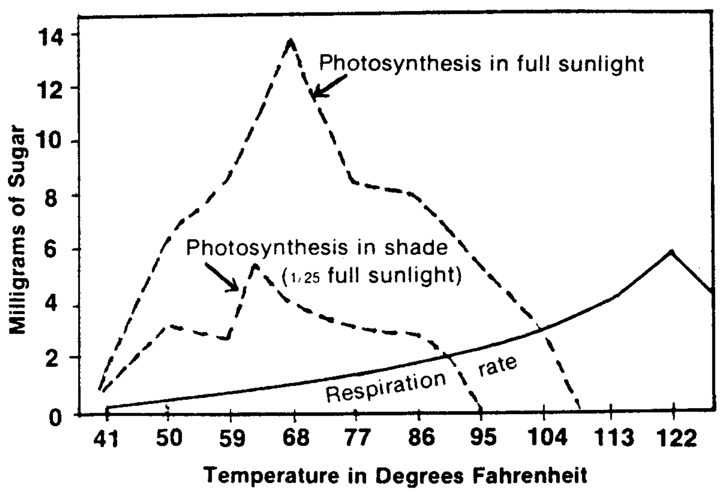
*More efficient use of sunlight by a crop plant will result in higher yields, if other factors are not limiting.

PLANT GROWTH VARIANCE WITH TEMPERATURE CHANGE



TM 9

Rate of Photosynthesis and Respiration as Affected by Temperature

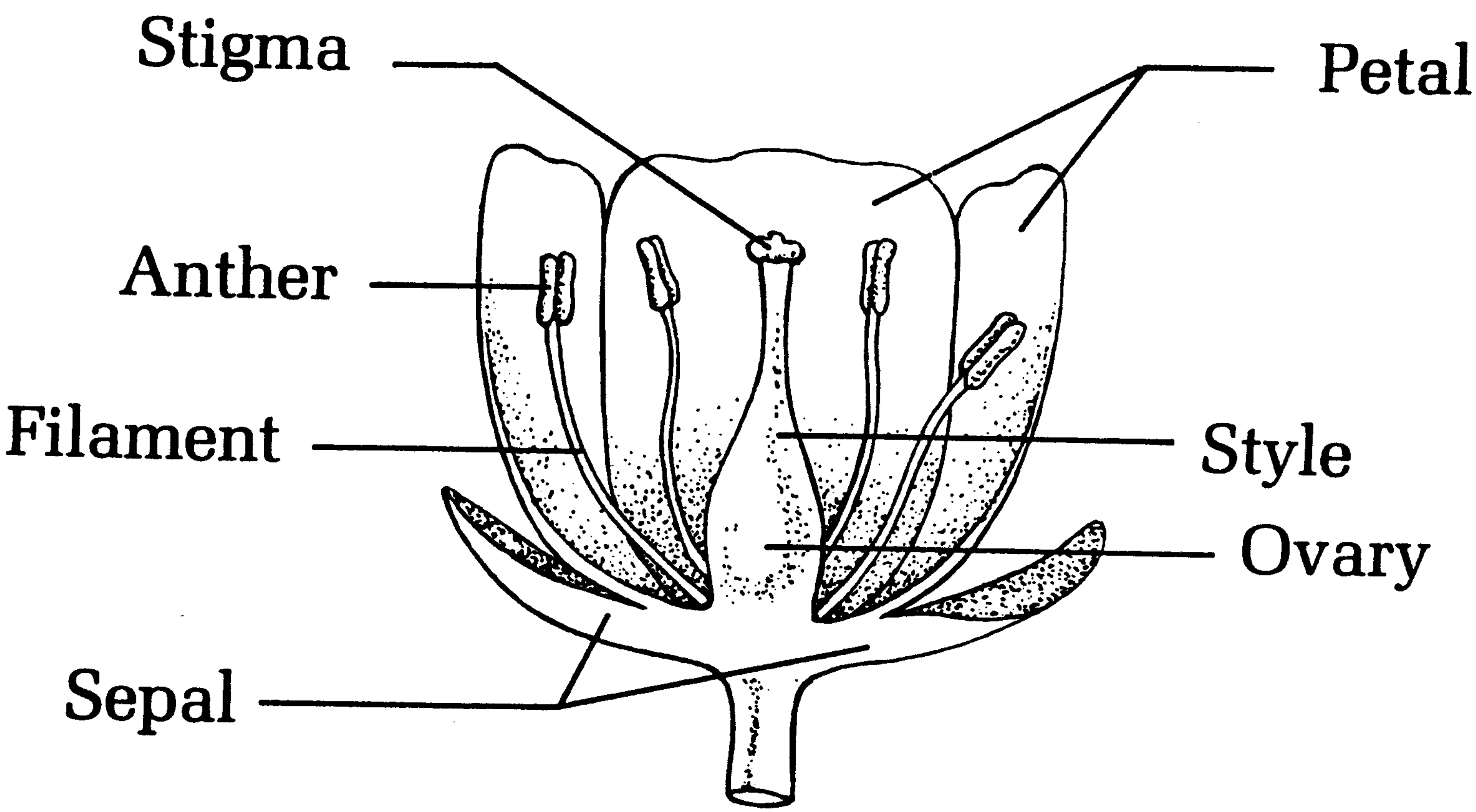


Approximate Pounds of Water Required to Produce One Pound of Dry Matter*

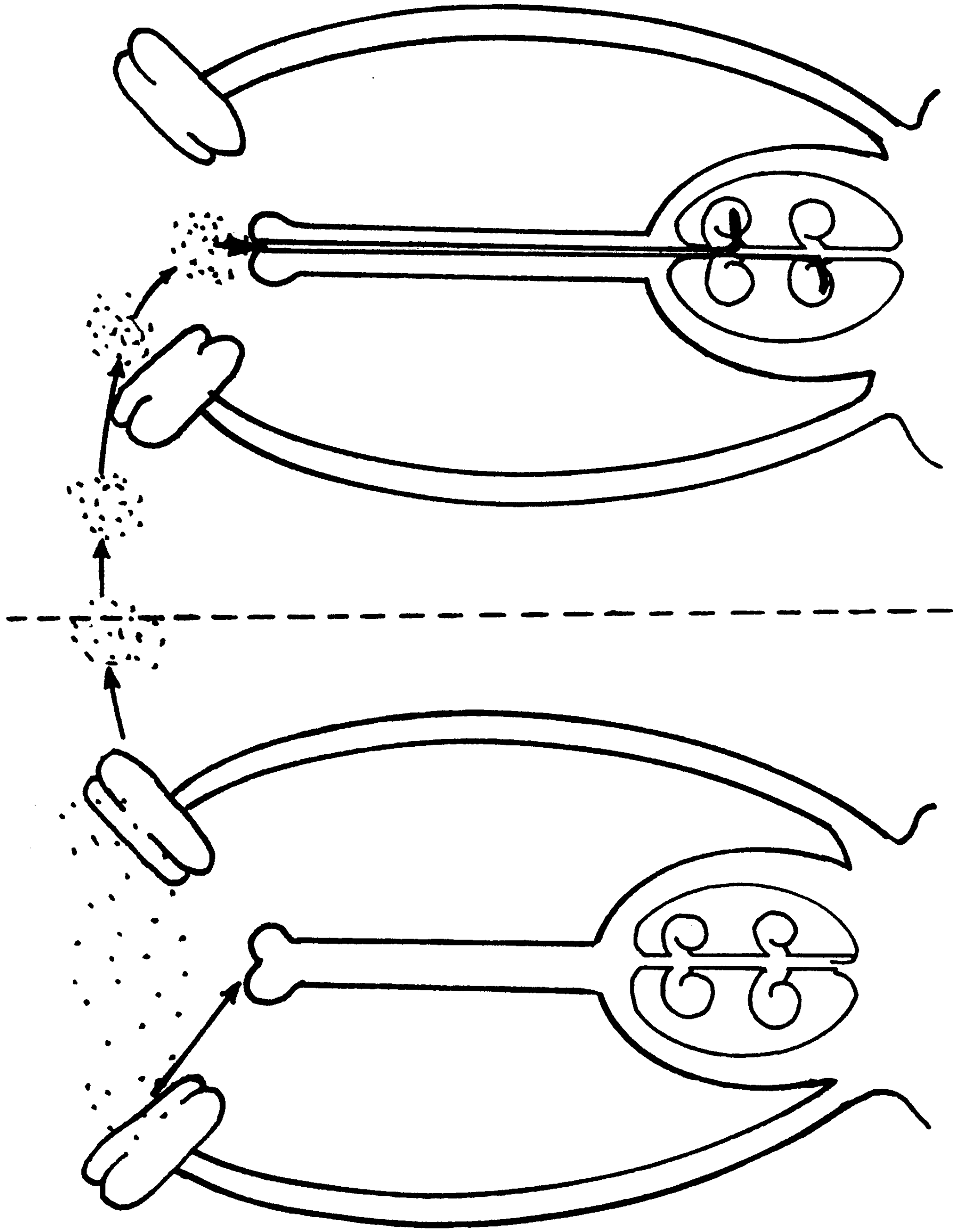
Crop	Pounds of Water
Corn	350
Soybeans	650
Wheat and Oats	550
Alfalfa	850
Red Clover	650

*The availability of water, either by precipitation or irrigation, influences crop yield more than any other factor.

Parts of a Complete Flower



SELF-POLLINATION AND CROSS-POLLINATION



PLANT GROWTH AND DEVELOPMENT

AG 150 - I

UNIT TEST

Name ____ Score_______________________________

1. Match terms associated with plant growth and development to the correct definitions. Write the correct numbers in the blanks.

_____a. Union of the male (pollen) nucleus with the female (egg) cell

_____b. Plant having two seed leaves

_____c. The part of a stem between two nodes

_____d. Vascular tissue that transports water and minerals from the root system to the leaves

_____e. The embryonic root

_____f. Seed bearing organ of a flower; composed of ovary, style and stigma

_____g. Plant having one seed leaf

_____h. The part of a stem where a leaf is attached

_____i. An embryonic shoot of a plant

_____j. The part of the embryo above the cotyledons and below the next leaves

_____k. A scar left on the stem when a leaf falls

_____l. Transfer of pollen from the anther to the stigma

_____m. The young plantlet within the seed

_____n. The part of an embryo between the cotyledons and the radicle

_____o. Part of the flower which produces the pollen; composed of the filament and anther

_____p. A strand of tissue containing xylem and phloem enclosed by a sheath of cells

1. Node
2. Internode
3. Bud
4. Leaf scar
5. Vascular bundle scar
6. Monocot
7. Dicot
8. Vascular bundle
9. Xylem
10. Phloem
11. Pistil
12. Stamen
13. Fertilization
14. Pollination
15. Embryo
16. Radicle
17. Hypocotyl
18. Epicotyl

_____q. A spot within a leaf scar left by the vascular bundles when a leaf falls

_____r. Vascular tissue that conducts food from the leaves to regions of growth or storage

2. Name the three stages of plant growth and development.

a. ______________________________

b. ______________________________

c. ______________________________

3. Name three requirements for good seed germination.

a. ______________________________

b. ______________________________

c. ______________________________

4. Select from the following list factors that cause poor seed germination. Write an "X" in the blank before each correct answer.

_____a. Number of seeds per pound

_____b. Seeds planted too deeply in soil

_____c. Presence of hardpan in root zone

_____d. Fungal disease

_____e. Low soil temperature

_____f. Low soil moisture

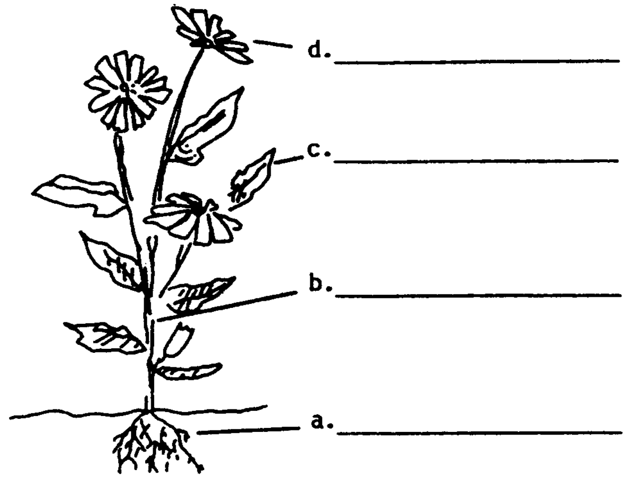
_____g. Damaged seed

_____h. Deficiency of nutrients in soil

_____i. Period of time between harvesting and planting of seed

_____j. Conditions under which seed is stored

5. Label the primary parts of a plant. Write the correct names in the blanks.



6. Match the primary plant part to its correct function. Write the correct numbers in the blanks.

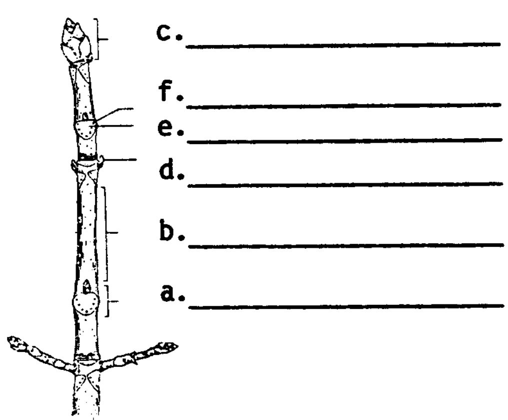
_____a.	Absorb water and nutrients; anchor and support the plant; site of food storage in carrots	1. Roots
_____b.	Site of photosynthesis; necessary for transpiration; site of food storage in lettuce	2. Stems
_____c.	Support leaves and flowers; conduct water, nutrients and food; site of food storage in potatoes	3. Leaves
_____d.	Site of reproduction; site of food storage in apples	4. Flowers

7. Name two types of root systems.

a. ____

b. ____

8. Label the parts of a stem. Write the correct names in the blanks.



9. Match the stem modification with the correct description. Write the correct numbers in the blanks.

_____a.	Enlarged fleshy part found at the tip of a rhizome; potato	1.	Crown
_____b.	Appears laterally on branches of fruit trees and bears fruit; apple	2.	Stolon
_____c.	Short disc-shaped stem surrounded by leaf-like scales; onion	3.	Spur
_____d.	Fleshy, short underground stem with very few buds; gladiolus	4.	Rhizome
_____e.	Runners that grow along top of soil surface; strawberry	5.	Tuber
_____f.	Underground stems that grow horizontally below soil surface; quackgrass	6.	Corm
_____g.	Appears just above or just below ground level from which modified stems grow; wheat	7.	Bulb

10. Select from the following list conditions affecting the vegetative growth of crop plants. Write an "X" in the blank before each correct answer.

_____a. Soil fertility

_____b. Amount of erosion

_____c. Depth seed is planted

_____d. Amount of rainfall

_____e. Presence of weeds

_____f. Soil moisture

_____g. Crop being produced

_____h. Presence of insects

_____i. Soil compaction

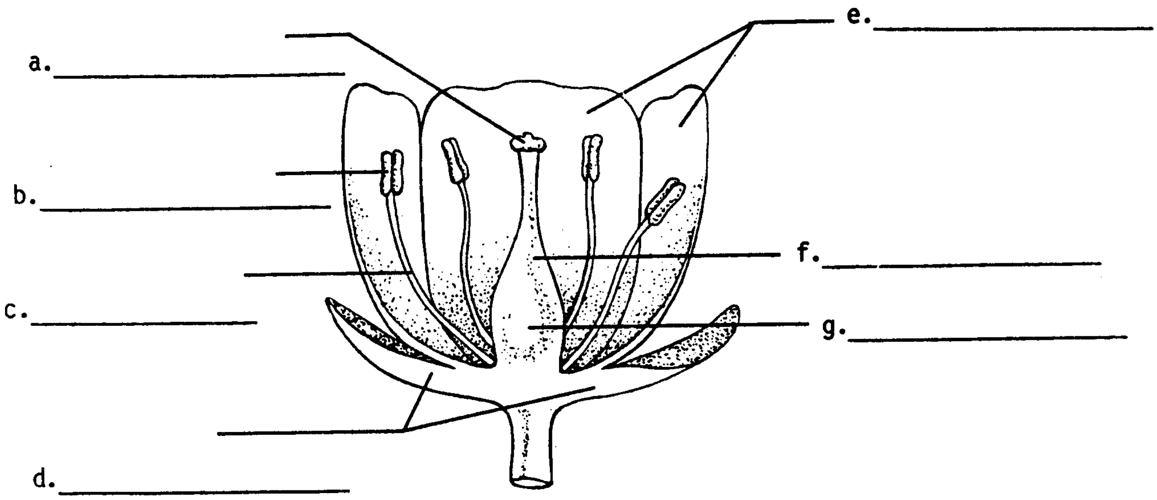
_____j. Presence of disease

11. Name two means of reproduction in plants.

a. ____

b. ____

12. Label the parts of a complete flower. Write the correct names in the blanks.



13. Match the type of flower to the correct description. Write the correct numbers in the blanks.

_____a.	Has only male flower parts	1.	Complete
_____b.	Has stamens and pistils, but no petals or sepals; common to monocots	2.	Incomplete
		3.	Perfect
_____c.	Staminate and pistillate flowers found on the same plant; corn	4.	Imperfect
_____d.	Has both stamens and pistils on the same flower	5.	Staminate
		6.	Pistillate
_____e.	Has only female flower parts	7.	Monoecious
_____f.	Staminate and pistillate flowers found on separate plants; spinach	8.	Dioecious
_____g.	Has stamens, pistils, petals and sepals on the same flower; common to dicots		
_____h.	Has either stamens or pistils, but not both on the same flower		

14. Match the types of pollination to the correct description. Write the correct numbers in the blanks.

_____a.	Transfer of pollen from the anthers to the stigma of the same flower on the same plant	1.	Self-pollination
_____b.	Transfer of pollen from the anthers of one plant to the stigmas of another plant	2.	Cross-pollination

PLANT GROWTH AND DEVELOPMENT

AG 150 - I

ANSWERS TO TEST

1.

a.	13	f.	11	k.	4	p.	8
b.	7	g.	6	l.	14	q.	5
c.	2	h.	1	m.	15	r.	10
d.	9	i.	3	n.	17		
e.	16	j.	18	o.	12		

2. Seed germination and seedling growth; Vegetative; Reproduction

3. Proper temperature; Sufficient moisture; Ample supply of oxygen

4. b, d, e, f, g, i, j

5.

a.	Roots	c.	Leaves
b.	Stem	d.	Flowers

6. a. 1 b. 3 c. 2 d. 4

7. Tap root system; Fibrous root system

8.

a.	Node	d.	Lateral bud
b.	Internode	e.	Leaf scar
c.	Terminal bud	f.	Vascular bundle scar

9.

a.	5	d.	6	g.	1
b.	3	e.	2		
c.	7	f.	4		

10. a, b, d, e, f, g, h, i, j

11. Sexual; Asexual

12.

a.	Stigma	e.	Petal
b.	Anther	f.	Style
c.	Filament	g.	Ovary
d.	Sepal		

13.

a.	5	e.	6
b.	2	f.	8
c.	7	g.	1
d.	3	h.	4

14. a. 1 b. 2

CROP AND WEED IDENTIFICATION

AG 150 - J

UNIT OBJECTIVE

After completion of this unit, students should be able to match terms and definitions and identify the parts of a leaf, flower and stem. Students should also be able to classify plants and identify common crop and weed plants. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with crop and weed identification to the correct definitions.
2. Arrange in order the binomial system of plant classification.
3. Label a drawing showing the parts of a simple leaf.
4. Label a drawing showing the parts of a compound leaf.
5. Identify three types of leaf arrangements.
6. Identify the four types of leaf veination.
7. Identify three types of leaf margins.
8. Identify four types of leaf attachment to the stem.
9. Label a drawing showing the parts of a stem.
10. Label a drawing showing the parts of a complete flower.
11. Identify four types of inflorescence.
12. Name three natural resources crops and weeds are in competition for.
13. Name three losses caused by weeds.
14. Select ways that weeds spread.
15. Select methods of cultural weed control.
16. Select methods of mechanical weed control.
17. Match the classifications of herbicides to the correct description.
18. Discuss biological weed control.
19. Identify weed seeds as either prohibitive noxious or restricted noxious.

CROP AND WEED IDENTIFICATION

AG 150 - J

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Crop Plants*, 80-page manual, color photos and descriptions; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801; approximate cost $12.00.

b. *Weed Plants*, 80-page manual, color photos and descriptions; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801; approximate cost $12.00.

c. *Weeds*, instructional unit; available from Agri-Farm Publications, Inc., 1019 Market Street, Gowrie, Iowa 50543; approximate cost $17.50; order no. 209.

2. Filmstrips, slideshows, etc.

a. *Agricultural Weed Identification*, 40 slides; available from VEP, Cal Poly State University, San Luis Obispo, California 93407; approximate cost $25.25.

b. *An Aid to Identifying 70 Crop and Weed Plants*, slides, script and manual; available from Ohio Agricultural Education Curriculum Materials Center, Ohio State University, Columbus, Ohio 43210; approximate cost $23.00; order no. 1005M, 1006S.

c. *Crop Seed Identification*, 105 slides and cassette, 28 minutes; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $41.60; order no. D1.

d. *Fundamentals of Plant Identification*, slides and manual; available from Ohio Agricultural Education Curriculum Materials Center, Ohio State University, Columbus, Ohio 43210; approximate cost $8.50; order no. 1008M, 1009S.

e. *Identification of Weed Seedling - Broadleaf*, filmstrip or slide set; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801; 2 parts.

f. *Identification of Weed Seedling - Grasses*, filmstrip or slide set; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801.

g. *Plant and Seed Identification*, slide set or video; available from Department of Agricultural Education, University of Idaho, Moscow, Idaho 83843, (208-885-6358).

h. *Seedling Identification of Legume Plants*, 24 slides and cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $31.20; order no. D6.

i. *Weed Identification*, filmstrip or slide set; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Dr., Urbana, Illinois 61801.

j. *Weeds and Weed Seed Identification*, 29 slides and cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $120.64; order no. D2.

k. *Weed Seed Identification Kit*, 30 weed seeds in plastic holders on 3" x 5" cards; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $12.50; order no. 450.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information sheet and discuss.

E. Invite county weed supervisor to speak on noxious weed laws, identification and control.

F. Tour county with students, parents, etc. to determine the status of noxious and common weeds in your locality.

G. Have a weed collection and identification contest. Have students collect pressed samples of weeds, identify them and submit to the instructor. The student with the largest number of different weed/crop specimens wins. Save the collected samples for future classroom use.

H. Invite a county agent, seed specialist or other qualified person to speak to class on economics of weeds and weed control.

I. Assign students or let them select an agronomic crop, identify problem weeds for that crop, and develop a weed control plan to use.

J. Review and give test.

K. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Binomial System of Plant Classification
2. TM 2--Parts of a Simple Leaf
3. TM 3--Parts of a Compound Leaf
4. TM 4--Types of Leaf Arrangement
5. TM 5--Types of Leaf Veination
6. TM 6--Types of Leaf Margins
7. TM 7--Types of Leaf Attachment
8. TM 8--Parts of the Stem
9. TM 9--Parts of a Complete Flower
10. TM 10--Types of Inflorescence
11. TM 11--Types of Inflorescence (continued)

E. Test

F. Answers to test

III. Unit references

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CROP AND WEED IDENTIFICATION

AG 150 - J

INFORMATION SHEET

I. Terms and definitions

A. Weed--Any plant that interferes with human affairs

B. Noxious weed--Any plant which is determined by a state agency to be injurious to public health, crops, livestock, land or other property

C. Shrub--A woody perennial plant smaller than a tree and usually with several basal stems

D. Herb--A plant with no persistent woody stem above ground

E. Vine--A plant that climbs on some support, the stem cannot stand upright by itself

F. Tree--A perennial woody plant of considerable stature at maturity with a main trunk

G. Rosette--A dense, basal cluster of leaves arranged in a circular fashion like the leaves of the common dandelion

H. Prostrate--Lying flat on the ground

I. Evergreen--Bearing green leaves throughout the year

J. Deciduous--Plants that shed their leaves annually

K. Alternate--Not opposite, one leaf at a node

L. Opposite--Leaves two at a node and situated across the stem from each other

M. Simple leaf--Of only one part; leaf not completely divided into separate segments

N. Compound leaf--A leaf completely separated into two or more leaflets

O. Midrib--The main or central rib of a leaf

P. Vein--Threads of vascular tissue in a leaf

Q. Blade--The expanded, usually flat portion of a leaf or petal

R. Petiole--The stalk of a leaf blade or compound leaf

S. Pinnate--Compound leaf with the leaflets on opposite sides

T. Internode--The part of a stem between two nodes

U. Node--The place on a stem where one or more leaves are attached

II. The binomial system of plant classification (Transparency 1)

(Note: Several hundred thousand species of plants exist in the world. Botanists have chosen to organize, classify and group plants according to what they think has been their evolutionary development, with related plants near and unrelated plants far apart.)

A. Division--A group of related classes

B. Class--A group of related orders

C. Order--A group of related families

D. Family--A group of related genera

E. Genus--A group of related species

F. Species--The plants of one kind

Example:

CORN

Category	Name	Description
Division	Anthophyta	Vascular plants with seeds and flowers; ovules enclosed in an ovary; pollination indirect; the angiosperms
Class	Monocotyledonae	Embryo with one cotyledon; flower parts usually in threes; many scattered vascular bundles in stem
Order	Commelinales	Monocots with fibrous leaves; reduction and fusion in flower parts
Family	Poaceae	Hollow stemmed monocots with reduced greenish flowers; fruit a specialized achene; the grasses
Genus	Zea	Robust grasses with separate staminate and pistillate flower clusters
Species	Zea Mays	Corn

III. Parts of a simple leaf (Transparency 2)

A. Blade

B. Veins

C. Petiole

D. Stipules

IV. Parts of a compound leaf (Transparency 3)

A. Leaflet

B. Veins

C. Petiolule

D. Rachis

E. Petiole

F. Stipules

V. Types of leaf arrangement (Transparency 4)

A. Alternate

B. Opposite

C. Whorled

VI. Types of leaf veination (Transparency 5)

A. Parallel

B. Pinnate

C. Palmate

D. Netted

VII. Types of leaf margins (Transparency 6)

A. Entire--No teeth or lobes on margin

B. Serrate--Toothed with teeth directed forward

C. Incised--Toothed with sinuses deeper than teeth

D. Lobed--Margin cut in about one-half way to midrib; sinuses and tips of segments rounded

VIII. Types of leaf attachment to the stem (Transparency 7)

A. Petiolate--Leaf attached by a petiole

B. Sessile--Leaf without a petiole; blade attached to stem

C. Clasping--Sessile leaf with the lower edges of the blade partly surrounding the stem

D. Decurrent--Point of attachment extends downward on the stem

IX. Parts of a stem (Transparency 8)

A. Node

B. Internode

C. Terminal bud

D. Lateral bud

E. Leaf scar

F. Vascular bundle scar

X. Parts of a complete flower (Transparency 9)

A. Stamen--Male part of the flower producing the pollen

1. Anther--Bears the pollen

2. Filament--Supports the anther

B. Pistil--Female part of the flower producing the egg

1. Stigma--Upper part of pistil that catches pollen

2. Style--Supports stigma

3. Ovary--Produces ovules which develop into seeds

C. Accessory parts

1. Corolla--Petals of the flower

2. Calyx--Sepals of the flower

3. Pedicel--Stalk of an individual flower

XI. Types of inflorescence (Transparencies 10, 11)

A. Spike--Flowers sessile along the main axis

B. Raceme--Flowers single on pedicels along the rachis

C. Panicle--Two or more flowers on each pedicel, arranged along rachis

D. Corymb--A raceme with lower pedicels elongated and rachis shortened

E. Umbel--Pedicel of each flower attaches to a common point

F. Compound umbel

G. Head--Dense cluster of flowers

H. Solitary--Flowers borne singly, not in clusters

XII. Weed competition with crops

A. Competition for water

B. Competition for nutrients

C. Competition for light

(Note: Crops and weeds have the same basic requirements for normal growth and development. In a mixed community of crops and weeds, the more aggressive species will dominate.)

XIII. Losses caused by weeds

(Note: Losses from weeds exceed losses by any other agricultural pest. One estimate put the total loss from weeds in the U.S. at $15 billion per year, or $6000 per year per farm.)

A. Decreased crop yields

B. Decreased crop quality

C. Cost of control activities

XIV. How weeds spread

A. Wind

B. Flowing water

C. Animals and manure

D. Impure seed

E. Farm machinery, cars, pickups and trucks

F. Earth moving equipment

G. Wild flower pickers

XV. Methods of cultural control

A. Weed-free crop seed--Planting only crop seeds that have been cleaned to remove weed seeds

B. Smother crops--Crops that are highly competitive with weed species for light, nutrients and water
(Note: Examples are small grains, grasses and alfalfa.)

C. Crop rotation--Prevent or reduce the build up of certain weeds common to a particular crop

XVI. Methods of mechanical control

A. Hand pulling--Best adapted to small areas for control of annual and biennial weeds

B. Hoeing--Best adapted for small areas for control of annual, biennial and perennial weed seedlings

C. Mowing--Prevent seed production and restrict rank weed growth

D. Cultivation--Kill weeds by cutting off tops, burying or removing from soil

E. Mulching--Smother plants to cut off sunlight

F. Burning

XVII. Classification of herbicides

A. Herbicide selectivity

1. Selective--Used to kill weeds without significant damage to crop

2. Non-selective--Kill all plants present if applied at an adequate rate

B. Mode of herbicide action

1. Contact--Kills only part of plant to which it is applied; not translocated

2. Systemic--Absorbed by roots or foliage and translocated throughout plant

C. Time of application

1. Preplant--Applied to soil before crop is planted

2. Preemergence--Applied prior to emergence but after crop planting

3. Postemergence--Applied after emergence of the crops or weeds

XVIII. Biological weed control--Involves the introduction of a natural enemy to weaken or destroy a particular weed species; insects have achieved the most success, but microorganisms, parasitic plants, animals, birds and fish are also used. The goal is not eradication, but reduction of the weed population to an acceptable level

Example: Leafcutting beetles to control St. Johnswort

XIX. Plants of economic impact to Idaho

A. Crops

Alfalfa

Alsike Clover

Beans

Birdsfoot Trefoil

Club Wheat

Common Wheat

Crested Wheat Grass

Kentucky Bluegrass

Lentils

Oats

Orchard Grass

Peas

Potatoes

Red Clover

Rye

Six Row Barley

Smooth Brome Grass

Strawberry Clover

Sugar beet

Sweet Clover

Tall Fescue

Tall Oat grass

Timothy

Two Row Barley

White Clover

B. Weeds

Barnyard Grass

Black Medic
(Yellow Trefoil)

Black Mustard

Broadleaf Plantain

Buckhorn Plantain

Bull Thistle

Burdock

Mallow

Mayweed
(Dog Fennel)

Meadow Salsify
(Yellow Goatsbeard)

Medusahead

Musk Thistle

Nut Sedge
(Yellow Nut Sedge)

Canada Thistle

Chicory

Cocklebur

Common Groundsel

Crab Grass

Curled Dock

Cutleaf Night Shade

Dalmation Toadflax

Death Camas

Diffuse Knapweed

Dodder

Downey Brome Grass

Dyers Woad

Field Bindweed
(Morning Glory)

Field Pennycress
(Fan Weed)

Foxtail Barley

Green Foxtail

Hairy Night Shade

Halogeton

Hoary Cress
(White Top)

Hounds Tongue

Kochia

Lambsquarter

Larkspur

Leafy Spurge

Longleaf Groundcherry

Perennial Pepperweed

Poison Hemlock

Poverty Weed

Prickly Lettuce

Prostrate Knotweed

Puncture Vine

Purslane

Quack grass

Red Root (erect)
(Rough Pigweed)

Rush Skeletonweed

Russian Knapweed

Russian Thistle

St. Johnswort
(Goat Weed)

Scotch Thistle

Shepards Purse

Showy Milkweed

Silvery Lupine
(Lupine)

Sow Thistle

Spotted Knapweed

Teasel

Water Hemlock

Wild Buckwheat

Wild Oat

Yarrow

Yellow Starthistle

XX. Prohibited noxious weed seeds

A. Syrian Beancaper

B. Field Bindweed

C. Buffalobur

D. Skeleton Leaf Bursage

E. Camelthorn

F. Wild Carrot

G. Hoary Cress

H. Common Crupina

I. Austrian Fieldcress

J. Goatgrass

K. Smooth Groundcherry

L. Black Henbane

M. Johnsongrass

N. Diffuse Knapweed

O. Russian Knapweed

P. Spotted Knapweed

Q. Purple Lythrum

R. Silverleaf Nightshade

S. Perennial Pepperweed

T. Poison-Hemlock

U. Puncturevine

V. Quackgrass

W. Tansy Ragwort

X. Rush Skeletonweed

Y. Perennial Sowthistle

Z. Leafy Spurge

AA. Common St. Johnswort

BB. Yellow Starthistle

CC. Swainsonpea

DD. Canada Thistle

EE. Musk Thistle

FF. Scotch Thistle

GG. Dalmation Toadflax

HH. Yellow Toadflax

II. Dyers Woad

XXI. Restricted noxious weed seeds

A. Dodder

B. Halogeton

C. Blue Lettuce

D. Wild Oats

E. Buckhorn Plantain

F. Western and Perennial Ragweed

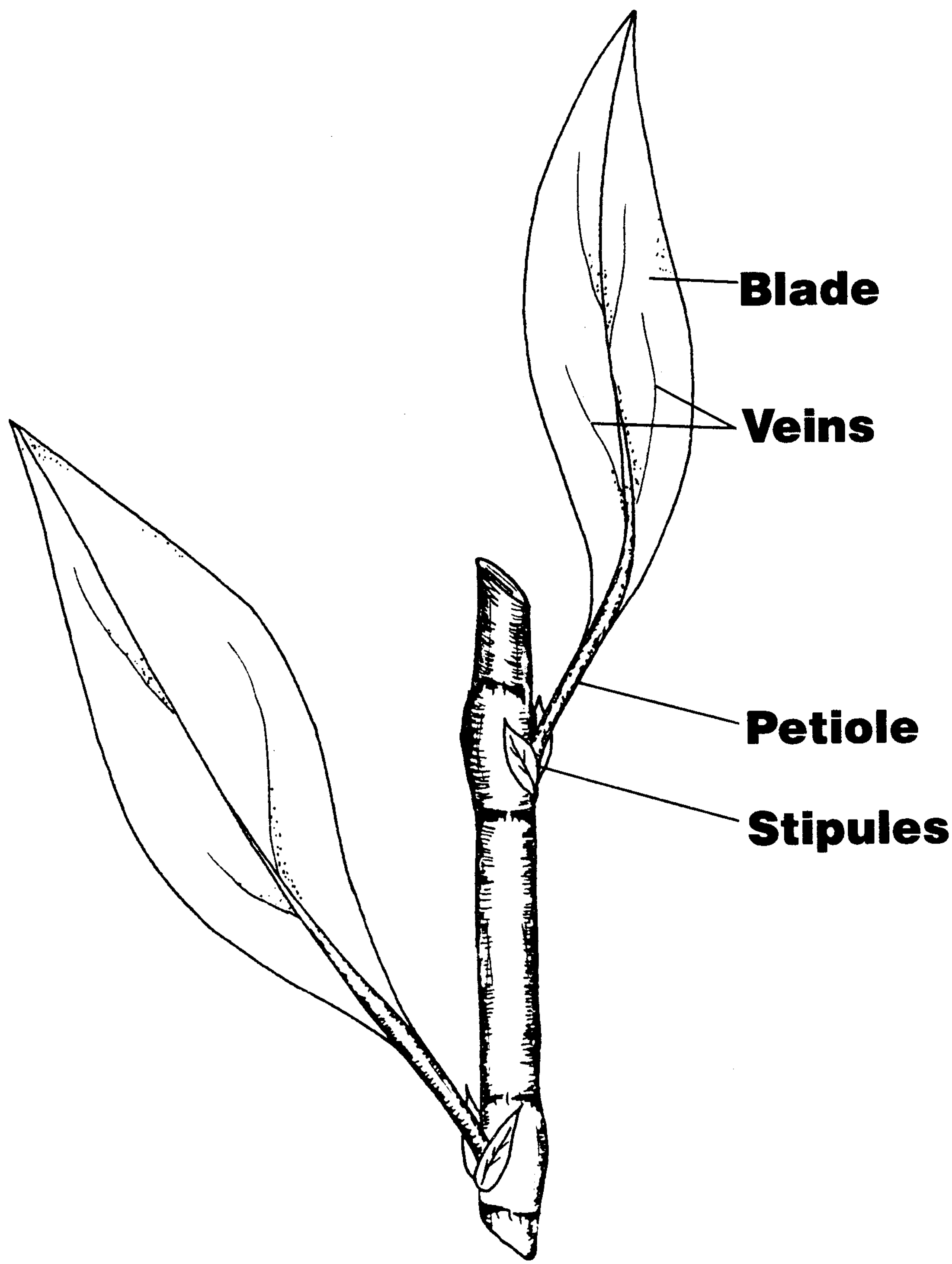
G. Medusahead Rye

H. Poverty Sumpweed

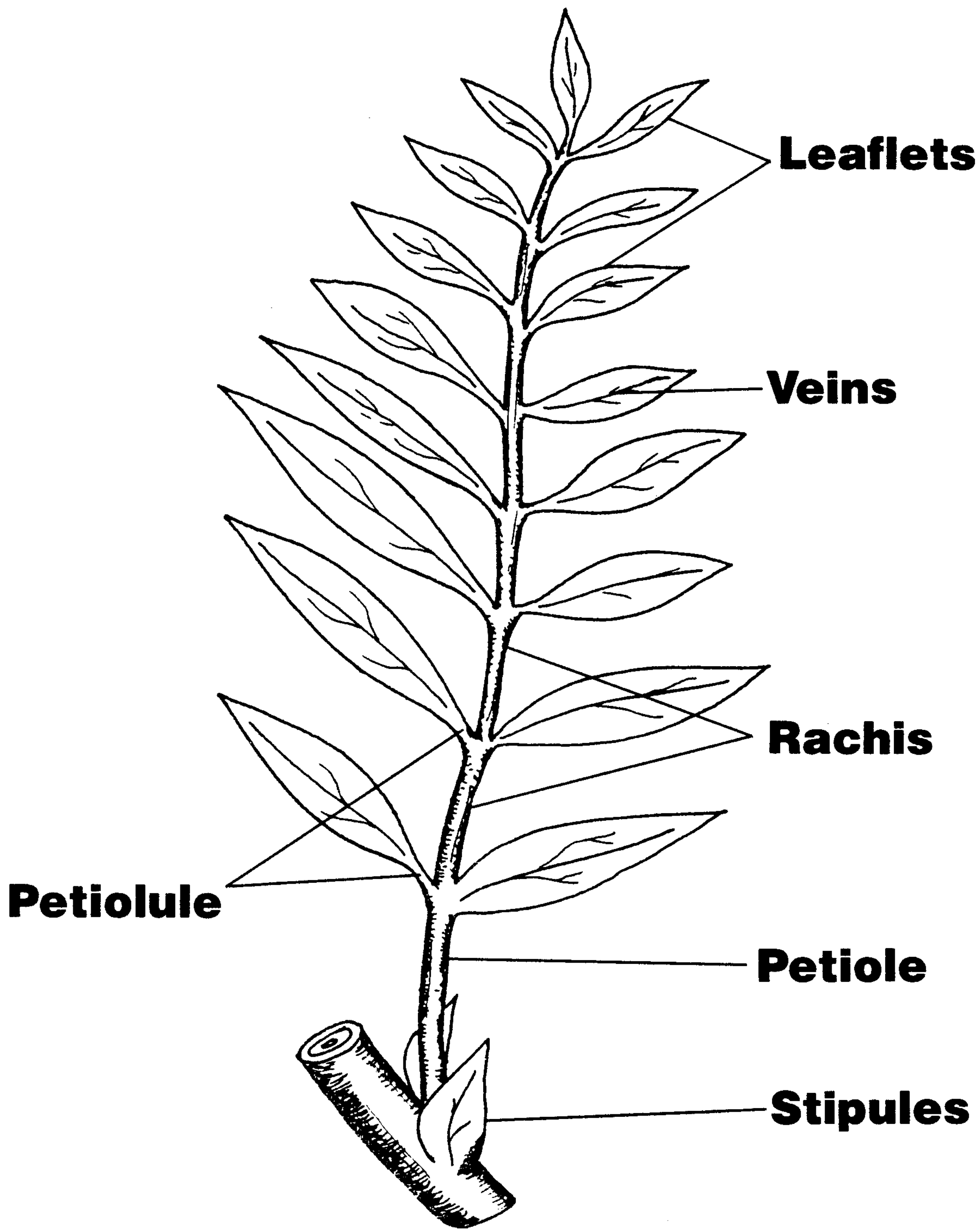
Binomial System of Plant Classification

Division	**General**
Class	
Order	
Family	
Genus	
Species	**Specific**

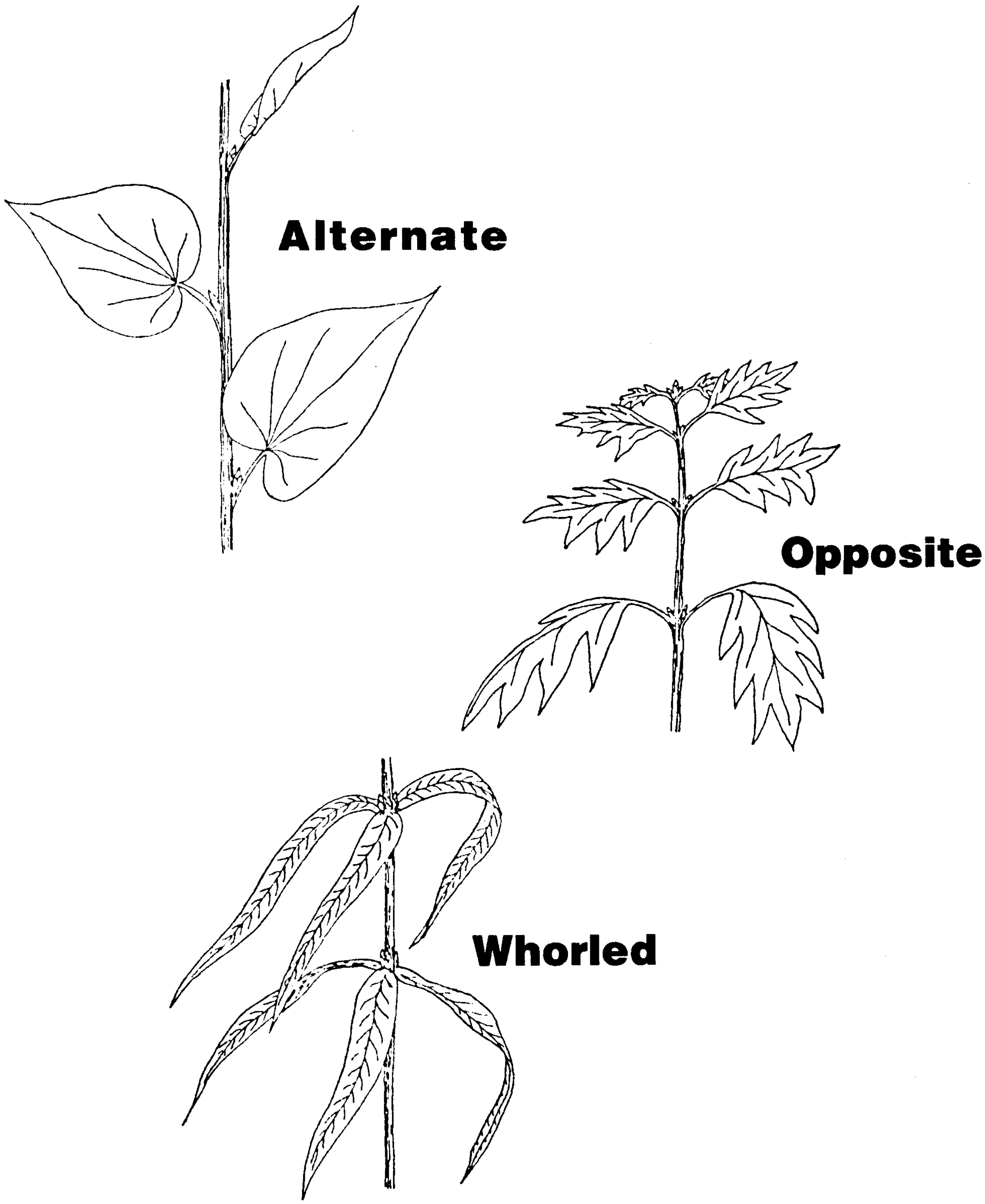
Parts of a Simple Leaf



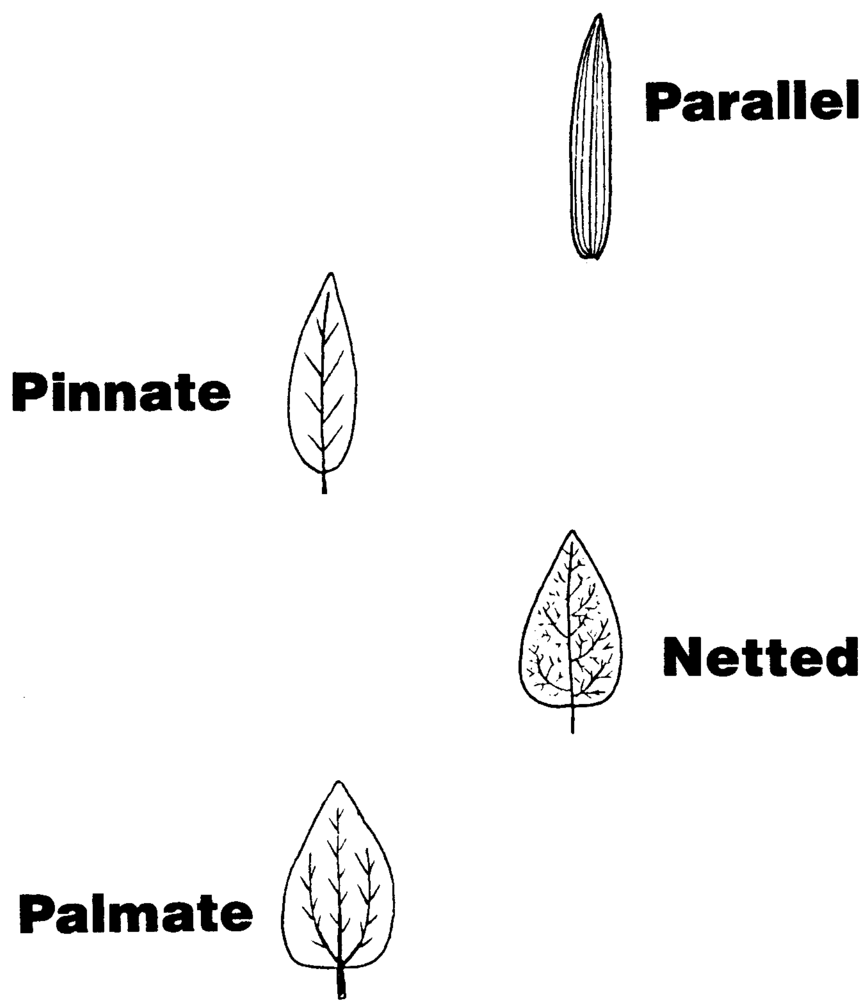
Parts of a Compound Leaf



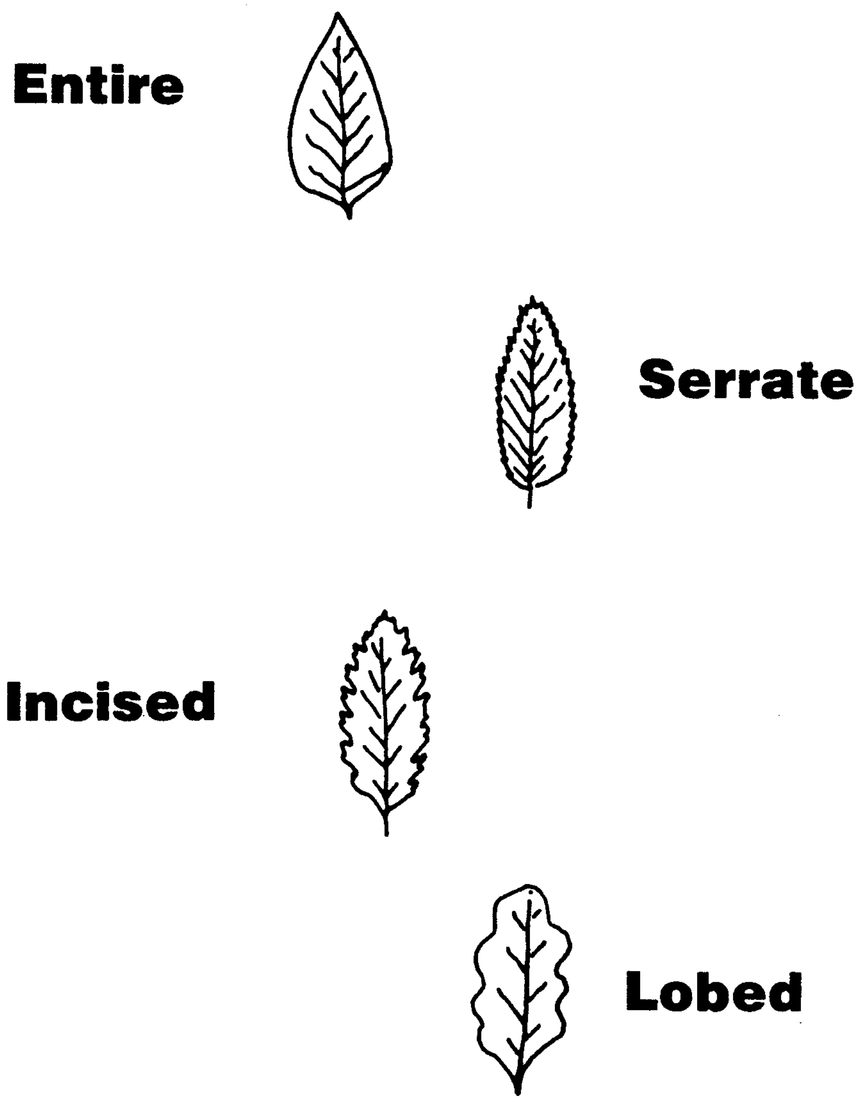
Types of Leaf Arrangement



Types of Leaf Veination



Types of Leaf Margins

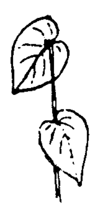


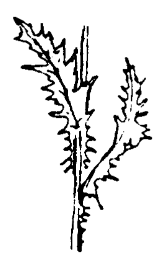
Types of Leaf Attachment

Petiolate

Sessile

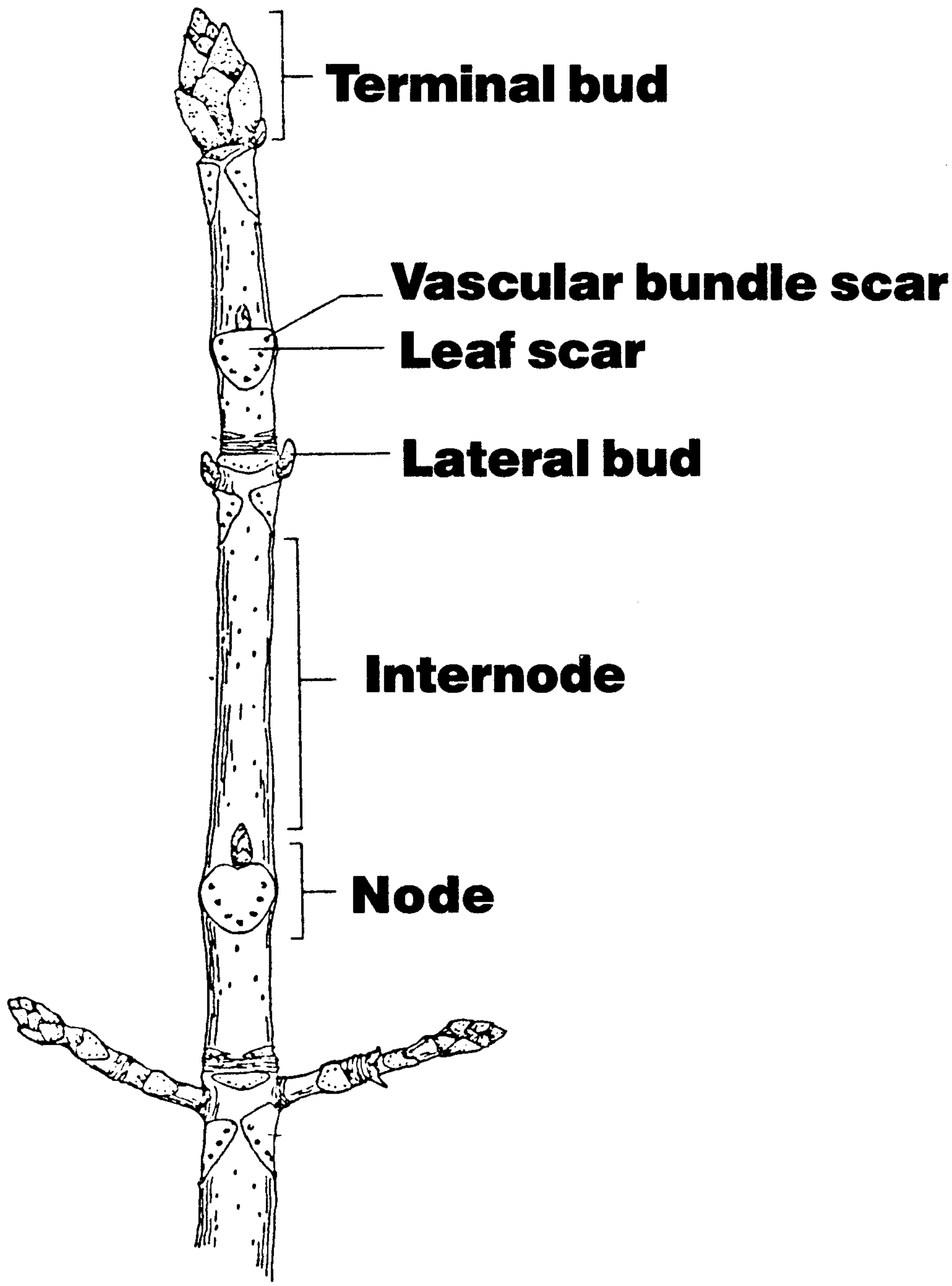
Clasping



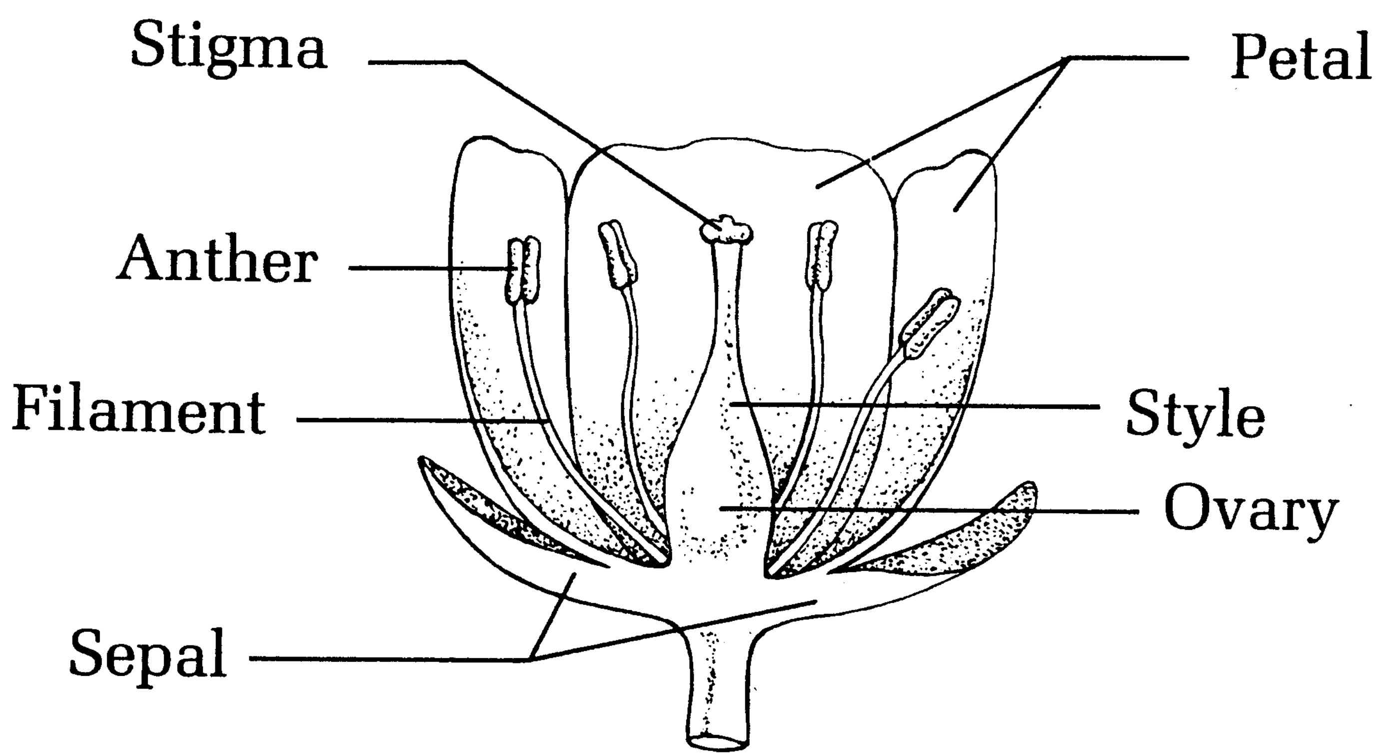


Decurrent

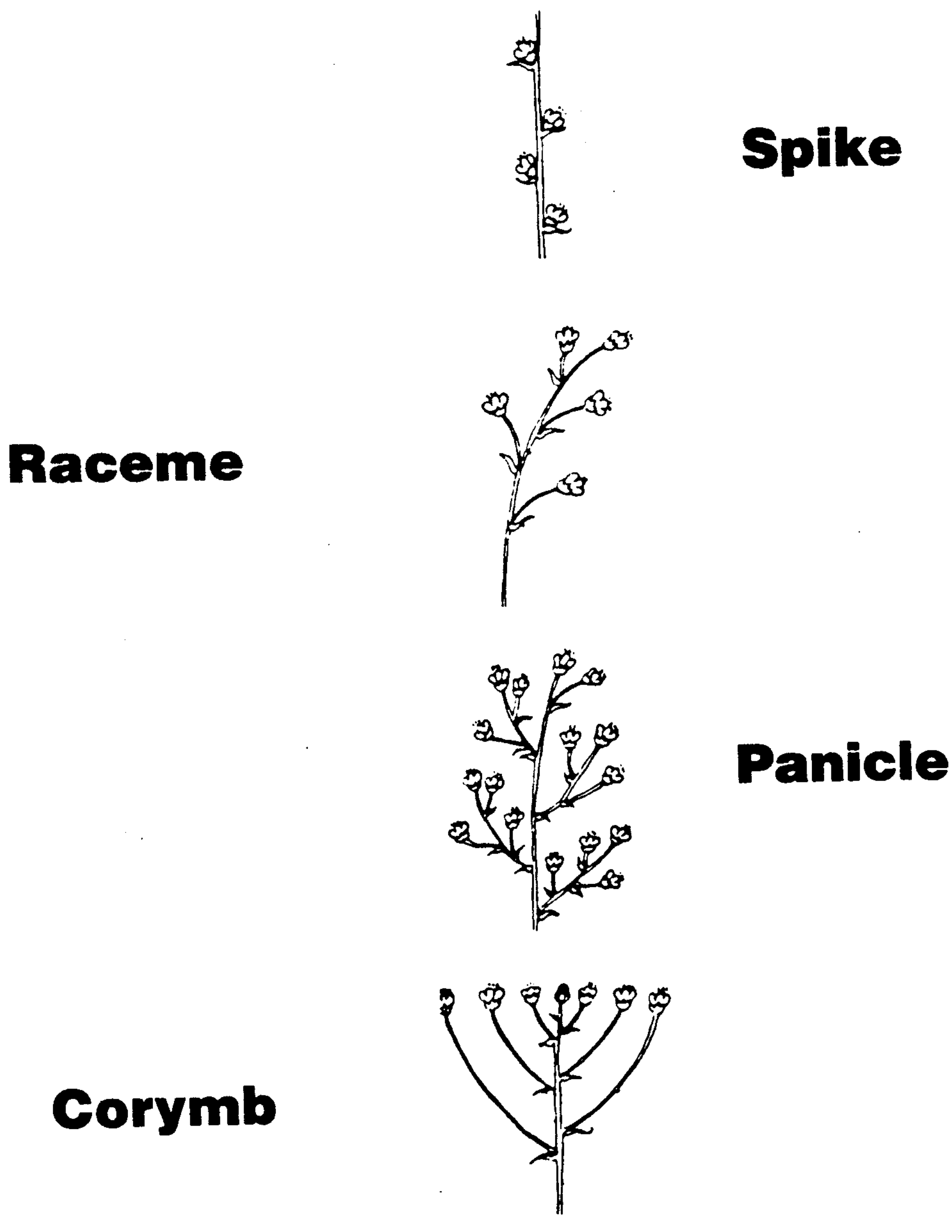
Parts of the Stem



Parts of a Complete Flower

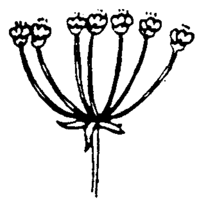


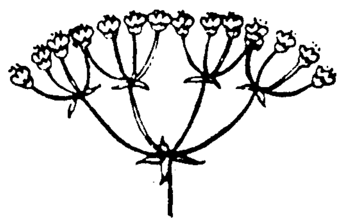
Types of Inflorescence



Types of Inflorescence (Continued)

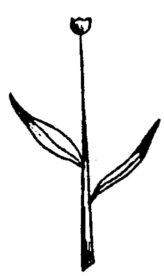
Umbel





Compound Umbel

Head



Solitary

CROP AND WEED IDENTIFICATION

AG 150 - J

UNIT TEST

Name ____ Score ________________________________

1. Match terms associated with the identification of plants and weed pests to the correct definitions. Write the correct numbers in the blanks.

_____a.	The part of a stem between two nodes	1.	Weed
_____b.	Not opposite; one leaf at a node	2.	Noxious weed
_____c.	A plant with no persistent woody stem above ground	3.	Shrub
_____d.	Any plant that interferes with human affairs	4.	Herb
_____e.	The expanded, usually flat portion of a leaf	5.	Vine
_____f.	The main or central rib of a leaf	6.	Tree
_____g.	Lying flat on the ground	7.	Rosette
_____h.	A plant that climbs on some support, the stem cannot stand upright by itself	8.	Prostrate
		9.	Evergreen
_____i.	A leaf completely separated into two or more leaflets	10.	Deciduous
_____j.	Leaves two at a node and situated across the stem from each other	11.	Alternate
		12.	Opposite
_____k.	A perennial woody plant of considerable stature at maturity with a main trunk	13.	Simple leaf
_____l.	Compound leaf with the leaflets on opposite sides	14.	Compound leaf
		15.	Midrib
_____m.	Place on a stem where leaves are attached	16.	Vein
_____n.	Any plant which is determined by a state agency to be injurious to public health, crops, livestock, land or other property	17.	Blade
		18.	Petiole
_____o.	A dense, basal cluster of leaves arranged in a circular fashion	19.	Pinnate
_____p.	Of only one part; leaf not completely divided into separate segments	20.	Internode
		21.	Node
_____q.	The stalk of a leaf blade or compound leaf		

_____r. Bearing green leaves throughout the year

_____s. A woody perennial plant smaller than a tree

_____t. Plants that shed their leaves annually

_____u. Threads of vascular tissue in a leaf

2. Arrange in order the binomial system of plant classification. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Order

_____b. Species

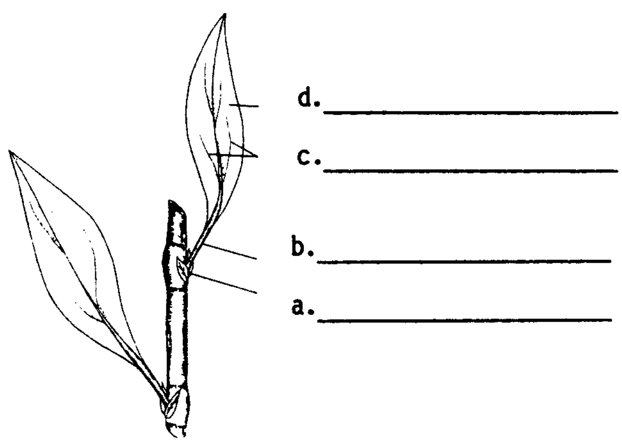
_____c. Class

_____d. Genus

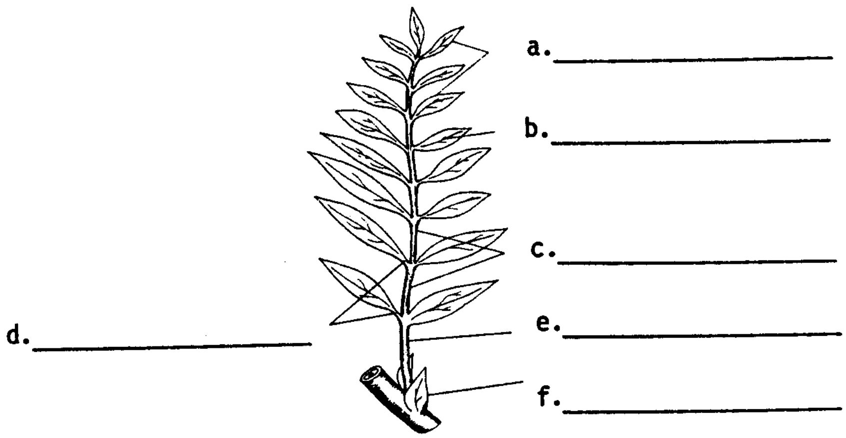
_____e. Division

_____f. Family

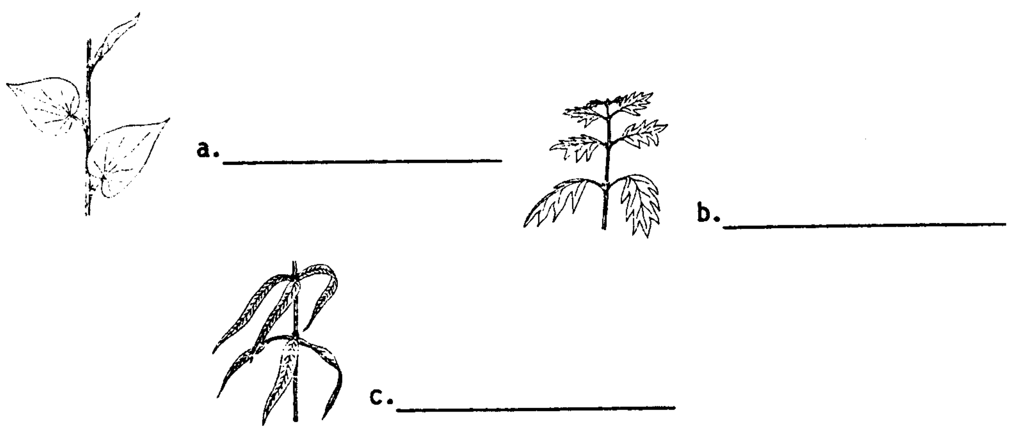
3. Label the parts of a simple leaf. Write the correct names in the blanks.



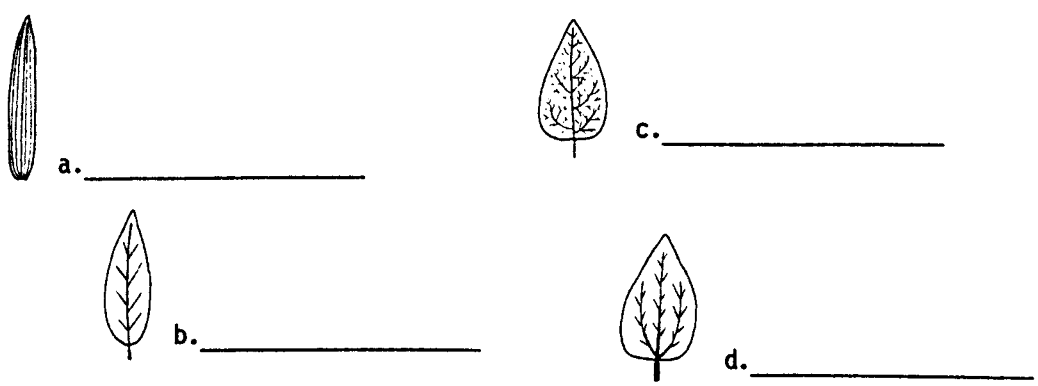
4. Label the parts of a compound leaf. Write the correct names in the blanks.



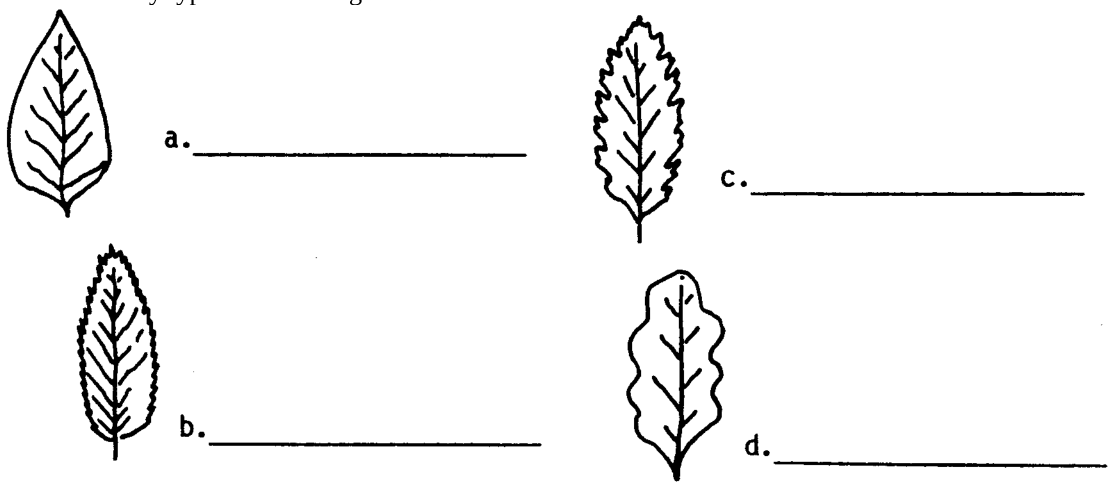
5. Identify types of leaf arrangement. Write the correct names in the blanks.



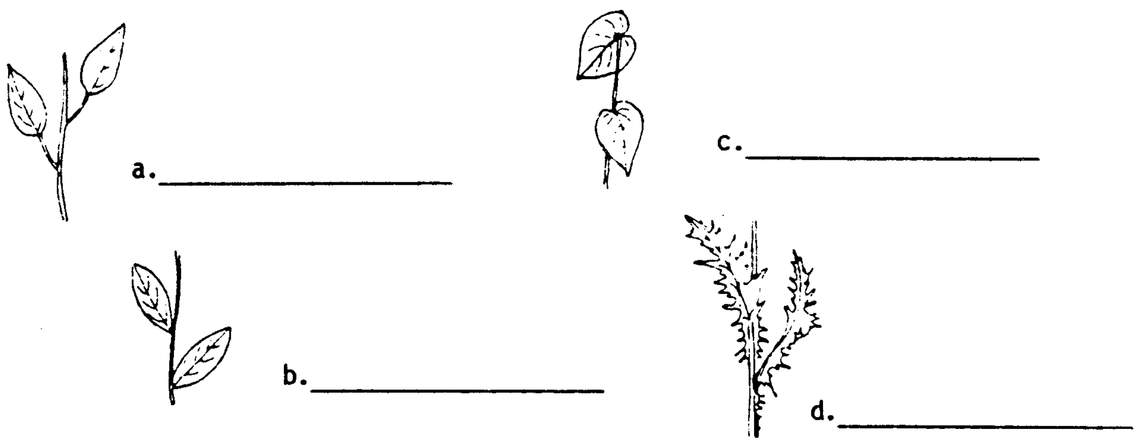
6. Identify types of leaf veination. Write the correct names in the blanks.



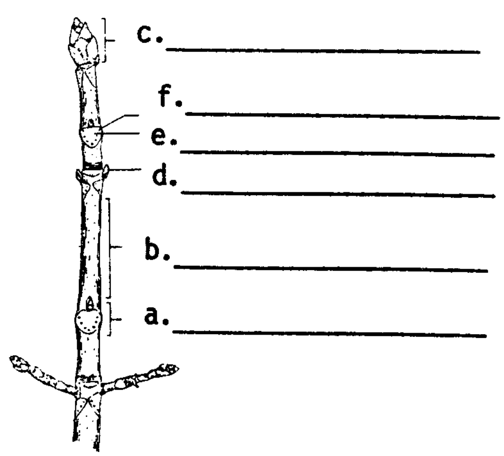
7. Identify types of leaf margins. Write the correct names in the blanks.



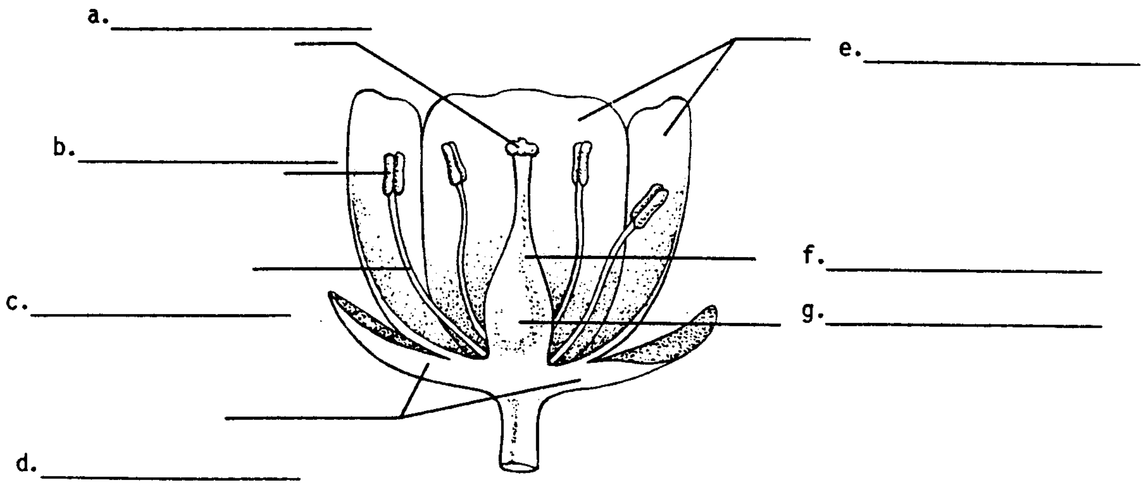
8. Identify types of leaf attachment to the stem. Write the correct names in the blanks.



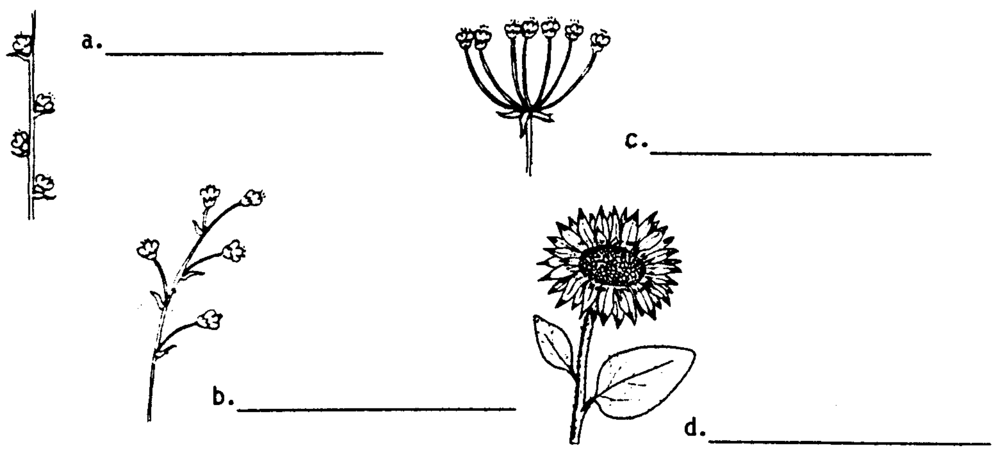
9.Label the parts of a stem. Write the correct names in the blanks.



10. Label the parts of a complete flower. Write the correct names in the blanks.



11. Identify types of inflorescence. Write the correct names in the blanks.



12. Name three natural resources crops and weeds are in competition for.

a. ______________________________

b. ______________________________

c. ______________________________

13. Name three losses caused by weeds.

a. ______________________________

b. ______________________________

c. ______________________________

14. Select from the following list ways that weeds spread. Write an "X" in the blank before each correct answer.

_____a. Irrigation water

_____b. Livestock

_____c. Manure

_____d. Wildflower gatherers

_____e. Farm machinery

_____f. Wind

_____g. Fill soil

_____h. Planting of weed seed

15. Select from the following list methods of cultural weed control. Write an "X" in the blank before each correct answer.

_____a. Cultivation

_____b. Crop rotation

_____c. Burning

_____d. Smother crops

_____e. Use of selective herbicide

_____f. Use of weed-free crop seed

16. Select from the following list methods of mechanical weed control. Write an "X" in the blank before each correct answer.

_____a. Crop rotation

_____b. Discing

_____c. Burning

_____d. Use of contact herbicide

_____e. Use of weed-free crop seed

_____f. Mowing

_____g. Mulching

_____h. Hoeing

17. Match the classifications of herbicides to the correct description. Write the correct numbers in the blanks.

_____a. Kills only part of plant to which it is applied; not translocated

_____b. Applied to soil before crop is planted

_____c. Absorbed by roots or foliage and translocated throughout plant

_____d. Kills all plants present if applied at an adequate rate

_____e. Applied after emergence of the crops or weeds

_____f. Applied prior to emergence but after crop planting

_____g. Used to kill weeds without significant damage to crop

1. Selective
2. Non-selective
3. Contact
4. Systemic
5. Preplant
6. Preemergence
7. Postemergence

18. Discuss biological weed control.

____

____

____

____

____

____

19. Identify the following weed seeds as either prohibitive noxious weed seeds or restricted noxious weed seeds. If the seed is prohibitive noxious, write an "X" in the blank. If it is restricted noxious, write an "O" in the blank.

_____a. Hoary Cress

_____b. Spotted Knapweed

_____c. Dodder

_____d. Canada Thistle

_____e. Buckhorn Plantain

_____f. Quackgrass

_____g. Blue Lettuce

_____h. Medusahead Rye

_____i. Russian Knapweed

_____j. Dalmation Toadflax

_____k. Field Bindweed

_____l. Yellow Starthistle

_____m. Perennial Sowthistle

_____n. Goatgrass

CROP AND WEED IDENTIFICATION

AG 150 - J

ANSWERS TO TEST

1.
a.	20	g.	8	m.	21	s.	3
b.	11	h.	5	n.	2	t.	10
c.	4	i.	14	o.	7	u.	16
d.	1	j.	12	p.	13		
e.	17	k.	6	q.	18		
f.	15	l.	19	r.	9		

2.
a.	3	d.	5
b.	6	e.	1
c.	2	f.	4

3. a. Stipules
   b. Petiole
   c. Veins
   d. Blade

4. a. Leaflets; b. Veins; c. Rachis; d. Petiolule; e. Petiole; f. Stipules

5. a. Alternate; b. Opposite; c. Whorled

6. a. Parallel; b. Pinnate; c. Netted; d. Palmate

7. a. Entire; b. Serrate; c. Incised; d. Lobed

8. a. Petiolate; b. Sessile; c. Clasping; d. Decurrent

9. a. Node; b. Internode; c. Terminal bud; d. Lateral bud; e. Leaf scar; f. Vascular bundle scar

10. a. Stigma; b. Anther; c. Filament; d. Sepal; e. Petal; f. Style; g. Ovary

11. a. Spike; b. Raceme; c. Umbel; d. Head

12. Water; Nutrients; Light

13. Decreased crop yields; Decreased crop quality; Cost of control activities

14. a, b, c, d, e, f, g, h

15. b, d, f

16. b, c, f, g, h

17.

a.	3	e.	7
b.	5	f.	6
c.	4	g.	1
d.	2		

18. Biological weed control--Involves the introduction of a natural enemy to weaken or destroy a particular weed species; insects have achieved the most success, but microorganisms, parasitic plants, animals, birds and fish are also used. The goal is not eradication, but reduction of the weed population to an acceptable level

19.

a.	X	e.	O	i.	X	m.	X
b.	X	f.	X	j.	X	n.	X
c.	O	g.	O	k.	X		
d.	X	h.	O	l.	X		

INSECT PESTS OF CROPS

AG 150 - K

UNIT OBJECTIVE

After completion of this unit, students should be able to list ways that insects cause losses to crops, as well as their beneficial effects. Students should also be able to identify the body regions of an insect and classify insects according to feeding habits. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with insect pests of crops to the correct definition.
2. Name three ways insects cause losses to crops.
3. Select beneficial effects of insects.
4. Discuss the economic importance of insect control.
5. Label a drawing showing the body regions of an insect.
6. Name two characteristics, which aid in distinguishing one insect from another.
7. Name three identifying characteristics of mites, ticks and spiders.
8. Match the insect feeding habit to the correct description.
9. Label a drawing showing the three and four stage life cycles of insects.
10. Select cultural control practices for insects.
11. Select biological control practices for insects.
12. Select chemical control practices for insects.
13. Match classifications of insecticides to the correct description.

INSECT PESTS OF CROPS

AG 150 - K

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

   A. Order materials to supplement unit.

      1. Literature

         a. *Insect Identification Manual*, available from VEP, Cal Poly State University, San Luis Obispo, California 93407; approximate cost $8.25.

         b. *Insect Pest Identification of Corn, Soybeans and Alfalfa*, 50-page manual; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland, Urbana, Illinois 61801; approximate cost $3.50.

         c. *Insect Pests of Field Crops and Stored Grains*, manual; available from Ohio Agriculture Education Curriculum Materials Center, Ohio State University, Columbus, Ohio 43210; approximate cost $4.00; order no. 1016M.

      2. Filmstrips, slideshows, etc.

         a. *Identification and Control of Common Crop Insects*, 49 slides and cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $62.40; order no. D12.

         b. *Identifying Common Insect Pests*, filmstrip or slide set, cassette and study guide; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland, Urbana, Illinois 61801.

   B. Make transparencies and necessary copies of materials.

   C. Provide students with objective sheet and discuss.

   D. Provide students with information sheet and discuss.

   E. Review and give test.

   F. Reteach and retest if necessary.

II. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

D. Transparency masters

1. TM 1--Insects Cause Losses to Crops

2. TM 2--Insect Damage

3. TM 3--Adult Insects

4. TM 4--Wings and Mouthparts

5. TM 5--Mite, Tick and Spider

6. TM 6--Insect Classification According to Feeding Habits

7. TM 7--Four Stage Life Cycle

8. TM 8--Three Stage Life Cycle

E. Test

F. Answers to test

III. Unit references

A. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

B. Farrington, William S., et al., *Fertilizer, Chemicals and Seed*, McGraw-Hill Book Company, New York, 1980.

C. Homan, H.W., et al., *Insects Affecting Idaho Agriculture*, University of Idaho, Moscow, Idaho, 1982.

D. Hughes, H.A., *Crop Chemicals*, 2nd edition, John Deere Technical Services, Moline, Illinois, 1982.

E. *Insect and Disease Control*, Vo-Ag II, Unit IV-D, Teaching Materials Center, Agriculture Education Department, Texas A & M University, College Station, Texas.

F. Romoser, W.S., *The Science of Entomology*, MacMillan Publishing Co., Inc., New York, New York, 1973.

G. Westcott, C., *The Gardener's Bug Book*, 3rd edition, Doubleday and Company, Inc., Garden City, New York, 1964.

INSECT PESTS OF CROPS

AG 150 - K

INFORMATION SHEET

I. Terms and definitions

A. Insect--Small, boneless animal whose body is divided into three sections and has six legs

B. Spider--A small, eight-legged animal having a body composed of two divisions (cephalothorax and abdomen); the spider is an arachnid, not an insect

C. Mite--Any of a large number of tiny arachnids, many of which live as parasites upon plants

D. Entomology--A branch of science that deals with the study of insects

E. Life cycle--Stages in the life development of an insect

F. Metamorphosis--A change in form, either gradual or sudden

G. Complete metamorphosis--Having four distinct growth stages in development in which a major change in structure and appearance of the insect occurs; each feeding life stage may eat different diets and occupy different environments

H. Incomplete metamorphosis--Gradual change in appearance as growth proceeds; the immature forms are called nymphs and eat the same as the adults

I. Larva--Immature form of an insect having complete metamorphosis

J. Pupa--Stage between the larva and adult in insects with complete metamorphosis

K. Cocoon--A silken case inside which the pupa is formed

L. Nymph--The immature stage of an insect with incomplete metamorphosis

M. Damage--Associated with crop loss and/or reduction in crop yield or crop quality

N. Injury--Deviation from normal appearance of the plant, from which it may recover and not depress yield and/or quality

O. Pesticide--Chemical used to control pests

P. Insecticide--A pesticide used to kill or control insects

Q. Acaricide--Pesticide used to kill or control mites, ticks and spiders

II. Ways insects cause losses to crops (Transparencies 1, 2)

A. Reduce crop yield

B. Reduce quality of the crop

C. Cost of control practices

D. Transmit plant diseases

(Note: Insects may cause damage or injury depending on seriousness of infestation and the effectiveness of control measures.)

III. Beneficial effects of insects

A. Carry pollen for pollination, which is essential to seed production of many crops

B. Natural enemies, which control pest insects

C. Production of useful products

1. Honey

2. Beeswax

3. Silk

IV. Economic importance of insect control

A. $1 billion spent annually on insect control

B. $5 billion estimated losses

C. Estimated 5% - 10% of total crop damaged

D. Over $100 million spent yearly on cotton alone

V. Body regions of an insect (Transparency 3)

A. Head--Bears one pair of antennae and mouth parts

B. Thorax--Bears three pairs of legs and often bears wings

C. Abdomen--Has as many as eleven segments, but never bears legs

(Note: Characteristics common to all adult insects include six jointed legs and three body regions.)

VI. Characteristics, which distinguish one insect from another (Transparency 4)

A. Wings

(Note: Some insects have no wings; others have two or four. The wings vary in shape, size, thickness and structure.)

B. Mouthparts

(Note: Insects with chewing mouthparts have toothed jaws that bite and tear the food. Insects with piercing-sucking mouthparts have tube-like beaks which they force into a plant to suck out fluids.)

VII. Characteristics of mites, ticks and spiders (Transparency 5)

A. Eight jointed legs

B. Two body regions

C. No wings

VIII. Insect classification by feeding habits (Transparency 6)

A. Chewing

(Note: These insects bite off, chew and swallow plant parts. This results in ragged, deformed or stunted plants that may be more susceptible to disease and may die due to excessive damage.)

1. Grasshopper

2. Armyworm

3. Potato beetle

4. Blister beetle

B. Sucking

(Note: These insects pierce the outer layer of the plant tissue with their "coke straw" beak and feed on the plant sap.)

1. Aphid

2. Leafhopper

3. Thrips

4. Hessian Fly

5. Greenbug

C. Internal (borers and miners)

(Note: This group includes mostly chewing insects that enter the plant and feed from within.)

1. European corn borer

2. Cotton boll weevil larva

3. Wheat stem sawfly

D. Subterranean

(Note: This group includes both chewing and sucking insects, which enter the plant below the soil surface.)

1. Corn rootworm

2. Wireworm

IX. Life cycles of insects

(Note: Because insects live inside a chitinous exoskeleton, which cannot be expanded as they grow, they progress by a series of molts, splitting and casting off the old shell. Between the time the insect pulls free from its old covering and before the new form is solidified, there is a chance for expansion in size. There may be 3, 4, 5 or even 20 molts depending on the species. The adult insect never increases in size; growth is always in the immature life stage.)

A. Four stage group (complete metamorphosis) (Transparency 7)

(Note: Insects in this group include beetles, flies, moths, bees and butterflies.)

1. Egg

2. Larva

3. Pupa

4. Adult

B. Three stage group (incomplete metamorphosis) (Transparency 8)

(Note: Insects in this group include grasshoppers, aphids, termites, dragonflies and mayflies.)

1. Egg

2. Nymph

3. Adult

X. Cultural control practices for insects

A. Crop rotation

B. Trap crops

(Note: Small plots of a host plant the insect favors near susceptible crop. After insects have been attracted to the "trap", they can be killed by burning or with an insecticide.)

C. Tillage

D. Residue management

(Note: Shredding and incorporating of crop residue helps eradicate plant-borne insects.)

E. Timing of operations

(Note: Proper timing of planting or harvesting operations can be used to control insect damage if the host plant is resistant or susceptible for a brief period or if the damaging stage of the insect's life cycle is out of synchronization with the plant's development.)

F. Resistant varieties

(Note: This involves selection of plants less damaged by the insects and plants that are more vigorous so it is better able to resist insect attacks.)

XI. Biological control practices for insects--Natural enemies to a particular insect

(Note: The use of natural enemies, for example: predators, parasites and insect disease, sometimes can be used to control a pest.)

XII. Chemical control practices for insects

(Note: Chemicals may be applied to seeds, growing plants or soil. Effectiveness depends on the characteristics of the chemical, susceptibility of the insect, plus the timing and method of application.)

A. Poison the insects

B. Repel the insects from specific areas

C. Attract insects to a place where they can be killed

XIII. Classifications of insecticides

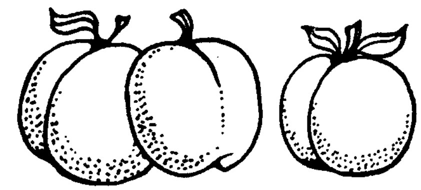
A. Fumigant poison--Enters the insect's body through the respiratory system in the form of a gas

B. Stomach poison--Eaten and digested by the insect

C. Contact poison--Absorbed through the insect's skin or body wall and acts upon the pest's nervous system

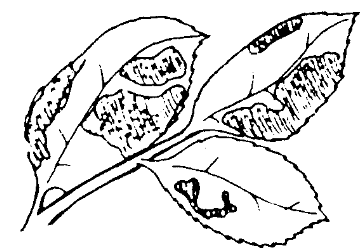
Insects Cause Losses to Crops

Reduce Crop Yield



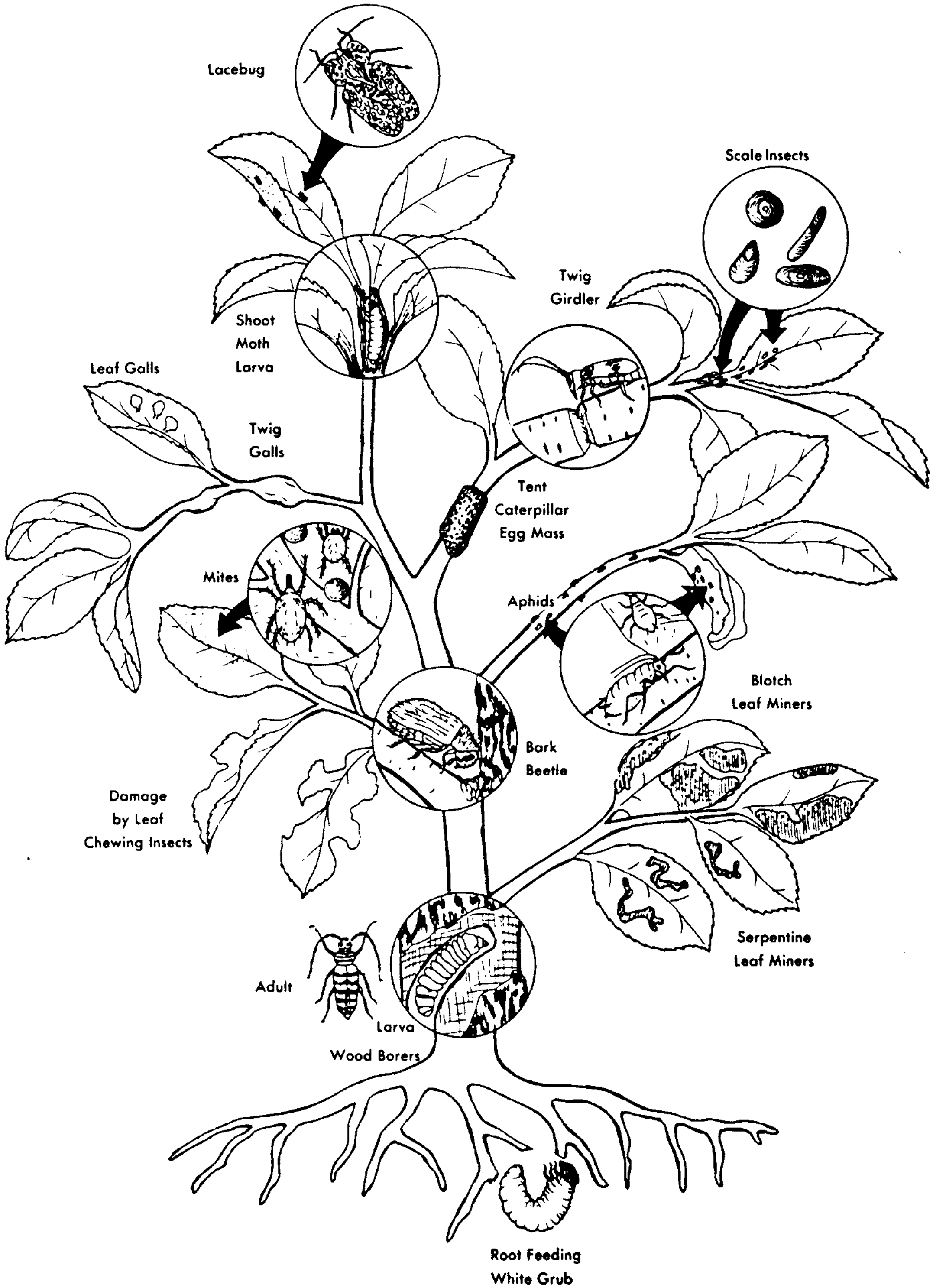
Reduce Quality of the Crop

Cost of Control Activities

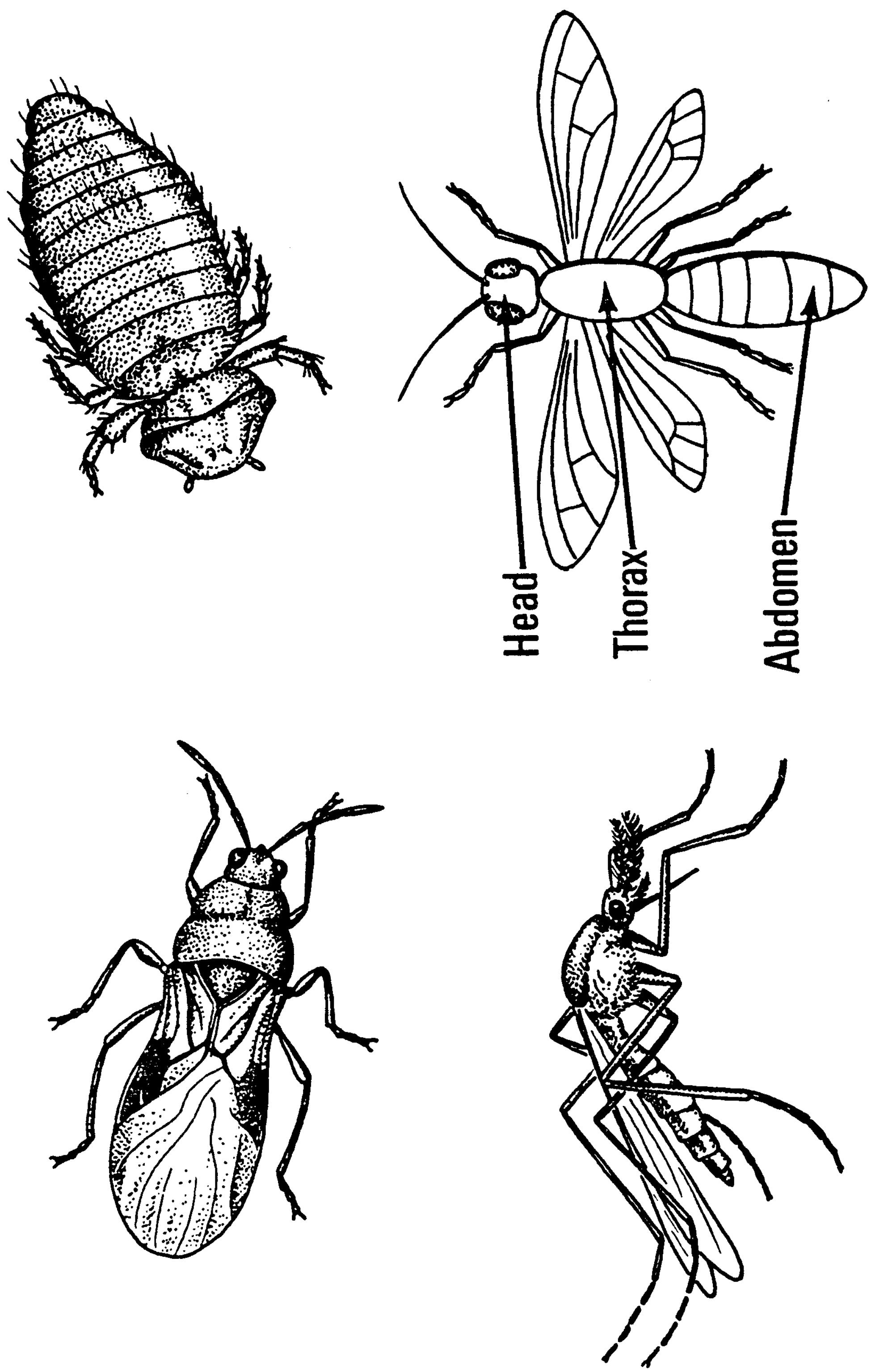


Transmit Plant Disease

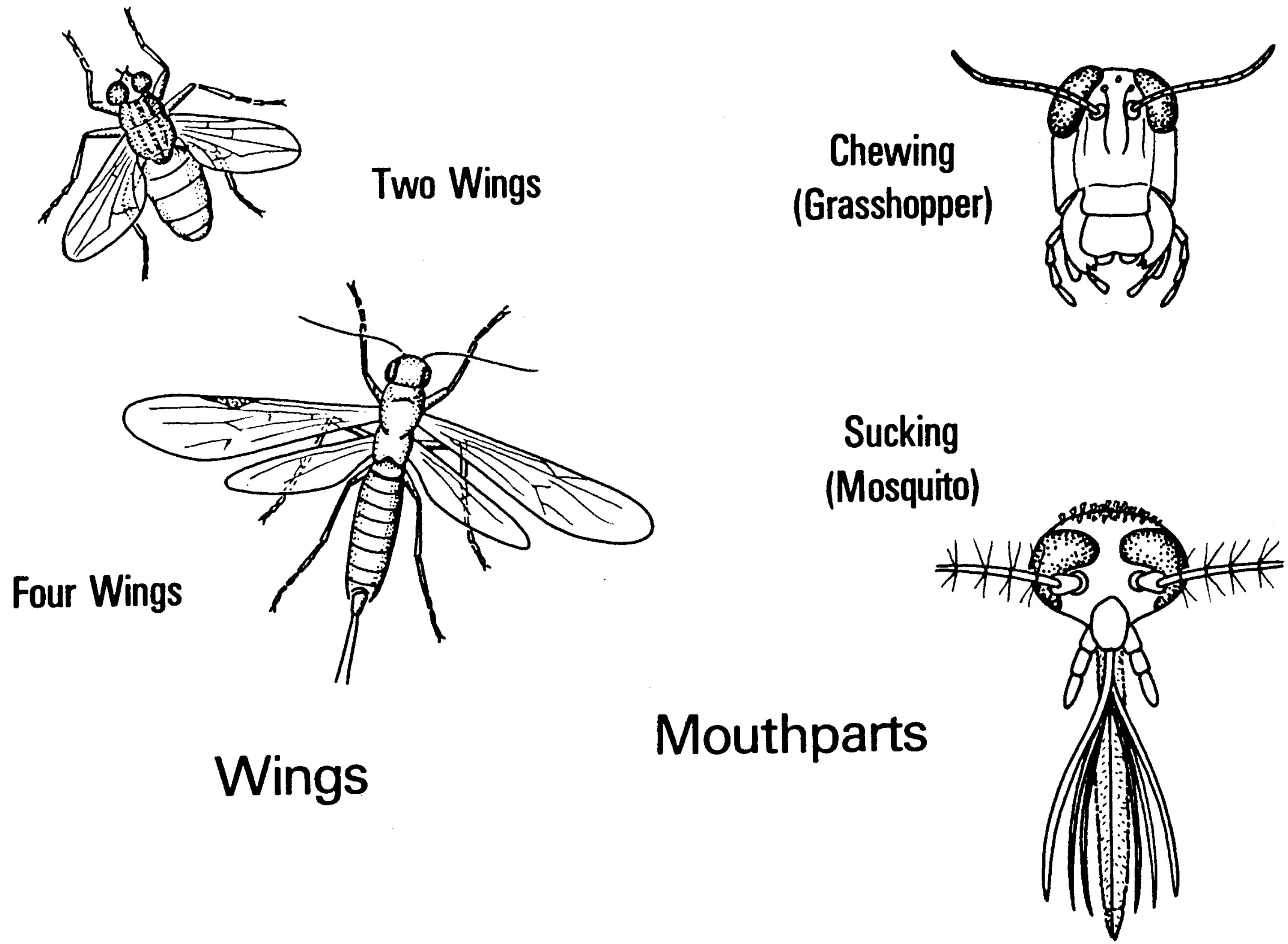
Insect Damage



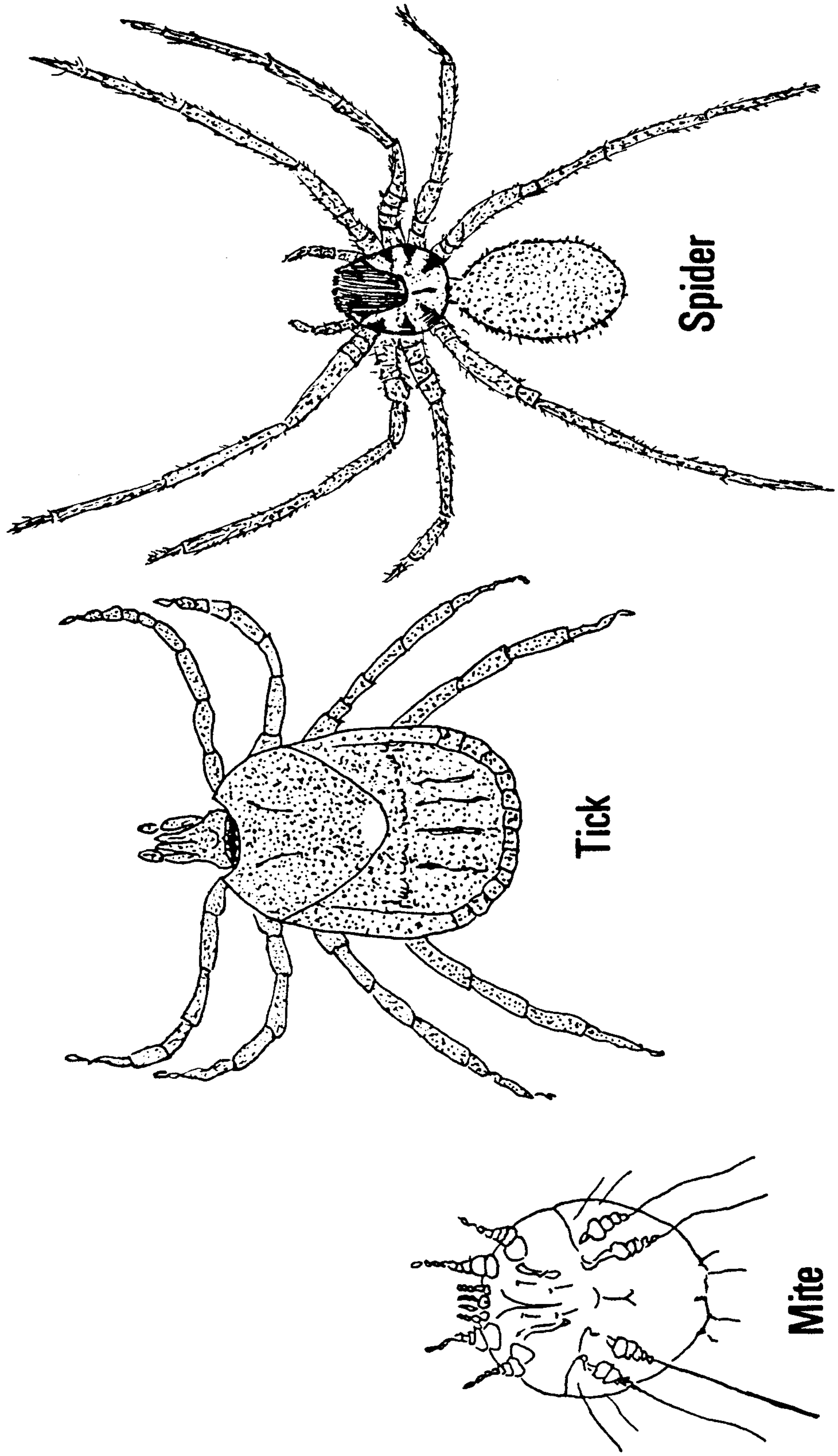
Adult Insects



Wings and Mouthparts



Mite, Tick, and Spider

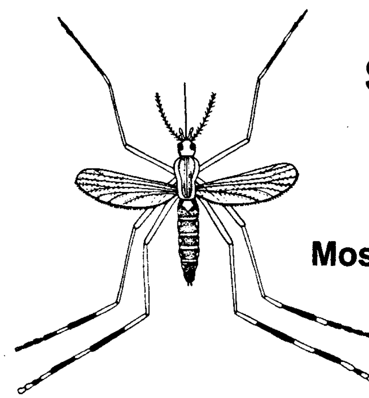


Insect Classification According to Feeding Habits

Chewing

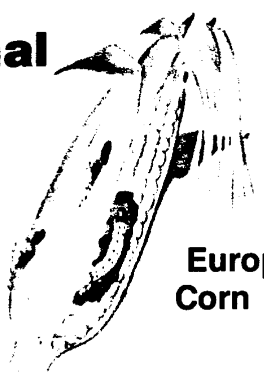
Colorado Potato Beetle

Sucking



Mosquito

Internal

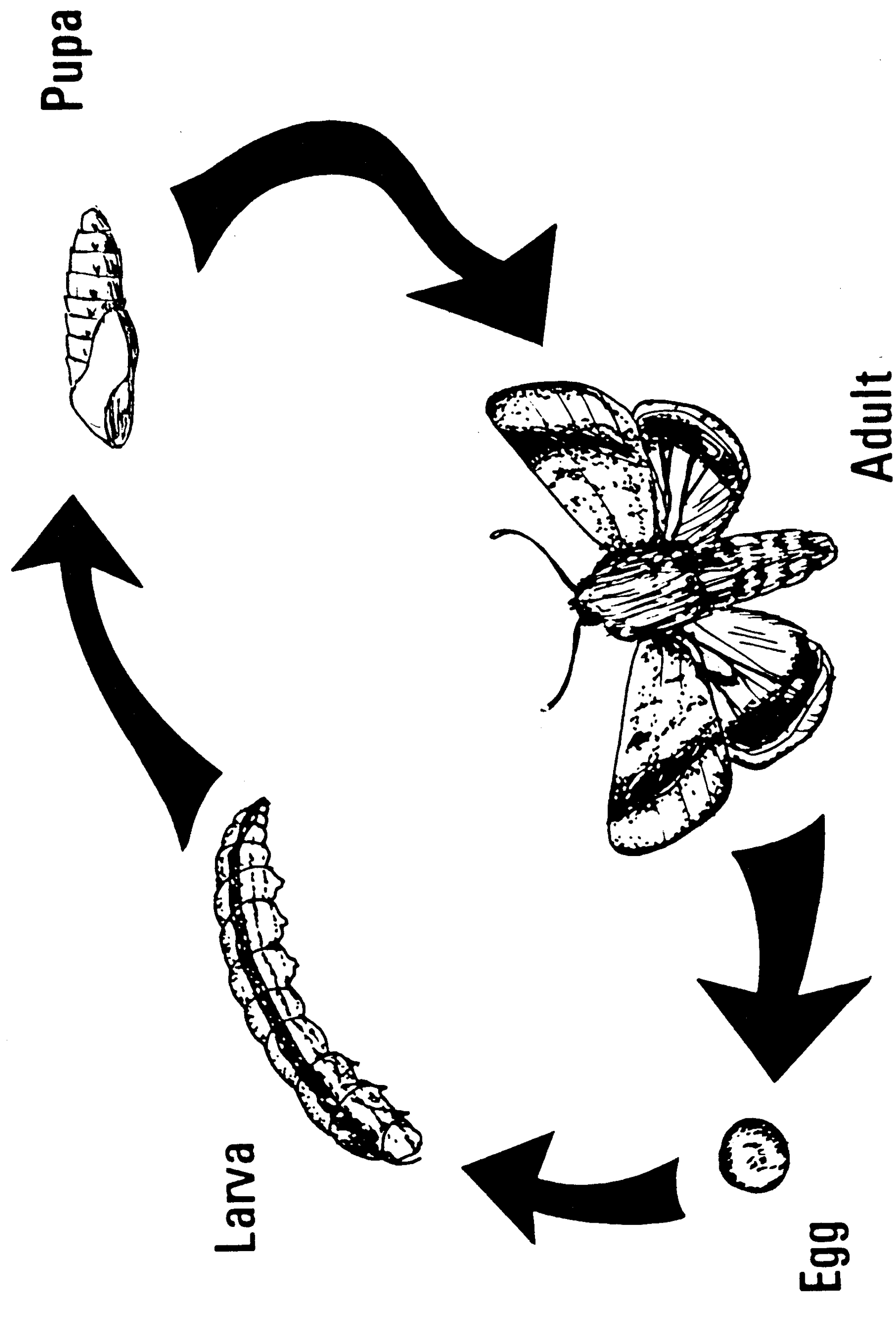


European Corn Borer

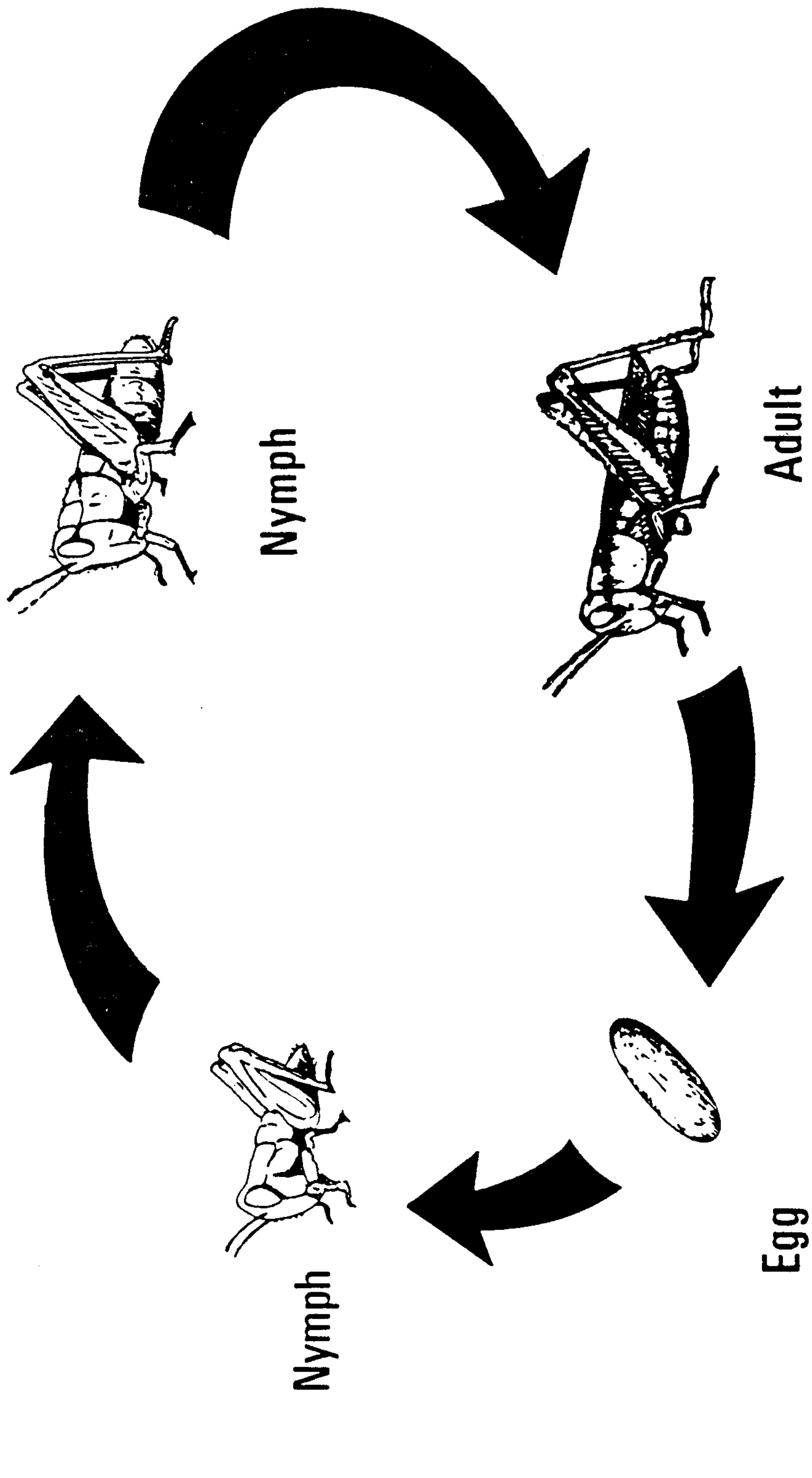
Subterranean

Wireworm

Four Stage Life Cycle



Three Stage Life Cycle



INSECT PESTS OF CROPS

AG 150 - K

UNIT TEST

Name ____ Score_______________________________

1. Match terms associated with insect pests of crops to the correct definition. Write the correct numbers in the blanks.

_____a. A change in form, either gradual or sudden

_____b. A silken case inside which the pupa is formed

_____c. Stages in the development of an insect

_____d. Chemical used to control pests

_____e. Any of a large number of tiny arachnids, many of which live as parasites upon plants

_____f. Immature form of an insect having complete metamorphosis

_____g. Associated with crop loss and/or reduction in crop yield or crop quality

_____h. A branch of science that deals with the study of insects

_____i. A small, eight legged arachnid having a body composed of two divisions

_____j. Gradual change in appearance as growth proceeds

_____k. Stage between the larva and adult in insects with complete metamorphosis

_____l. A pesticide used to kill or control insects

_____m. Having four distinct growth stages in development in which a major change in structure and appearance of the insect occurs

_____n. The immature stage of an insect with incomplete metamorphosis

_____o. Deviation from normal appearance of the plant, from which it may recover and not depress yield and/or quality

1. Insect
2. Spider
3. Mite
4. Entomology
5. Life cycle
6. Metamorphosis
7. Complete metamorphosis
8. Incomplete metamorphosis
9. Larva
10. Pupa
11. Cocoon
12. Nymph
13. Damage
14. Injury
15. Pesticide
16. Insecticide
17. Acaricide

_____p. Pesticide used to control mites, ticks and spiders

_____q. Small, boneless animal whose body is divided into three sections and has six legs

2. Name three ways insects cause losses to crops.

a. ____

b. ____

c. ____

3. Select from the following list beneficial effects of insects. Write an "X" in the blank before each correct answer.

_____a. Silk production

_____b. Spread plant disease

_____c. Lower crop quality

_____d. Natural enemies of harmful insects

_____e. Honey

_____f. Pollination

4. Discuss the economic importance of insect control.

____

____

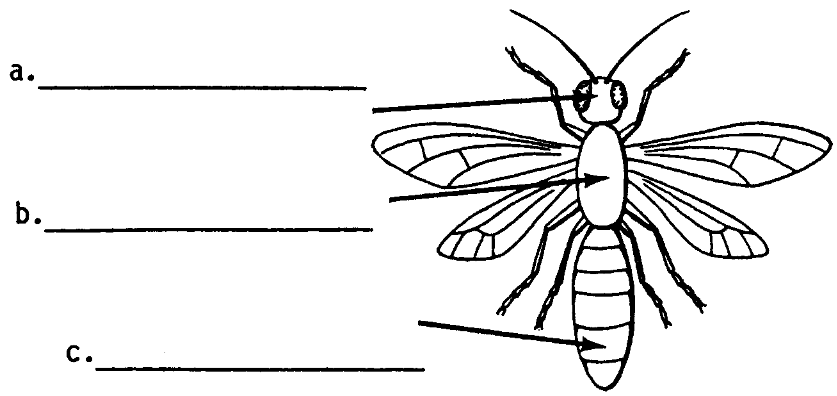
____

____

____

____

5. Label the body regions of an insect. Write the correct names in the blanks.



6. Name two characteristics, which aid in distinguishing one insect from another.

a. ____

b. ____

7. Name three identifying characteristics of mites, ticks and spiders.

a. ____

b. ____

c. ____

8. Match the insect feeding habit to the correct description. Write the correct numbers in the blanks.

_____a. This group includes mostly chewing insects that enter the plant and feed from within; European corn borer

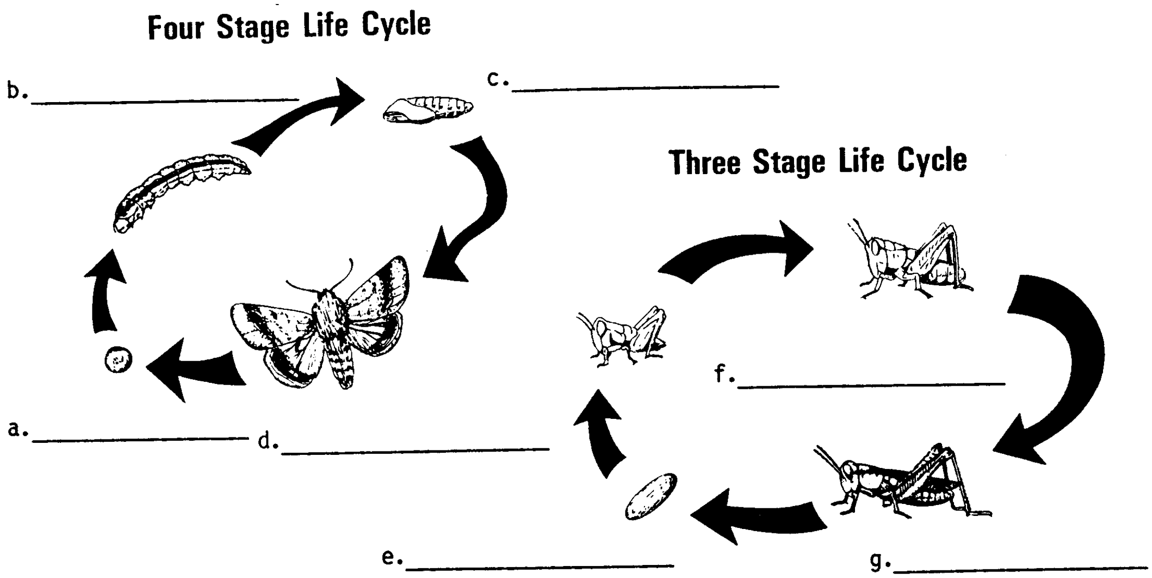
_____b. These insects pierce plant tissue with their "coke straw" beak and feed on plant fluids; aphids

_____c. These insects bite off, chew and swallow plant parts; potato beetle

_____d. This group includes both chewing and sucking insects which feed on the plant below the soil surface; wireworm

1. Chewing
2. Sucking
3. Internal
4. Subterranean

9. Label the life cycles of insects. Write the correct names in the blanks.



10. Select from the following list cultural control practices for insects. Write an "X" in the blank before each correct answer.

_____a. Discing under grain stubble

_____b. Crop rotation

_____c. Use of natural enemies to control insects

_____d. Application of insecticides

_____e. Trap crops

_____f. Use of crop varieties resistant to insects

_____g. Proper timing of planting or harvesting operations

11. Select from the following list biological control practices for insects. Write an "X" in the blank before each correct answer.

_____a. Application of pesticide to infected area

_____b. Discing under grain stubble

_____c. Proper timing of tillage operations

_____d. Use of resistant crop varieties

_____e. Shredding of crop residue

_____f. Use of natural enemies

12. Select from the following list chemical control practices for insects. Write an "X" in the blank before each correct answer.

_____a. Application of malathion to control aphids

_____b. Crop rotation

_____c. Soil application of Temik to control potato insects

_____d. Trap crops to attract insects

_____e. Insecticide application to infected crop

_____f. Use of resistant crop varieties

13. Match classifications of insecticides to the correct description. Write the correct numbers in the blanks.

_____a. Eaten and digested by the insect

_____b. Enters through the respiratory system in the form of a gas

_____c. Absorbed through the skin or the body wall of the insect and acts upon the pest's nervous system

1. Fumigant poison
2. Stomach poison
3. Contact poison

INSECT PESTS OF CROPS

AG 150 - K

ANSWERS TO TEST

1.

a.	6	f.	9	k.	10	p.	17
b.	11	g.	13	l.	16	q.	1
c.	5	h.	4	m.	7		
d.	15	i.	2	n	12		
e.	3	j.	8	o.	14		

2. Answer should include three of the following:

   Reduce crop yield; Reduce crop quality; Cost of control activities; Transmit plant disease

3. a, d, e, f

4. Answer may include information from the following:

   $1 billion spend annually on insect control; $5 billion estimated losses; Estimated 5% - 10% of total crop damaged; Over $100 million spent yearly on cotton alone

5. a. Head
   b. Thorax
   c. Abdomen

6. Wings; Mouthparts

7. Eight jointed legs; two body regions; No wings

8. a. 3 b. 2 c. 1 d. 4

9.

a.	Egg	e.	Egg
b.	Larva	f.	Nymph
c.	Pupa	g.	Adult
d.	Adult		

10. a, b, e, f, g

11. f

12. a, c, e

13. a. 2 b. 1 c. 3

PLANT DISEASE IDENTIFICATION AND CONTROL

AG 150 - L

UNIT OBJECTIVE

After completion of this unit, students should be able to match terms and definitions, list the five groups of biological pathogens and discuss methods of prevention and control of plant disease. This knowledge will be demonstrated by completion of the unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with plant disease to the correct definitions.
2. Name three ways diseases cause economic loss in plants.
3. List the five groups of biological pathogens.
4. Match the two types of fungi to the correct description.
5. List three methods by which pathogens spread.
6. Match the general approaches to disease control to the correct descriptions.
7. List three primary disease control methods available to the farmer.
8. Select practices used to control plant diseases.
9. Select diseases caused by fungal infection.
10. Select diseases caused by bacterial infection.
11. Select diseases caused by viral infection.
12. Select diseases caused by nematode infection.
13. Select diseases caused by mycoplasm infection.

PLANT DISEASE IDENTIFICATION AND CONTROL

AG 150 - L

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Field Crop Diseases*, manual available from Ohio Agriculture Education Curriculum Materials Center, Ohio State University, Columbus, Ohio 43210; approximate cost $3.00; order no. 1017M.

2. Filmstrips, slideshows, etc.

a. *Symptomology and Control of Common Crop Disease*, 107 slides and cassette; available from Hobar Publications, 1234 Tiller Lane, St. Paul, Minnesota 55112; approximate cost $145.60; order no. D12.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information sheet and discuss.

E. Invite local extension agent or crop specialist to speak to class on local diseases and control practices.

F. Review and give test.

G. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Biological Pathogens

2. TM 2--Means by Which Pathogens Spread

3. TM 3--Symptoms of Diseases

4. TM 4--Fungi

5. TM 5--Fungi

6. TM 6--Bacterial Diseases

7. TM 7--Bacterial Diseases - Cotton Leaf Blight

8. TM 8--Viruses

9. TM 9--Nematodes

E. Test

F. Answers to test

III. Unit references

A. Delorit, R.J., et al., *Crop Production*, 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

B. Hartmann, Hudson T., et al., *Plant Science - Growth, Development, and Utilization of Cultivated Plants*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632, 1988.

C. *Insect and Disease Control*, Vo-Ag II, Unit IV-D, Vocational Instructional Services, Texas A & M University, College Station, Texas.

D. *Plant Diseases*, Ag II, Unit VIII, Oklahoma State Board for Vocational-Technical Education, Oklahoma State University, Stillwater, Oklahoma.

PLANT DISEASE IDENTIFICATION AND CONTROL

AG 150 - L

INFORMATION SHEET

I. Terms and definitions

A. Plant disease--An abnormal plant condition caused by a pathogen or improper environmental condition

B. Pathogen--A disease-producing agent

C. Host--Plant that is susceptible to a pathogen

D. Fungi--Small filamentous organisms that lack chlorophyll and which cause rots, mildews and other diseases

E. Bacteria--A single-celled microscopic organism

F. Nematode--Tiny, tubular, unsegmented, eel-like worms that feed on plant parts

G. Nematicide--Pesticide used to control nematodes

H. Virus--A submicroscopic entity consisting of nucleic acids and amino acids capable of causing mosaic and other diseases

I. Blight--Rapid discoloration and death of tissue over certain portions of the plant

J. Fungicide--Chemical or biological material used to kill or destroy fungi

K. Resistant--Inherited ability of a plant to retard growth of disease-causing organisms

L. Scab--Crust-like, diseased lesion produced as a result of disease infection

M. Lesion--A localized area of discolored diseased tissue

N. Wilt--Loss of freshness and drooping leaves

O. Gall--Knob on the plant parts produced by certain nematodes, bacteria or fungi causing stunting, chlorosis, necrosis, malformations and may result in reduction of yield or quality

P. Chlorosis--Loss of green color (yellowing or whitening) in foliage

Q. Symptom--Evidence or indicator of disease; reaction of a plant to a pathogen

R. Necrosis--Death of plant parts

S. Sign--Visible evidence of the pathogen

II. Diseases cause economic loss in plants

A. Reduced yield

B. Reduced crop quality

C. Spoilage in storage and transportation

D. Render food unfit for use

E. Cost of control activities

III. Groups of biological pathogens (Transparency 1)

A. Fungi

B. Bacteria

C. Virus and viroids

D. Nematodes

E. Mycoplasmas

IV. Types of fungi

A. Saprophytic fungi--Fungi that live on dead or decaying organic matter

(Note: They are important because they eventually release the nutrients they take from dead plants and animals, thus contributing to soil fertility. Some species, such as mushrooms and truffles, are edible and of considerable economic importance.)

B. Parasitic fungi--Fungi that live on or in a living host plant; may be obligate or non-obligate parasites

(Note: About 7500 parasitic fungi are of economic importance because of the damage and yield reduction in affected crops.)

V. Means by which pathogens spread (Transparency 2)

A. Wind

B. Rain

C. Insects, mites

D. Machinery

VI. General approaches to disease control (Transparency 3)

(Note: Satisfactory control of most plant diseases requires the application of several control measures and usually involves an integrated program of environmental, biological and chemical factors. Correct diagnosis is essential to plant disease control. Then, control involves the application of one or more of the following principles.)

A. Avoidance--Avoiding disease by planting when and/or where pathogens are ineffective or absent

B. Exclusion--Keeping pathogens out of a "clean" area

C. Eradication--Eliminating the pathogen source, whether an infected plant, field or region

D. Protection--Preventing an infection by using a chemical or physical barrier to keep pathogens out

E. Resistance--Using plants that tolerate, resist or are immune to the disease

F. Therapy--Reducing the severity of disease in an infected plant

VII. Primary disease control methods available to the farmer

A. Cultural practices

(Note: Crop management to minimize development of disease is the oldest and most applicable approach. A pathogen and its host must be brought together under proper environmental conditions for a disease to develop. Cultural practices are used to alter the environment, the condition of the host or the behavior of the pathogen to prevent an infection.)

B. Control through disease resistance

(Note: Resistant varieties have been one of the major factors in maintaining high levels of crop productivity in the United States. For many diseases of forage and field crops with relatively low values per acre, chemical controls often cannot be used because the profit margin is too low. For these cases, resistant varieties provide the only means of ensuring continued protection.)

C. Chemical control

(Note: The use of fungicides is dependent on the crop, the disease and the specific conditions for use. For specific recommendations, contact your county extension agent or chemical supplier. For best results, the chemicals should be used with other control methods in a planned strategy.)

VIII. Practices used to control plant diseases

A. Use of resistant varieties

B. Eradication of alternate host plants

C. Treatment of soil

D. Rotation of crops

E. Destruction of plant residue

F. Use of disease-free seed

G. Applications of fungicides

IX. Diseases caused by fungal infection (Transparencies 4, 5)

A. Rusts--Wheat, oats, barley, rye

B. Powdery mildew--Grains, legumes

C. Downey mildew--Grains, alfalfa, onions, cucumbers

D. Smuts--Corn, wheat, oats, barley, grasses

E. Ergot--Rye, wheat, barley and other grasses

F. Scab--Barley, wheat, rye

G. Seed decay, damping off, root rots--All plants

H. Wilts--Potatoes, alfalfa, trees

I. Soft rots, dry rots--Fleshy organs, potatoes, onions, carrots, etc.

J. Scab--Potatoes

K. Cankers--Woody plants

X. Diseases caused by bacterial infection (Transparencies 6, 7)

A. Bacterial wilts--Corn, alfalfa, potatoes

B. Galls--Crown gall on many crops, trees

C. Leaf spot--Cotton, beans, peas, trees

D. Blights--Vegetable crops, fruit trees

E. Cankers--Woody plants

F. Soft rots--Fleshy or succulent plant parts

XI. Diseases caused by viral infection (Transparency 8)

A. Mosaic--Tomatoes, potatoes, beans, corn, small grains, forage, legumes, peas, sugar beets, cucurbits

B. Curly top--Tomato, beans, sugar beets

C. Yellows--Barley yellow dwarf, potato leaf roll, sugar beet yellows

XII. Diseases caused by nematode infections (Transparency 9)

A. Galls--Root-knot nematodes; over 2,000 hosts

B. Hairy root--Cyst nematodes; sugar beets, soybeans, potatoes

C. Root lesions--Lesion nematodes; over 2,000 hosts

D. Necrosis, stunting--Foliar nematodes; alfalfa, clover, onions

XIII. Diseases caused by mycoplasmas

A. Aster yellows--Several hosts

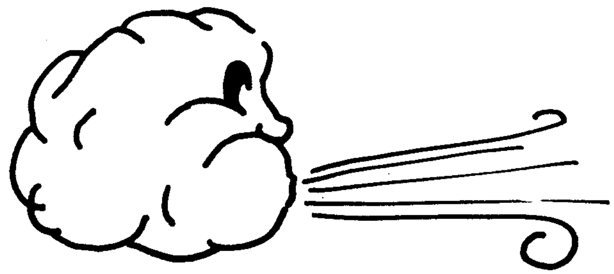
B. Pear decline--Pears

C. Western X--Stone fruit trees

Biological Pathogens

1. Fungi
2. Bacteria
3. Virus and viroids
4. Nematodes
5. Mycoplasmas

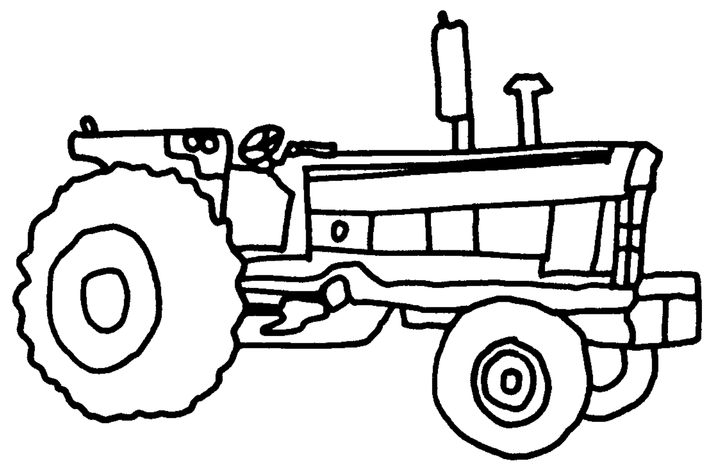
Means by Which Pathogens Spread



Wind

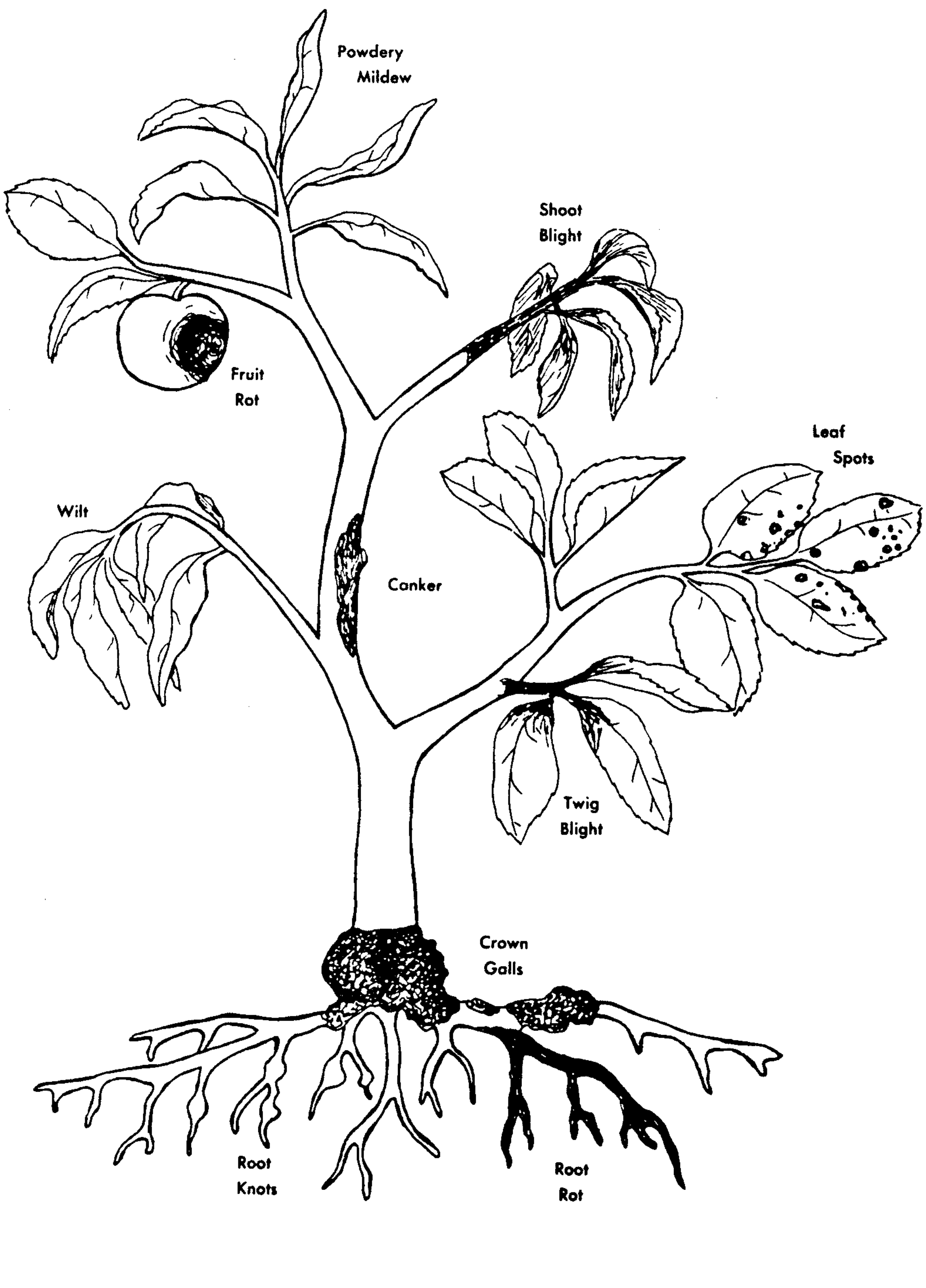
Insects

Rain

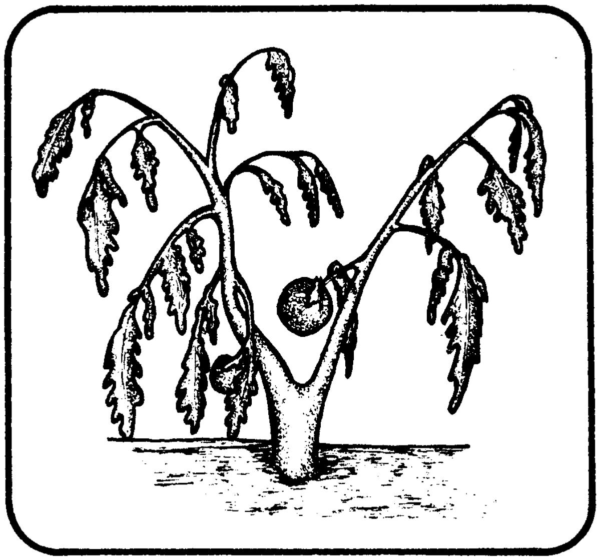


Machinery

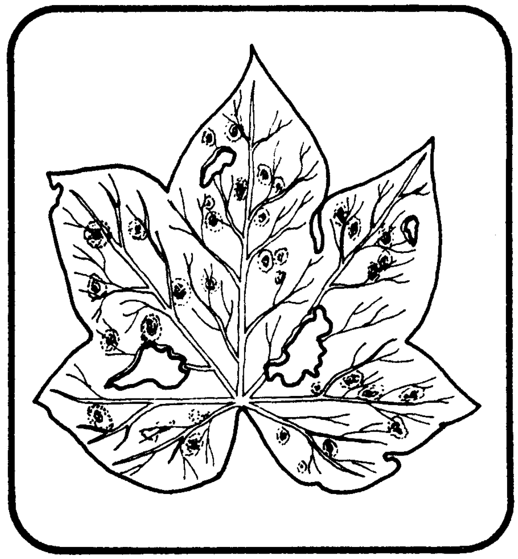
Symptoms of Diseases



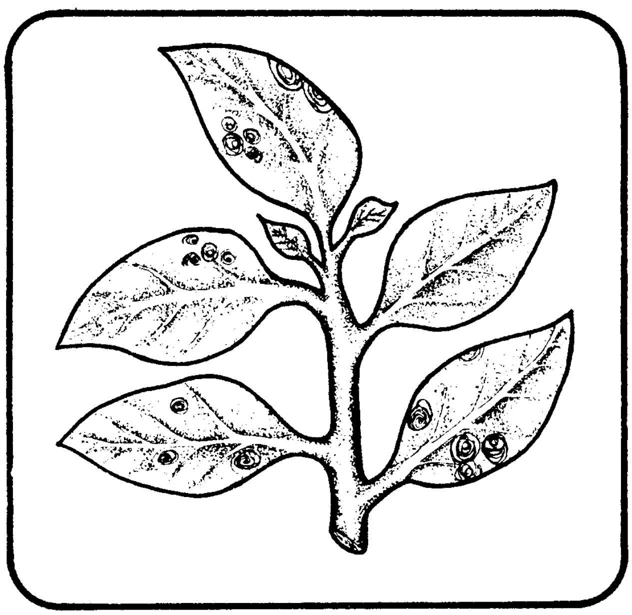
FUNGI



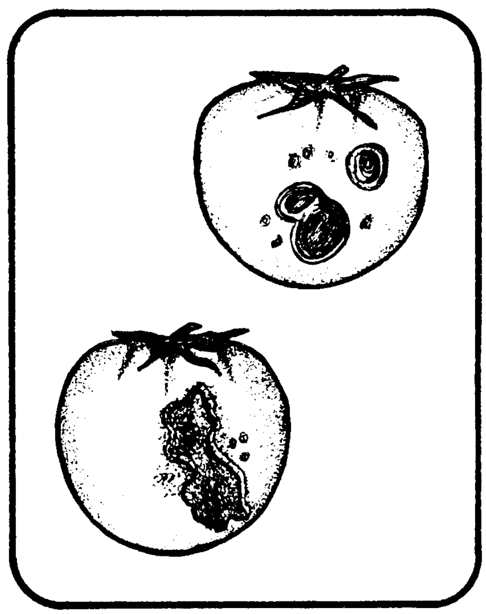
WILT - CAUSED BY FUNGI ENTERING ROOT AND STEM



RUST ON COTTON

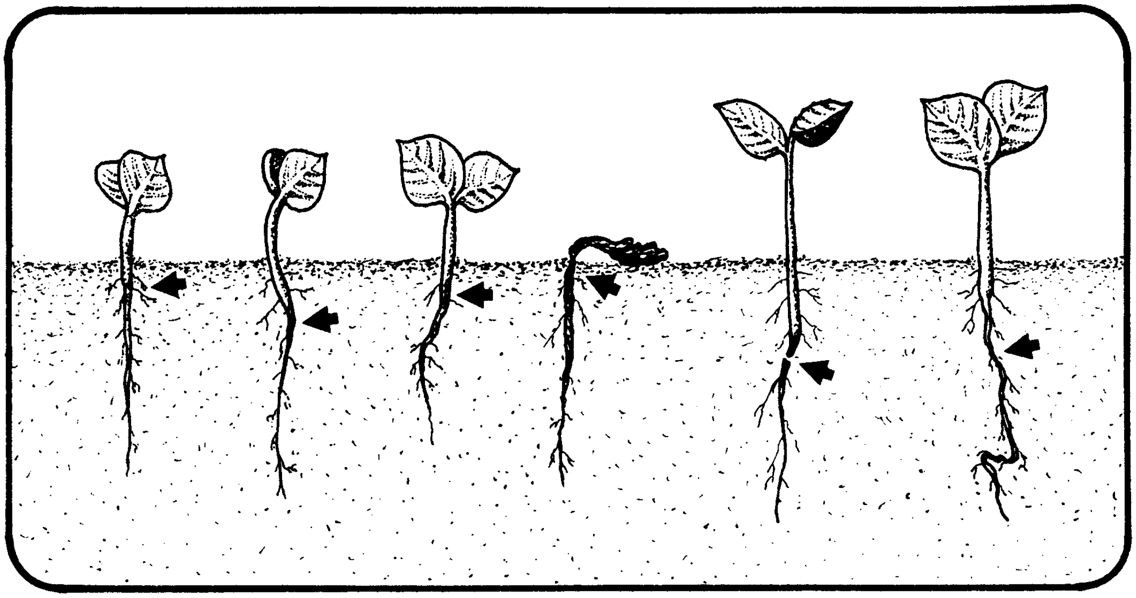


LEAF SPOT - OR EARLY BLIGHT

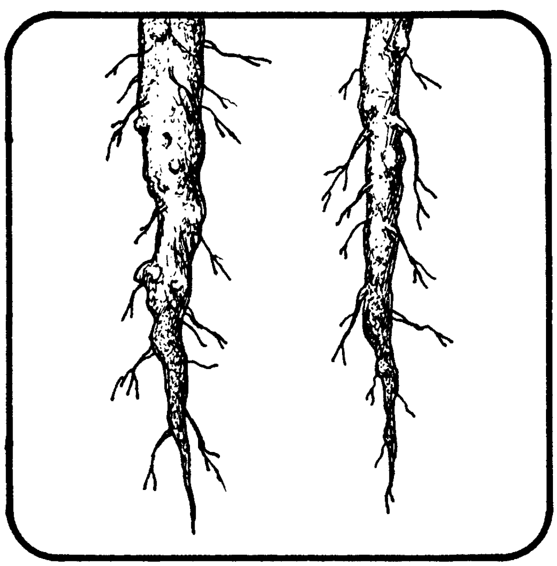


SOIL ROT IN WET SOIL

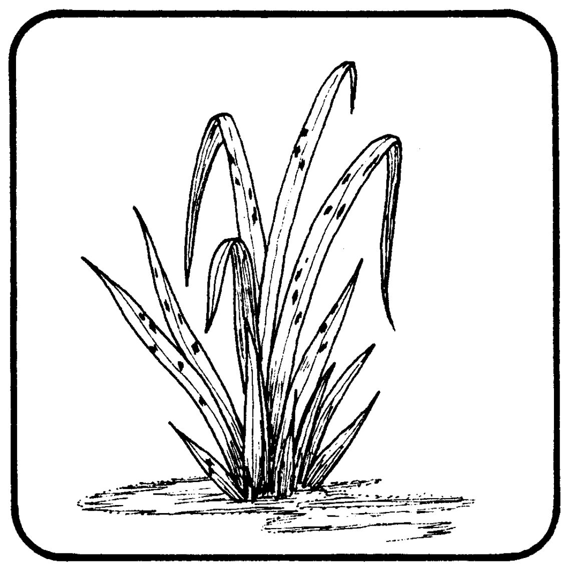
FUNGI



YOUNG PLANT ROOTS DESTROYED BY FUNGI

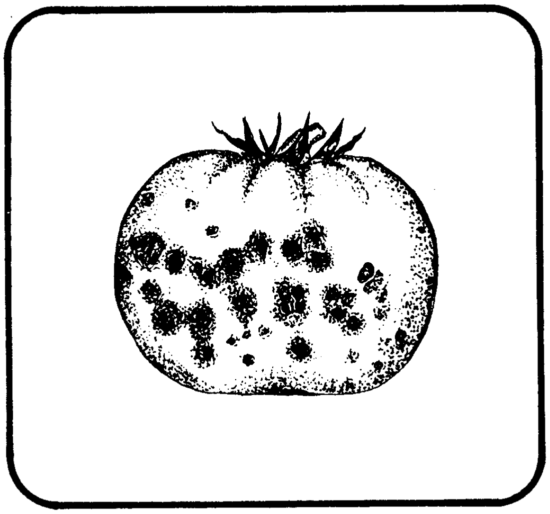


COTTON ROOT ROT

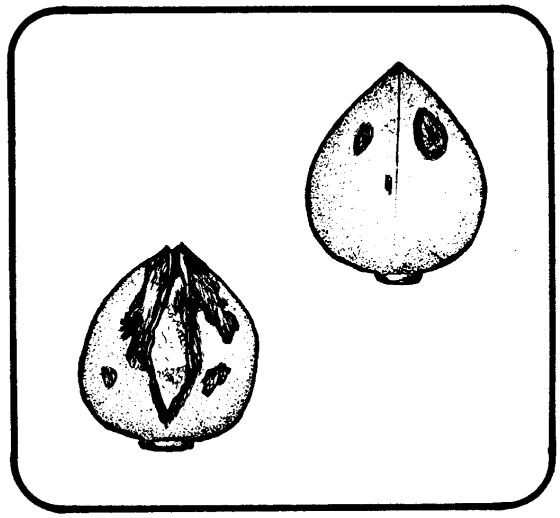


RUST FUNGUS ON GRASS

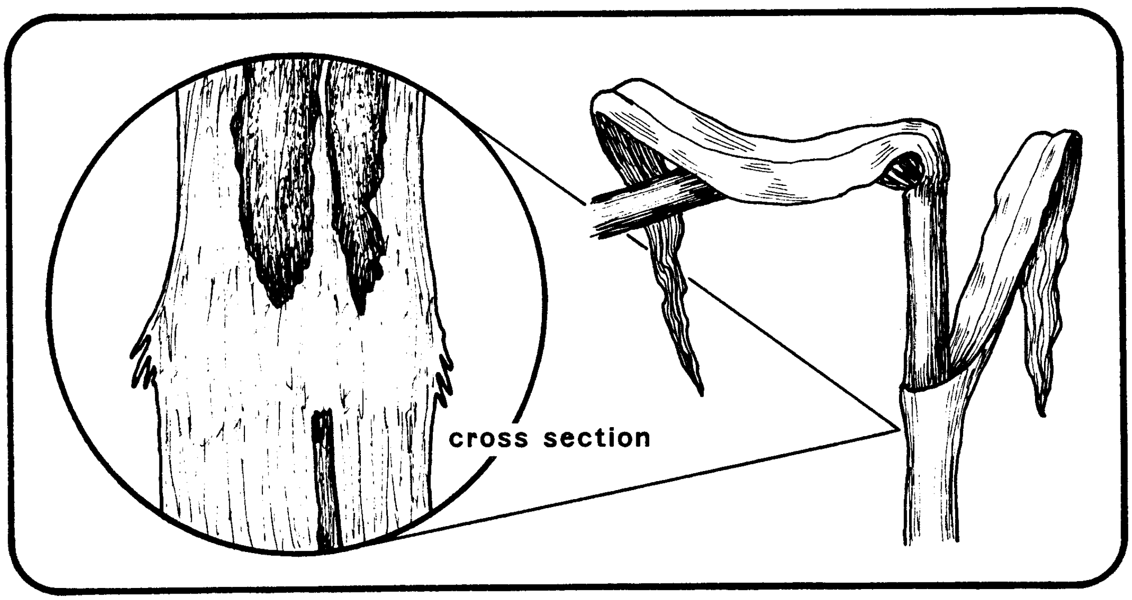
BACTERIAL DISEASES



BACTERIAL SPOT
ON TOMATO



BACTERIAL BLIGHT
ON COTTON BOLLS

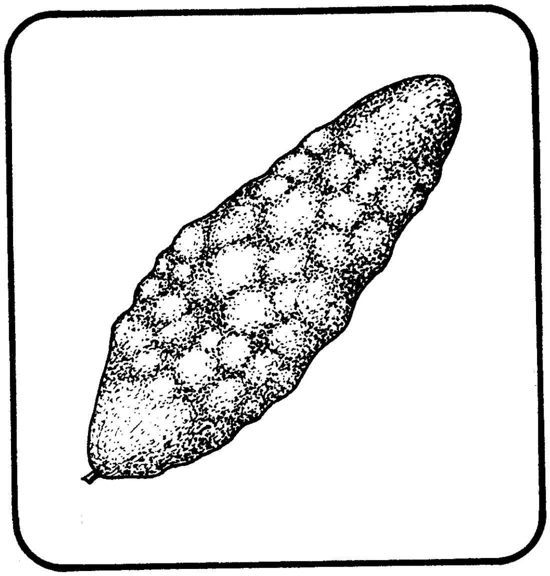


STALK ROT DISEASE IN CORN PLANT

Bacterial Diseases

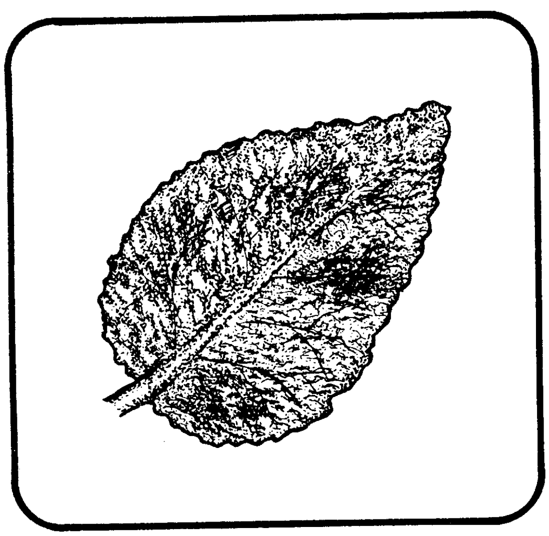
Cotton Leaf Blight

VIRUSES

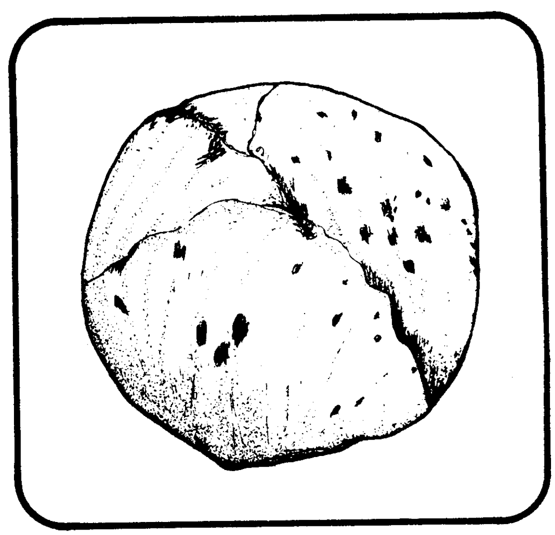


CUCUMBER WITH DARK GREEN WARTS - MOSAIC VIRUS

DARK GREEN MOTTLING DUE TO MOSAIC VIRUS

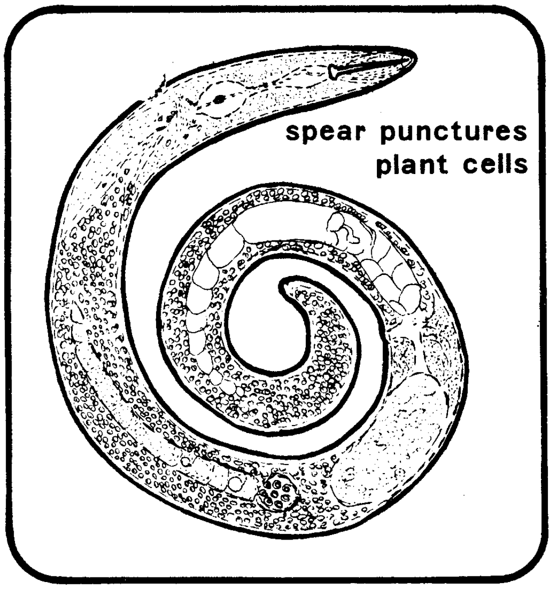


LEAF WRINKLED DUE TO VIRUS

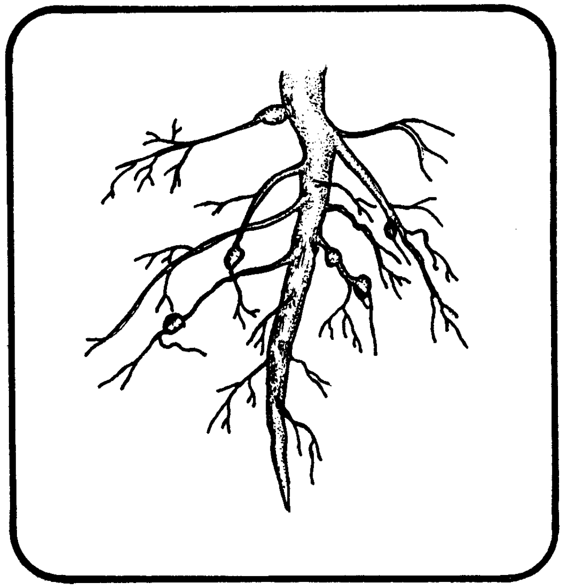


MOSAIC VIRUS ON CABBAGE

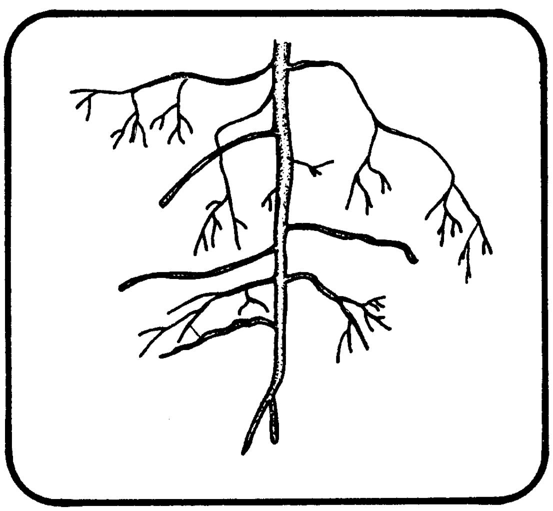
NEMATODES



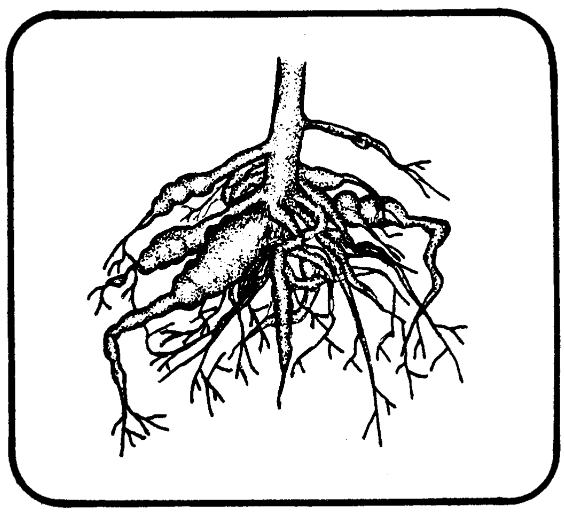
NEMATODE
(size less than 2.0 mm)



GALLS OR KNOTS ON ROOTS



STUBBY ROOT OR
PENIFORM NEMATODE



ROOT KNOT DISEASE

TM 9

PLANT DISEASE IDENTIFICATION AND CONTROL

AG 150 - L

UNIT TEST

Name ____ Score ______________________

1. Match terms associated with plant disease identification and control to the correct definitions. Write the correct numbers in the blanks.

_____a. Knob on the plant parts produced by certain nematodes, bacteria or fungi; may result in reduction of yield or quality

_____b. Chemical material used to kill or destroy fungi

_____c. A single-celled microscopic organism

_____d. A disease-producing agent

_____e. Inherited ability of a plant to retard growth of disease-causing organisms

_____f. Loss of green color in foliage

_____g. Death of plant parts

_____h. Crust-like, diseased lesion produced as a result of disease infection

_____i. An abnormal plant condition caused by a pathogen or improper environmental condition

_____j. Evidence or indicator of disease; reaction of a plant to a pathogen

_____k. Small, filamentous organisms that lack chlorophyll and which cause rots, mildews and other diseases

_____l. Pesticide used to control nematodes

_____m. Loss of freshness and drooping leaves

_____n. Visible evidence of the pathogen

_____o. Tiny, tubular, unsegmented, eel-like worms that feed on plant parts

_____p. A submicroscopic entity consisting of nucleic acids and amino acids capable of causing mosaic and other diseases

1. Plant disease
2. Pathogen
3. Host
4. Fungi
5. Bacteria
6. Nematode
7. Nematicide
8. Virus
9. Blight
10. Fungicide
11. Resistant
12. Scab
13. Lesion
14. Wilt
15. Gall
16. Chlorosis
17. Symptom
18. Necrosis
19. Sign

_____q. A localized area of discolored diseased tissue

_____r. Rapid discoloration and death of tissue over certain portions of the plant

_____s. Plant that is susceptible to a pathogen

2. Name three ways diseases cause economic loss in plants.

a. ____

b. ____

c. ____

3. Name the five groups of biological pathogens.

a. ____

b. ____

c. ____

d. ____

e. ____

4. Match the types of fungi to the correct description. Write the correct numbers in the blanks.

_____a. Fungi that live on dead or decaying organic matter

_____b. Fungi that live on or in a living host plant

1. Saprophytic fungi
2. Parasitic fungi

5. Name three methods by which pathogens spread.

a. ____

b. ____

c. ____

6. Match the general approaches to disease control to the correct descriptions. Write the correct numbers in the blanks.

_____a. Eliminating the pathogen source, whether an infected plant, field or region

_____b. Reducing the severity of disease in an infected plant

_____c. Keeping pathogens out of a "clean" area

1. Avoidance
2. Exclusion
3. Eradication
4. Protection

_____d.	Using plants that tolerate, resist or are immune to the disease	5. Resistance
_____e.	Avoiding disease by planting when and/or where pathogens are ineffective or absent	6. Therapy
_____f.	Preventing an infection by using a chemical or physical barrier to keep pathogens out	

7. Name three primary disease control methods available to the farmer.

   a. ____

   b. ____

   c. ____

8. Select from the following list practices used to control plant diseases. Write an "X" in the blank before each correct answer.

   _____a. Application of fungicides

   _____b. Use of disease-free seed

   _____c. Burning stubble

   _____d. Destruction of crop residue

   _____e. Rotation of crops

   _____f. Discing grain stubble

   _____g. Treatment of soil

   _____h. Eradication of alternate host plants

   _____i. Use of resistant varieties

9. Select from the following list diseases caused by fungal infection. Write an "X" in the blank before each correct answer.

   _____a. Bacterial blight

   _____b. Dry rots

   _____c. Mosaic

   _____d. Seed decay

   _____e. Ergot

   _____f. Rusts

10. Select from the following list diseases caused by bacterial infection. Write an "X" in the blank before each correct answer.

_____a. Smuts

_____b. Galls

_____c. Cankers

_____d. Hairy root

_____e. Curly top

_____f. Bacterial wilts

11. Select from the following list diseases caused by viral infection. Write an "X" in the blank before each correct answer.

_____a. Mosaic

_____b. Curly top

_____c. Yellows

_____d. Hairy rot

_____e. Powdery mildew

_____f. Blights

12. Select from the following list diseases caused by nematode infection. Write an "X" in the blank before each correct answer.

_____a. Rusts

_____b. Pear decline

_____c. Root lesions

_____d. Western X

_____e. Mosaic

_____f. Hairy root

_____g. Necrosis

13. Select from the following list diseases caused by mycoplasm infection. Write an "X" in the blank before each correct answer.

_____a. Aster yellows

_____b. Downey mildew

_____c. Western X

_____d. Blights

_____e. Pear decline

_____f. Root lesions

PLANT DISEASE IDENTIFICATION AND CONTROL

AG 150 - L

ANSWERS TO TEST

1.

a.	15	f.	16	k.	4	p.	8
b.	10	g.	18	l.	7	q.	13
c.	5	h.	12	m.	14	r.	9
d.	2	i.	1	n.	19	s.	3
e.	11	j.	17	o.	6		

2. Answer should include three of the following:

   Reduced yield; Reduced crop quality; Spoilage in storage and transportation; Render food unfit for use; Cost of control activities

3. Fungi; Bacteria; Virus and viroids; Nematodes; Mycoplasmas

4. a. 1 b. 2

5. Answer should include three of the following:

   Wind; Rain; Insects, mites; Machinery

6.

a.	3	d.	5
b.	6	e.	1
c.	2	f.	4

7. Cultural practices; Control through disease resistance; Chemical control

8. a, b, d, e, g, h, i

9. b, d, e, f

10. b, c, f

11. a, b, c

12. c, f, g

13. a, c, e

CROP CHEMICALS

AG 150 - M

UNIT OBJECTIVE

After completion of this unit, students should be able to discuss proper and improper use of pesticides and how they affect the environment; identify available formulations, calculate amounts of pesticide to apply, list and discuss factors that affect application of chemicals and discuss safety practices in relation to prevention of accidents using crop chemicals. This knowledge will be demonstrated by completion of assignment sheets and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with crop chemicals to the correct definitions.
2. List two functions of agricultural chemicals.
3. Name three main groups of pests.
4. Match pesticides with the pests controlled.
5. Select results of discontinued pesticide use.
6. Match EPA classification of pesticides to the correct definition.
7. Select resources necessary for man to exist.
8. Name two ways pesticides are beneficial to the environment.
9. Name two ways improper use of pesticides can harm the environment.
10. Select facts contained on a pesticide label.
11. Match signal words found on labels with the correct level of toxicity.
12. Match the herbicide classification with the correct description.
13. Match the types of pesticide formulations to the correct description.
14. Discuss advantages, disadvantages and principal uses of granule and wettable powder formulations.
15. Arrange in proper sequence the procedure for mixing wettable powders (dry).
16. Arrange in proper sequence the procedure for mixing emulsifiable concentrates (liquid).
17. List four safety precautions when mixing and handling pesticides.
18. Describe proper pesticide storage site, building and conditions.

19. Calculate problems determining amounts of wettable powder (dry) to use.

20. Calculate problems determining amounts of emulsifiable concentrate (liquid) to use.

21. Match methods of pesticide application to the correct description.

22. Identify the parts of a sprayer.

23. Identify the type of nozzle by its spray pattern.

24. Name two climatic factors that affect pesticide application.

25. List four factors to consider when choosing the appropriate pesticide.

26. Name the two causes of most pesticide poisonings.

27. List three ways pesticides enter the body.

28. List the most important routes of entry for applicators and small children.

29. List three steps to follow in case of pesticide poisoning.

30. Name the local hospital or poison control center that serves your area that can provide emergency treatment for pesticide poisoning.

31. Select protective clothing and equipment needed for pesticide applications.

32. Select ways to prevent exposure during application.

33. Name four methods for disposal of pesticides and pesticide containers.

34. List four reasons for keeping records of pesticide use.

35. Discuss regulations governing pesticide use.

36. Interpret pesticide labels correctly when given questions concerning pests.

CROP CHEMICALS

AG 150 - M

SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Apply Pesticides Correctly: Instructors Manual*, available from United States Environmental Protection Agency, National Audiovisual Center, Government Services Administration, Washington, DC 20409.

b. *Crop Chemicals*, an FMO publication by John Deere; 9 chapters; available from John Deere Distribution Service Center, Service Publications, Department 150, 1400 13th Street East, Moline, Illinois 61244 (1-800-544-2122).

c. *Field Sprayer Calibration*, 21 transparency masters; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $2.25; order no. 503.

d. *Principles of Pesticide Use, Handling and Application*, basic requirements for private applicator pesticide certification; available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402; approximate cost $5.90; stock no. 055-004-00012-9.

e. *Weed Control*, set of 61 transparencies; available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland, Urbana, Illinois 61801; approximate cost $19.45.

2. Filmstrips, slideshows, etc.

a. *Agricultural Weed Control*, 53-frame filmstrip; available from VEP, Cal Poly State University, San Luis Obispo, California 93407; approximate cost $27.50.

b. *Applying Pesticides Properly*, color videocassettes; available from Kansas State University, Manhattan, Kansas 66506.

c. *Be A Pro: Avoid Pesticide Accidents*, 79 slides with cassette and script; available from Visual Communications, 4125 Roberts Hall, Cornell University, Ithaca, New York 14853.

d. *Be a Pro with Pesticides,* 72 slides with cassette and script; available from Visual Communications, 4125 Roberts Hall, Cornell University, Ithaca, New York 14853. Used in conjunction with *Be a Pro with Pesticides*, 16mm film, 22 1/2 minutes.

e. *Crop Chemicals*, slide set available from John Deere Distribution Service Center, Service Publications, Department 150, 1400 13th Street East, Moline, Illinois 61244 (1-800-544-2122); approximate cost $124.00.

f. *Modern Agricultural Spraying Equipment*, 54-frame filmstrip with script; available from IAVIM, 208 Davidson Hall, Iowa State University, Ames, Iowa 50011; approximate cost $8.75; order no. 331.

g. *Pesticide Use Training*, 420 slides with cassettes and scripts; available from United States Environmental Protection Agency, National Audiovisual Center, Government Services Administration, Washington, DC 20409.

h. *Pesticides: Safe Handling and Use*, 6 cassettes, 6 film strips and study guide; available from Teaching Aids, Inc., P. O. Box 1798, Costa Mesa, California 92626; approximate cost $229.00; order no. B260.

i. *Proper Pesticide Use Series: Pesticides*, color videocassettes; available from Oregon State University, Corvallis, Oregon 97331.

j. *Sprayer Calibration*, 1 disk, transparency and handout masters; available from Teaching Aids, Inc., P. O. Box 1798, Costa Mesa, California 92626; approximate cost $22.00; order no. ACS-5.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information and assignment sheets and discuss.

E. Invite a resource person to visit with class concerning the importance of private pesticide applicator certification and applicable federal, state and local laws and regulations.

F. Ask students to clip magazine and newspaper articles, which demonstrate ways, that pesticides improve the environment.

G. Ask students to list the pesticides on their farms and in their homes. Have them list them according to type, such as insecticide or herbicide.

H. Invite local pest management specialist to speak to class about on-going projects. Ask the specialist to bring examples of natural enemies and beneficial plants and animals found in your area.

I. Secure pesticide labels and make them available to students.

J. Contact a trained medical person at the local hospital or poison control center that provides treatment for pesticide poisoning and ask the person to speak to the class.

K. Assemble the different types of respirators and demonstrate proper use, clean up and storage of each.

L. Assemble the basic types of protective clothing and equipment. Give students a sample label, target pest and application site and ask them to put on the necessary clothing and equipment for the job. Allow class to critique both <u>over</u> and <u>under</u> protection for the job.

M. Provide students with opportunity to practice mixing pesticides by using flour for wettable powder and oil as an emulsifiable concentrate. Use water to dilute them. DO NOT USE ACTUAL PESTICIDES!

N. Borrow equipment from local dealers or farms and allow students to practice calibrating equipment.

O. Review and give test.

P. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency masters

1. TM 1--Pesticide and Pest Controlled
2. TM 2--Without Pesticides
3. TM 3--Food Chain or Food Web
4. TM 4--Existing Pesticide Label
5. TM 5--Signal Words
6. TM 6--Selective vs Nonselective Herbicide
7. TM 7--Ways Pesticides Attack Pests
8. TM 8--Preemergence and Postemergence
9. TM 9--Types of Formulations
10. TM 10--Proper Mixing

11. TM 11--Proper Clothing for Mixing
12. TM 12--Storage Area
13. TM 13--Methods of Application
14. TM 14--Types of Pesticide Application Equipment
15. TM 15--Parts of a Sprayer
16. TM 16--Types of Nozzles
17. TM 17--Ways Pesticides Enter Body
18. TM 18--Protective Clothing and Equipment
19. TM 19--Container Classification
20. TM 20--Disposal of Containers
21. TM 21--Spray Record Sheet

E. Assignment sheets

1. AS 1--Interpret Pesticide Label
2. AS 2--Calculate Spray Materials Using Wettable Powder
3. AS 3--Calculate Spray Materials Using Emulsifiable Concentrate

F. Answers to assignment sheets

G. Test

H. Answers to test

III. Unit references

A. Anderson, W.P., *Weed Science: Principles*, 2nd edition, West Publishing Co., St. Paul, Minnesota, 1983.

B. *Apply Pesticides Correctly - A Guide for Private Applicators*, U.S. Environmental Protection Agency, U.S. Department of Agriculture.

C. Callihan, R., *"Plant Science 338: Weed Control,"* Class notes, Fall 1984, University of Idaho, Moscow, Idaho.

D. *Chemical Weed Control*, Vo-Ag II, Unit VI, Oklahoma State Board for Vocational-Technical Education, Oklahoma State University, Stillwater, Oklahoma.

E. Colvin, Thomas S., Turner, J. Howard, *Applying Pesticides: Management-Application-Safety*, American Association for Vocational Instructional Materials, Engineering Center, Athens, Georgia 30602, 1980.

F. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

G. *Farm Chemicals Handbook - 1979*, Meister Publishing Co., Willoughby, Ohio.

H. Hughes, H.A., *Crop Chemicals*, 2nd edition, John Deere Technical Services, Moline, Illinois, 1982.

I. Murray, G., *"Plant Science 407: Crop Production,"* Class notes, Spring 1984, University of Idaho, Moscow, Idaho.

J. *Principles of Pesticide Use, Handling, and Application*, United States Environmental Protection Agency, Washington, DC, 1976.

K. *Weed Control*, Vo-Ag II, Unit IV-E, Teaching Materials Center, Agriculture Education Department, Texas A & M University, College Station, Texas.

CROP CHEMICALS

AG 150 - M

INFORMATION SHEET

I. Terms and definitions

A. Pesticide--Chemical or other substance that will prevent, repel, destroy or control a pest or protect something from a pest

B. Tolerance--Maximum amount of pesticide, which can legally remain on or in any food or feed crop at harvest or animal at slaughter

C. Certification--Recognition by certifying agency that a person is competent and thus authorized to use or supervise the use of restricted-use pesticides

D. Phytotoxicity--Causing injury to plant life

E. Hazard--Risk of danger; chance that injury or harm will come to the applicator, other persons, plants or animals

F. EPA--Environmental Protection Agency

G. Organism--Any living thing

H. Pest--An unwanted organism

I. Weed--Any plant that interferes with human affairs

J. Drift--Movement of pesticide droplets or particles by wind and air currents

K. Target--Area, building, plant, animal or pest intended to be treated with pesticide

L. Short-term (non-persistent)--Pesticide that breaks down almost immediately into non-toxic by-products

M. Residual (persistent)--Pesticide that remains in the environment for a fairly long time

N. Broad spectrum (non-selective)--Pesticide which is toxic to a wide range of pests

O. Selective--Pesticide which is more toxic to some types of plants or animals than to others

P. Active ingredient--That part of a pesticide product, which will kill or control pests or prevent damage by them

Q. LD_{50}--Lethal dose or amount of a pesticide, which would kill half a large number of test animals if eaten or absorbed through the skin

(Note: The lower the LD value, the more poisonous the pesticide. LD stands for lethal dose.)

R. Oral--Through the mouth

S. Dermal--Absorbed through the skin

T. Inhalation--Breathed in through the lungs

U. Formulation--Mixture of one or more active ingredients with other materials needed to make a pesticide easy to store, handle, dilute and apply

V. Compatible--Able to be combined with other pesticides and applied as a mixture without reducing their effectiveness

W. Dilute--To make a pesticide thinner or weaker by adding water, oil or other materials

X. Calibration--Measurement of how much pesticide will be applied by the equipment to the site; measurement of the delivery rate

II. Functions of agricultural chemicals

A. Improve crop growth

B. Protect crop against pests

III. Main groups of pests

A. Insects

B. Mites, ticks and spiders

C. Bacteria, fungi and viruses

(Note: The plant disease is not the pest; the causal agent is.)

D. Nematodes

E. Vertebrate animals, for example: rodents, coyotes, squirrels, etc.

F. Weeds

IV. Pesticides and pest controlled (Transparency 1)

A. Herbicides--Control weeds

B. Insecticides--Control insects

C. Fungicides--Control fungal diseases

D. Bactericides--Control bacterial diseases

E. Nematicides--Control nematodes

F. Acaricides--Control mites, ticks and spiders

G. Rodenticides--Control rats, mice and other rodents

V. Economic importance of pesticide use

A. Large quantity used each year

(Note: In 1980, 846 million pounds of pesticide active ingredient were used on U.S. farms--about .81 pounds per acre. These materials cost $3.6 billion, approximately $16 for every person in the U.S.)

B. Without the use of pesticides (Transparency 2)

1. Yields would be reduced

2. Food would be more expensive

3. Food would be less available

4. Food would be of lower quality

5. Labor requirements would increase

6. Exports would decrease

7. Lower standard of living

8. More of work force involved in food production

VI. EPA classifications of pesticides

(Note: EPA will classify the use of each pesticide as either general or restricted.)

A. General use--Pesticide use which will not cause excessive damage in the environment or endanger the applicator or other persons when applied according to label directions

(Note: No certification requirements are necessary on the part of the applicator.)

B. Restricted use--Pesticide use which may cause damage in the environment or endanger the applicator or other persons unless label directions are followed

(Note: Certification is necessary on the part of the applicator to purchase and apply restricted use pesticides.)

VII. Resources necessary for man to exist (Transparency 3)

(Note: The surroundings in which man lives and the resources he depends on make up his environment.)

A. Place to live

B. Clean water

C. Clean air

D. Food

E. Clean soil

VIII. Ways pesticides are beneficial to the environment

A. Enable more food to be produced on same area

B. Control plant diseases, parasites, insects and weeds

C. Control animal diseases, parasites and insects

D. Preserve outdoor activities

IX. Ways improper use of some pesticides might harm the environment

A. Cause nature imbalance

B. Pollute streams and water supply

C. Pollute crops

D. Pollute soil

E. Injure desirable plants

F. Persistent residues in food chain

(Note: For more information on chemicals and the environment, contact your local office of the Environmental Protection Agency.)

X. Facts contained on a pesticide label (Transparency 4)

A. Name and address of chemical company

B. Brand (trade) name

C. Name and amounts of all active ingredients

(Note: The label will also list the amounts of inert ingredients.)

D. Type of pesticide

E. Kind of formulation

F. EPA registration and establishment numbers

G. Storage and disposal precautions

H. Hazard statement

(Note: This statement describes environmental hazards, human hazards, animal and plant hazards, and physical and chemical hazards.)

I. Directions for use

J. Net content

K. Words: "Keep Out of Reach of Children"

L. Signal word

M. Days to harvest or slaughter

N. Reentry interval, if applicable

O. General use or restricted use classification statement

XI. Signal words found on labels (Transparency 5)

A. Danger--Highly toxic pesticides; the word "poison" printed in red and the skull and crossbones symbol are also required on labels of highly toxic pesticides

B. Warning--Moderately toxic pesticides

C. Caution--Slightly toxic to relatively non-toxic pesticides

XII. Classification of herbicides (Transparencies 6, 7, 8)

A. Selectivity

1. Selective--Use to control weeds without significant damage to the crop

2. Nonselective--Kills all plants present if applied at adequate rates

B. Mode of action

1. Contact--Kills only part of plant to which it is applied; not translocated

2. Systemic--Absorbed by roots and foliage and translocated throughout plant; kills entire plant

C. Time of application

1. Preplant--Applied to soil before crop is planted

2. Preemergence--Applied to soil prior to emergence but after the crop is planted

3. Postemergence--Applied after emergence of the crop or weed

XIII. Types of pesticide formulations (Transparency 9)

A. Granule (G)--Ready-to-use dry mixture of a small amount of active ingredient and inert carriers with all particles larger than dust particles

B. Emulsifiable concentrate (EC or E)--Solution which contains a high concentration of active ingredient which should be mixed with water; may contain from one to several pounds of active ingredient per gallon of concentrate

C. Flowable (F)--Very finely ground solid material which is suspended in a liquid; usually contains a high concentration of active ingredient and is mixed with water when applied

D. Wettable powder (WP or W)--Dry preparation which may contain a fairly high concentration (15% - 95%) of active ingredient that dissolves in water to form a solution for application

E. Fumigant--Active ingredient is in the form of a gas or liquid which becomes gas when applied, and reaches the target as a gas

XIV. Advantages, disadvantages and principle uses of formulations

Formulation	Advantages	Disadvantages	Principle Uses
Granule	Ready to use; easy to apply; can be applied to target under dense foliage	Limited foliage use	Soil treatment
Emulsifiable Concentrate	High concentration; relatively inexpensive suitable for low pressure equipment with limited agitation	Easy to overdose; may be hazardous to applicator; phytotoxicity; requires agitation	Fruits and vegetables, farm animals, field crops

Formulation	Advantages	Disadvantages	Principle Uses
Flowable (a pre-wetted powder)	Can be mixed with water; reduces nozzle clogging	Requires agitation	Fruits and vegetables, farm animals, field crops
Wettable Powder	Relatively inexpensive; safer than emulsifiable concentrate to use on tender foliage; easy to measure	May be hazardous to applicator; requires mechanical agitation; difficult to mix; may clog nozzles; dusty	Fruits and vegetables, farm animals, field crops
Fumigant	Toxic to wide range of pests; will penetrate cracks and crevices of grain	Area must be sealed; requires special protective equipment; dangerous	Inside buildings, greenhouses, farm stored grain, soil

XV. Procedure for mixing wettable powders (Transparency 10)

A. Fill tank one-half full of water

B. Start agitator

(Note: Keep agitator going at all times.)

C. Measure out correct amount of wettable powder

D. Add powder to a small amount of water in a clean mixing bucket

E. Stir until well mixed

(Note: This will make a "slurry", a watery mixture of insoluble matter.)

F. Add slurry to tank

G. Finish filling the tank

XVI. Procedure for mixing emulsifiable concentrates

A. Fill tank one-fourth to one-half full with water

B. Measure out correct amount of emulsifiable concentrate (EC)

C. Add EC directly into spray tank

D. Mix thoroughly using mechanical or hydraulic agitation

(Note: Do not use air agitation.)

E. Finish filling the tank

XVII. Safety precautions when mixing and handling pesticides (Transparency 11)

A. Follow all safety precautions stated on the label

B. Use protective clothing and equipment as stated on the label

C. Rinse empty containers and measuring cups to remove any residue

D. Read the label or consult an expert to make sure mixes of two or more pesticides are compatible

E. Avoid splashes, spills and leaks

(Note: Clean up any splashes, spills or leaks.)

F. Wash all contaminated areas on clothing or equipment

G. Dispose of empty containers properly

XVIII. Pesticide storage (Transparency 12)

A. Site

1. Separate from other equipment or material storage facilities

2. Not located in flood plain

3. Spill and drainage containment for large storage facilities

B. Building

1. Fire resistant

2. Cement floor

3. Exhaust fan for ventilation

4. Well-lit

5. Locked door

6. Sufficient storage area

C. Conditions

1. Keep products off the floor

2. Store containers so that the labels remain in good condition

3. Keep pesticides dry, cool and out of direct sunlight

XIX. Determining amounts of wettable powder (dry) to use

A. Pounds per tank

1. Formula

$$\frac{\text{tank capacity}}{\text{gallons applied per acre}} \quad \times \quad \text{pounds per acre}$$

2. Problem--Label calls for 3 pounds of 25% WP per acre. Your sprayer holds 50 gallons and applies 10 gallons per acre

3. Solution

$$\frac{50}{10} \times 3 = 15 \text{ pounds per 50 gallon tank}$$

B. Pounds per gallon

1. Formula

$$\frac{\text{pounds of WP}}{\text{gallons water}} \quad \times \quad \text{tank capacity}$$

2. Problem--Label calls for 2 pounds of 50% WP per 100 gallons of water. Your tank holds 300 gallons

3. Solution

$$\frac{2}{100} \quad \times \quad 300 = 6 \text{ lbs per 300 gallons}$$

C. Active ingredient per acre

1. Formula

$$\frac{\text{tank capacity}}{\text{gallons applied per acre}} \quad \times \quad \text{pounds WP per acre}$$

2. Problem--A local expert recommends that you apply 1/2 pound of active ingredient per acre. You have a 50% WP on hand and your sprayer tank holds 50 gallons and applies 8 gallons per acre

3. Solution

(Given: 1 pound of 50% WP per acre = 1/2 pound of active ingredient per acre.)

$\frac{50}{8} \times 1$ = 6.25 pounds of 50% WP per tank to apply 1/2 pound per acre

XX. Determining amounts of emulsifiable concentrate (liquid) to use

A. Pints per gallon

1. Formula

$$\frac{\text{Pints EC}}{\text{gallons of water}} \quad \times \quad \text{tank capacity}$$

2. Problem--The label says to apply 1/4 pint of 8 EC per 100 gallons. Your tank holds 400 gallons. How much 8 EC is needed?

3. Solution

$\frac{1/4}{100} \times 400$ = 1 pint per 400 gallons

B. Pints, quarts or gallons per acre

1. Formula

$$\frac{\text{tank capacity}}{\text{gallons applied per acre}} \quad \times \quad \text{recommended amount of herbicide per acre}$$

2. Problem--The label recommends that you apply 2 quarts of 6 EC per acre. Your sprayer holds 42 gallons and applies 6 gallons per acre

3. Solution

$\frac{42}{6} \times 2$ = 14 quarts per tankful

C. Active ingredient per acre

1. Formula

$$\frac{\text{tank capacity}}{\text{gallons applied per acre}} \quad \times \quad \text{amount EC per acre}$$

2. Problem--A local expert recommends you apply 1/2 pound active ingredient per acre. You have 4 EC on hand which contains 4 pounds of active ingredient per gallon formulation. Your sprayer holds 40 gallons and applies 6 gallons per acre. How much 4 EC is needed to apply 1/2 pound active ingredient per acre?

3. Solution--(Given: 4 pounds of active ingredient/gallon = 4 pounds per 4 quarts = 1 pound per quart = 1/2 pound per pint.)

$\frac{40}{6}$ x 1 pint of 4 EC per acre = 6 2/3 pints per tankful

XXI. Methods of application and their descriptions (Transparencies 13, 14)

A. Band--Application to a strip or band over or along each crop row

B. Broadcast--Uniform application to an entire specified area

C. Directed--Aiming the pesticide at a portion of a plant

D. Drench--Saturation of the soil with a pesticide

E. Foliar--Application to the leaves of a plant, shrub or tree

F. In-furrow--Application to or in a furrow in which a crop is planted

G. Sidedress--Application along the side of a crop row

H. Soil incorporation--Application to the soil followed by use of tillage implements to mix the pesticide with the soil

I. Spot treatment--Application to a small area

XXII. Parts of a sprayer (Transparency 15)

A. Pump

B. Pressure regulator and gauge

C. Control valves

D. Tank

E. Agitation system

F. Booms

G. Nozzles

XXIII. Types of nozzles (Transparency 16)

A. Solid stream--Compact jet used in handguns to spray a distant target or fixed to apply a narrow band or to inject into the soil

B. Regular flat fan--Narrow oval pattern with lighter edges; used for broadcast spraying

C. Flooding flat fan--Wide angle spray pattern; used for broadcast spraying

D. Hollow cone--Circular pattern with little or no spray in the center; used for spraying foliage

E. Solid cone--Circular pattern (full); used for spraying foliage

XXIV. Climatic factors that affect pesticide application

A. Soil moisture

(Note: Pesticides work best with moderate soil moisture. Wetness may keep the pesticide from contacting the soil particles.)

B. Rain

(Note: Rain often causes pesticides to leach out of or run off the application site. It also may wash pesticides off foliage. However, preemergence herbicides and protectants or preventative fungicides are sometimes purposely applied just before or soon after rain.)

C. Humidity

(Note: Herbicides work best when weeds are growing fast. High humidity and warm temperatures help cause this growth.)

D. Temperature

(Note: High temperatures cause some pesticides to evaporate more quickly than is desirable. Low temperatures may slow down or stop the activity of some pesticides.)

E. Light

(Note: Light aids in breaking down pesticides.)

XXV. Factors to consider when choosing appropriate pesticide

A. Has directions on the label for the intended use

B. Is effective against the pest

C. Will not cause injury to the plant or other surface to which it is applied

D. Will cause the least damage to beneficial organisms

E. Will not move off the treated area and into environment to harm fish and wildlife

F. Works well in the machinery available

G. Is worth the cost

(Note: Cost of application should be compared to the increase in yield expected in the treated area.)

H. Toxicity to man, animals and other plants

XXVI. Cause of most pesticide poisoning

A. Careless practices

B. Ignorance

(Note: Learn safe procedures; it is for your own good!)

XXVII. Ways pesticides enter the body (Transparency 17)

A. Oral

B. Dermal

C. Inhalation

(Note: You can be poisoned no matter which way the pesticide enters your body. It may enter and poison you through all three routes of entry at the same time.)

XXVIII. Most important routes of entry for pesticides

A. Applicator--Dermal and inhalation

B. Small children--Oral and dermal

XXIX. Steps to follow in case of pesticide poisoning

A. Check to see if patient is breathing

B. Call doctor or take victim to doctor or hospital

C. Locate pesticide label and have available for doctor

XXX. Local hospital or poison control center that serves your area and that can provide emergency treatment for pesticide poisoning

A. City ___________________ Address _________________________________

B. Telephone: Area Code______ Number__________________________________

(Note: Make sure your doctor has the number of the poison control center.)

XXXI. Protective clothing and equipment needed for pesticide applications (Transparency 18)

(Note: Use protective clothing and equipment called for on the label.)

A. Gloves

1. Obtain unlined, elbow length neoprene or natural rubber gloves

   (Note: Some chemicals will dissolve rubber or make it sticky.)

2. Make sure sleeves are <u>outside</u> your gloves

   (Note: This should be done unless spraying overhead.)

3. Discard the gloves if any holes appear

4. Wash gloves with detergent and water before removing

   (Caution: Never use cotton or leather gloves unless specified on the label. These can be more hazardous than no protection at all because they hold the pesticide close to your skin.)

B. Coveralls

1. Wear clean tightly woven fabric coveralls that cover entire body or long sleeved shirt and long legged trousers

   (Note: Most applicators who apply pesticides regularly have special coveralls kept just for pesticide applications.)

2. Wear waterproof suit or apron when mixing highly toxic pesticides

3. Wear waterproof suit when you may be drenched during application

4. Wash clothes with detergent and water

C. Boots

1. Wear lightweight, unlined neoprene or natural rubber boots

   (Note: Boots should cover your ankles.)

2. Put pant legs <u>outside</u> of boots

   (Note: This will keep pesticide from draining into boot.)

3. Wash and dry boots inside and out after each use

D. Goggles and face shield

1. Wear tight-fitting goggles or a face shield when pesticide spray or dust could get on your face or in your eyes

2. Wear goggles or face shield when pouring and mixing

3. Wash goggles and face shield after each use

E. Head and neck covering

1. Protect hair and skin on neck from pesticide spray

2. Wear waterproof wide-brimmed hat or hard hat

(Note: In cool weather, a hooded waterproof parka and a bill cap are also good.)

XXXII. Ways to prevent exposure during application

A. Wear protective clothing and equipment

B. Do not wipe hands on clothing

(Note: Carry a special towel for wiping hands.)

(Caution: Do not wipe gloves on your clothing, especially if chemicals are on gloves. Your clothing can become contaminated and the chemicals may soak through to your skin.)

C. Never blow out clogged hoses, nozzles or lines with your mouth

D. Never eat, drink or smoke when handling pesticides

E. Work in pairs when handling hazardous pesticides or at least let someone know where you will be working

F. Keep persons, livestock and pets out of spray area

(Note: When working with pesticides day after day, even moderately toxic chemicals can poison you. Wear protective equipment, especially a respirator.)

(Caution: Do not let children or pets play around sprayers, dusters, filler tanks, storage areas or old pesticide containers. Use proper rates. Overdose won't kill a pest twice, but may injure humans, crops or wildlife.)

XXXIII. Methods of disposal of pesticides and pesticide containers (Transparencies 19, 20)

A. Open burning

(Note: Check local regulations. In some areas burnable containers may be burned on the farm in small quantities, usually the amount emptied in one day. Never burn containers, which held 2, 4-D, type herbicides because the smoke could injure sensitive plants.)

B. Burial

(Note: Many landfills will accept triple-rinsed pesticide containers, especially if broken, crushed or cut apart. Otherwise, the burial site should be selected in an area where water will not be contaminated and where public health and the environment will not be harmed. Do not bury pesticides and unrinsed pesticide containers that contain mercury, lead, cadmium, arsenic or inorganic pesticides unless they are encapsulated. Some landfills will take these containers if they have been triple rinsed.)

C. Recycling

(Note: Some non-burnable containers, such as plastic and steel drums, may be returned to the manufacturer for reuse.)

D. Incineration in a special pesticide-approved incinerator

(Note: Some pesticides and pesticide containers may be made harmless using this method. However, this method may not be used for pesticides or pesticide containers with mercury, lead, cadmium, arsenic or inorganic pesticides.)

E. Chemical degradation

(Note: Sometimes pesticides can be chemically broken down into non-toxic materials. These methods are specific for each chemical and cannot be described here. Check with the manufacturer or local Environmental Protection Agency officials for specific methods.)

F. Soil injection

(Note: Use soil injection methods only when recommended by state or federal regulatory officials.)

G. Encapsulation

(Note: This is usually the only method of disposal of pesticides or unrinsed containers with mercury, lead, cadmium, arsenic or inorganic pesticides.)

XXXIV. Reasons for keeping records of pesticide use (Transparency 21)

A. Help in finding an error if an error is made

B. Provide information to trace residue and/or damage problems

C. Help save money

D. Allow one to compare the results obtained from different pesticides

E. Help to reduce pesticide misuse

F. Provide guide to buying specific amount of pesticide needed

G. Establish proof of proper use in damage suit

XXXV. Regulations governing pesticide use

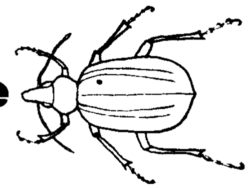
A. Applicator must be licensed to apply restricted-use pesticides

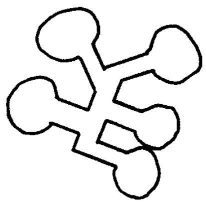
B. Custom applicator license required if applying chemical to land farmed by someone else

Pesticide and Pest Controlled

Herbicide

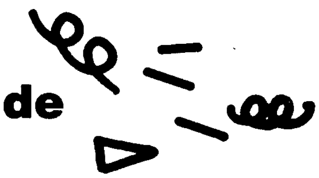
Insecticide





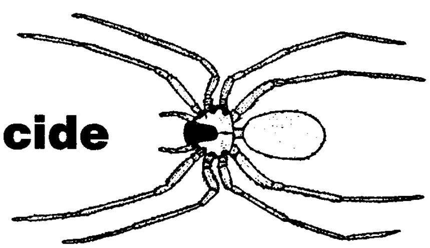
Fungicide

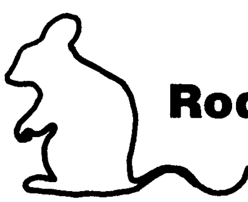
Bactericide



Nematicide

Acaricide



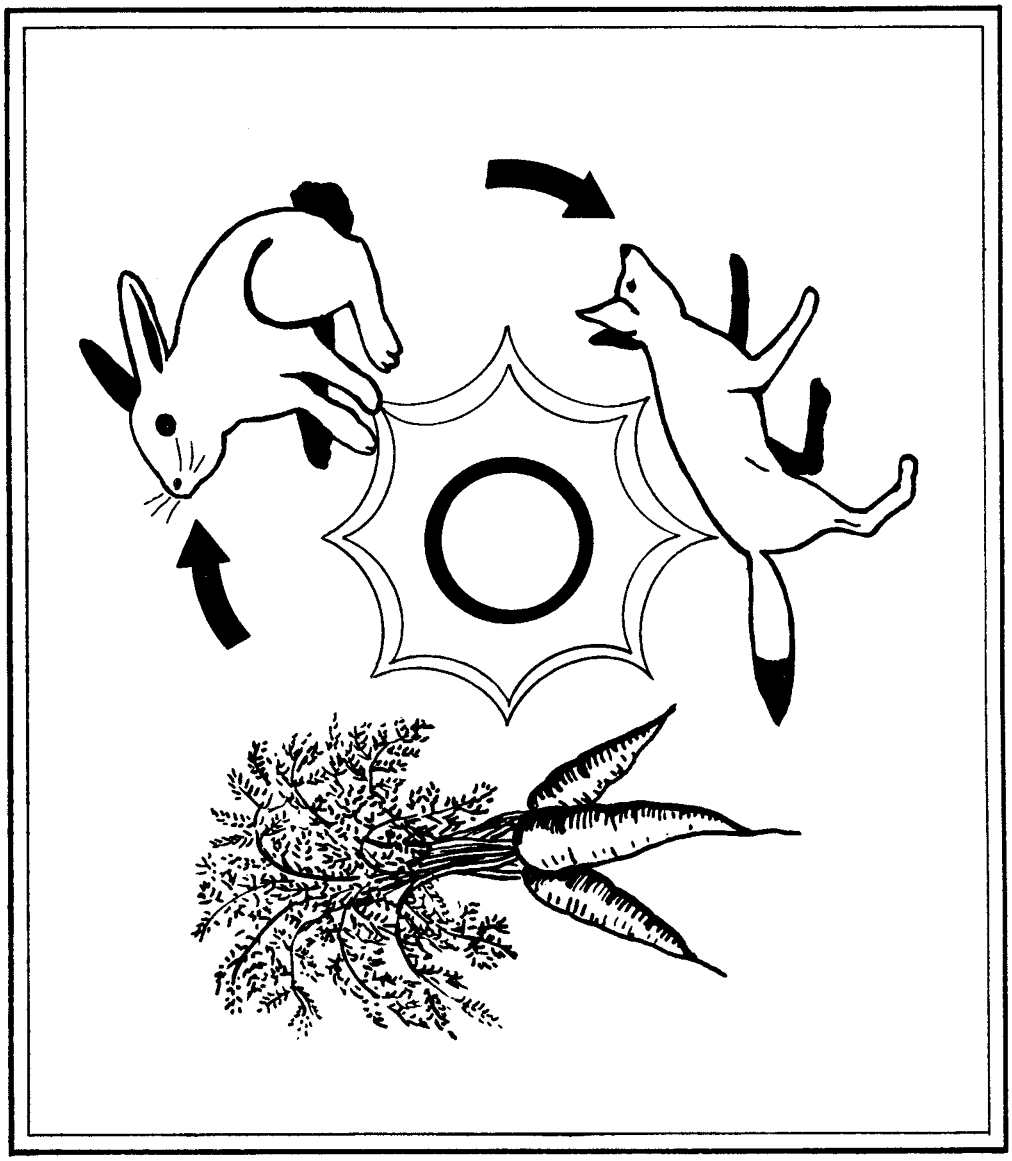


Rodenticide

Without Pesticides

1. Yield would be reduced
2. Food would be more expensive
3. Food would be less available
4. Food would be of lower quality
5. Labor requirements would increase
6. Exports would decrease
7. Lower standard of living
8. More of work force involved in food production

Food Chain or Food Web



Existing Pesticide Label

Brand Name

Common Name

Chemical Name

SAMPLE LABEL — FRONT PANEL

NOMITE® 50W

Miticide

Wettable Powder Formulation
For Control of Plant-Feeding Mites

ACTIVE INGREDIENT	
Methylethylbutyl phos (metbutin)	50.0%
INERT INGREDIENTS	50.0%

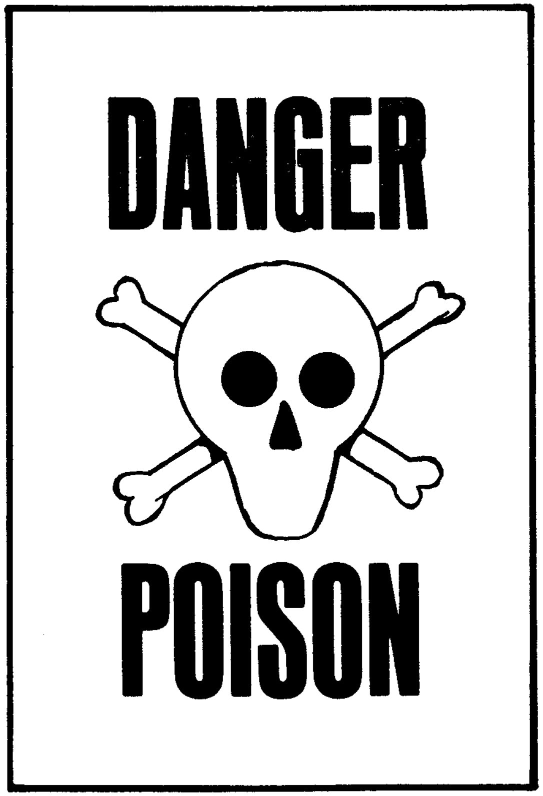
E.P.A. Registration No. 1576-491
E.P.A. Establishment No. 1576-NC-1

POISON DANGER

DANGER: KEEP OUT OF REACH OF CHILDREN
See other cautions on side panel

THE MOW CHEMICAL COMPANY
SNOWBALL, N.C. 27000

Signal Words



Highly Toxic

WARNING

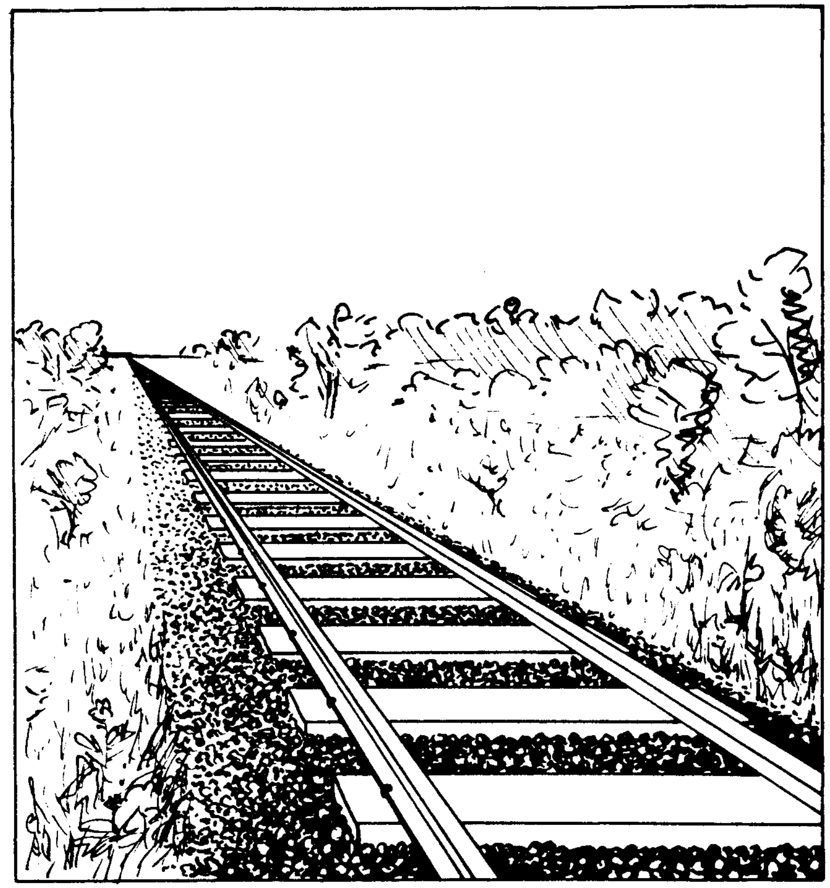
Moderately Toxic

CAUTION

Slightly Toxic to
Relatively Nontoxic

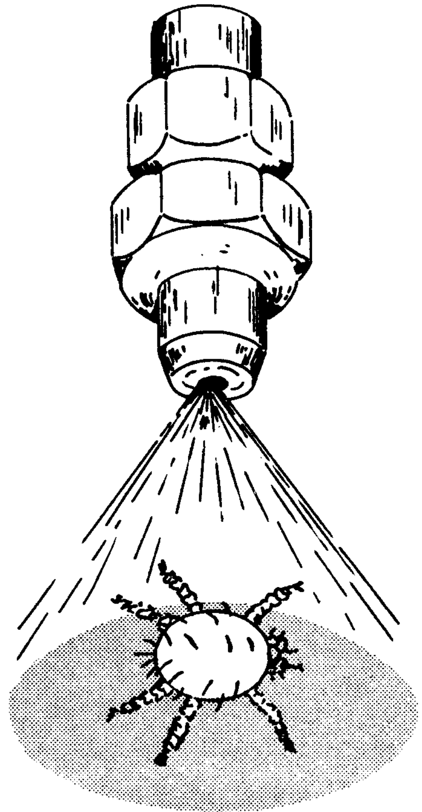
Selective vs Nonselective Herbicide

Selective

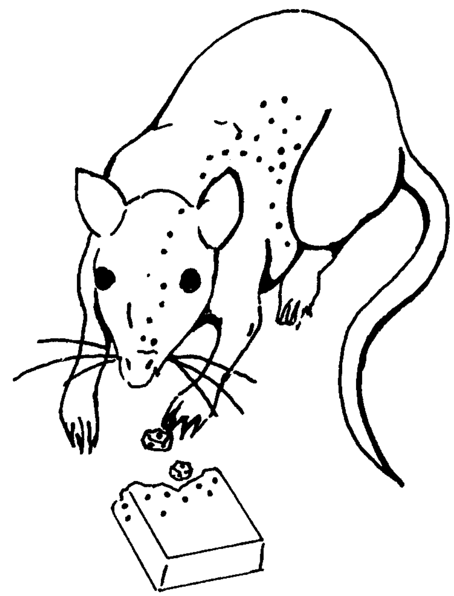


Nonselective

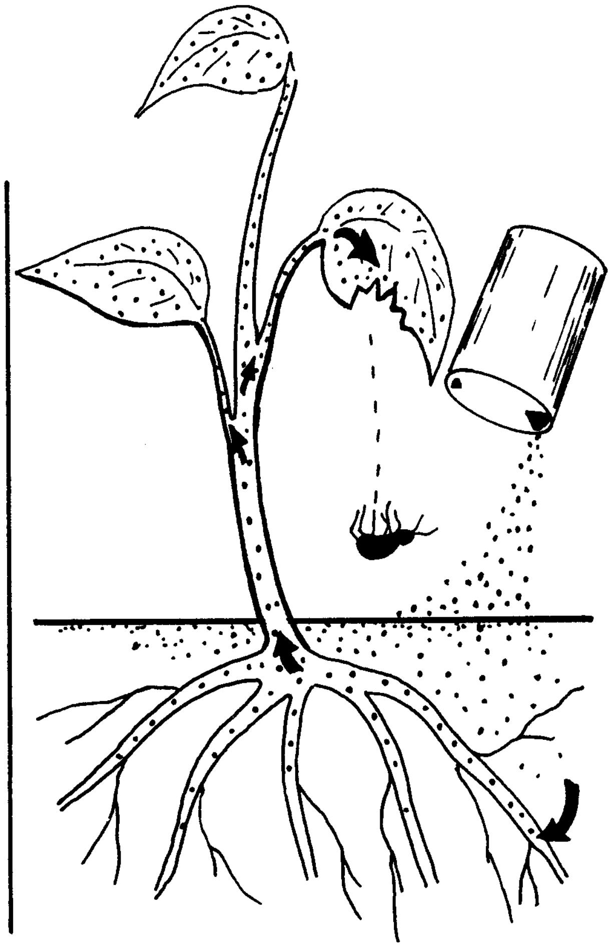
Ways Pesticides Attack Pests



Contact Poison

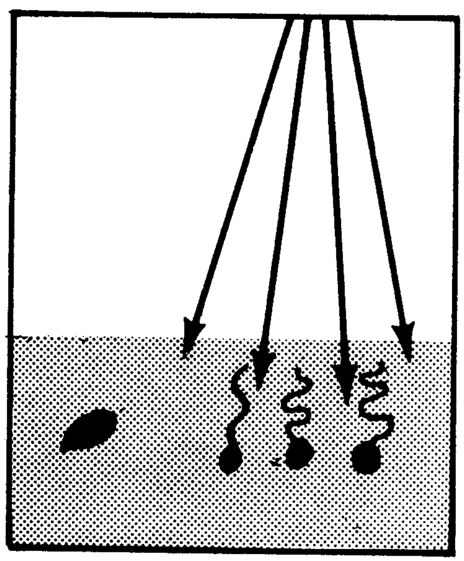


Stomach Poison

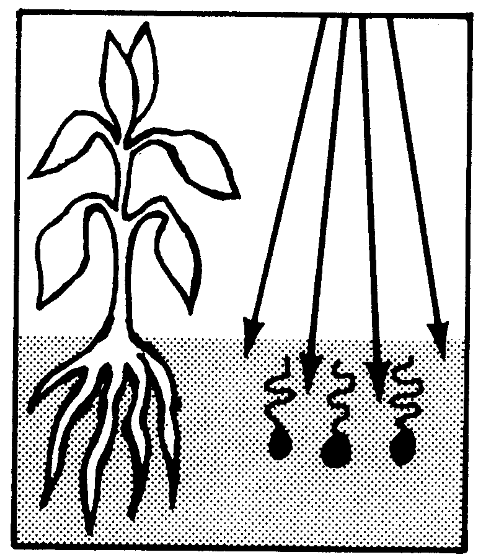


Systemic Poison

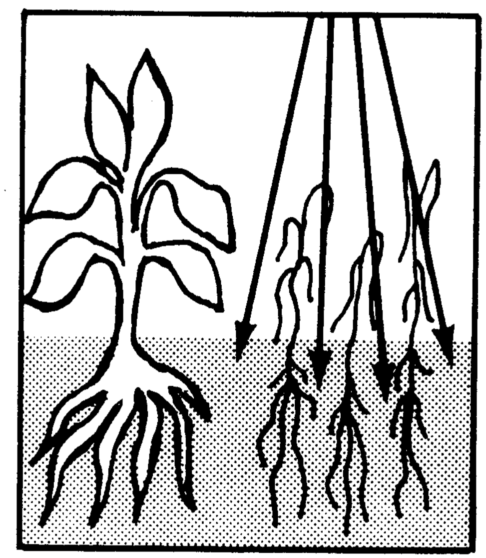
Preemergence and Postemergence



Preemergence to the
Crop and Weeds



Postemerged Crop
Preemerged Weeds



Postemergence to the
Crop and Weeds

Types of Formulations

Dry

Dust (D)

Poisonous Bait (B)

Granule (G)

Wettable Powder (WP or W)

Soluble Powder (SP)

Liquid

Low Concentrate Solution (S)

Emulsifiable Concentrate Solution (EC or E)

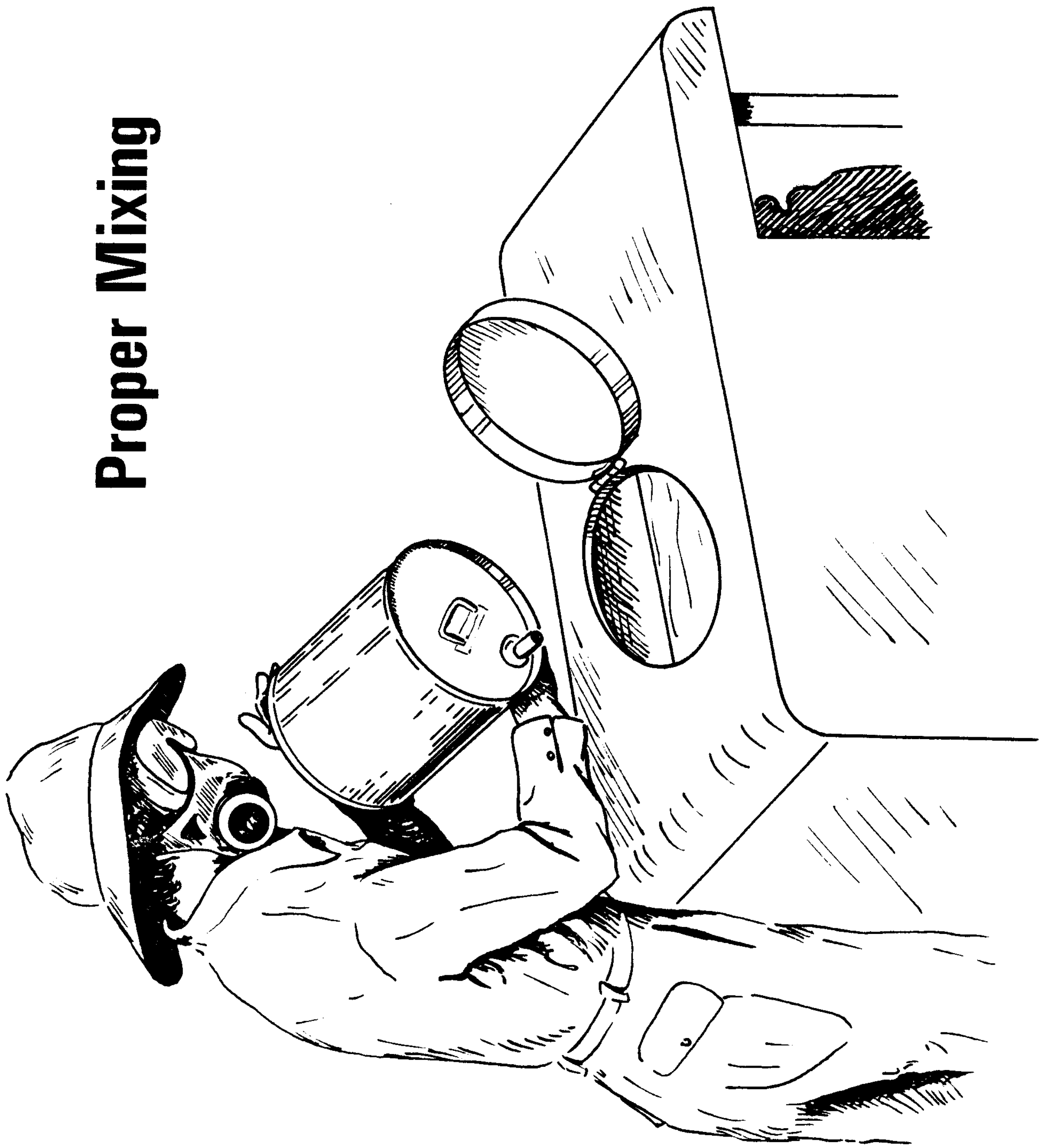
Ultra-Low Volume Concentrate Solution (ULV)

Flowable (F)

Gas

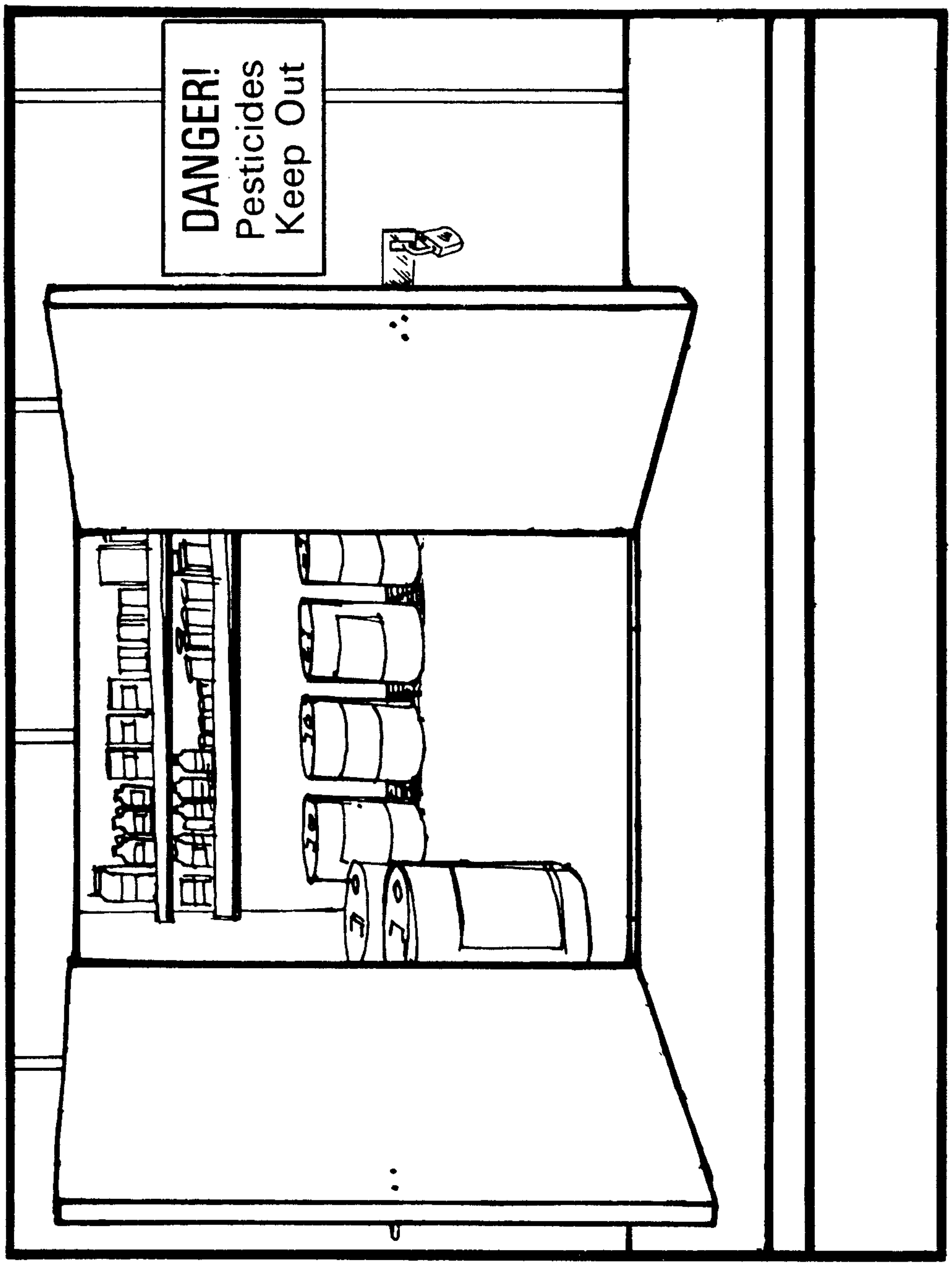
Fumigant

Proper Mixing

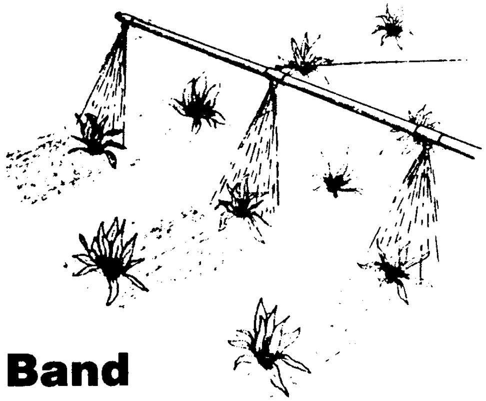


Proper Clothing for Mixing

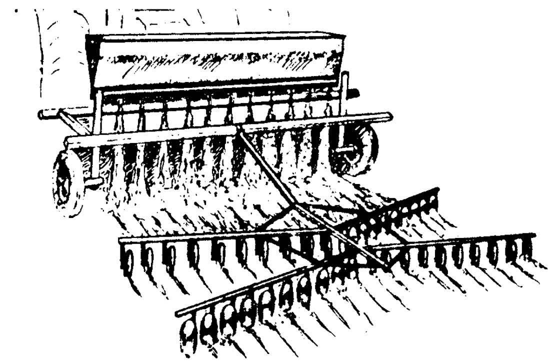
Storage Area



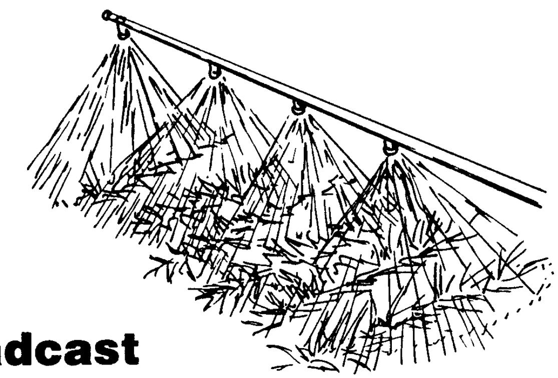
Methods of Application



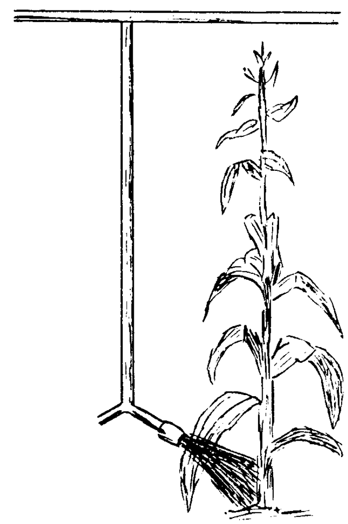
Band



Soil Incorporation

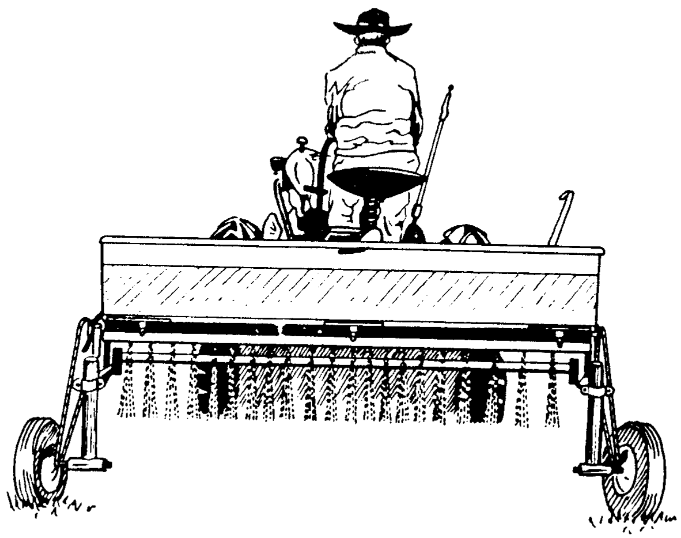


Broadcast

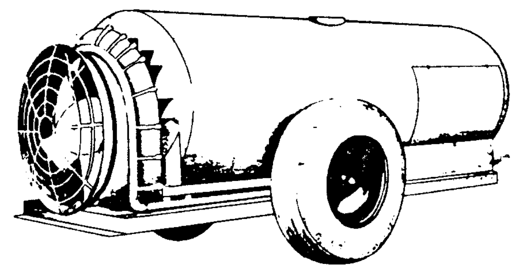


Directed

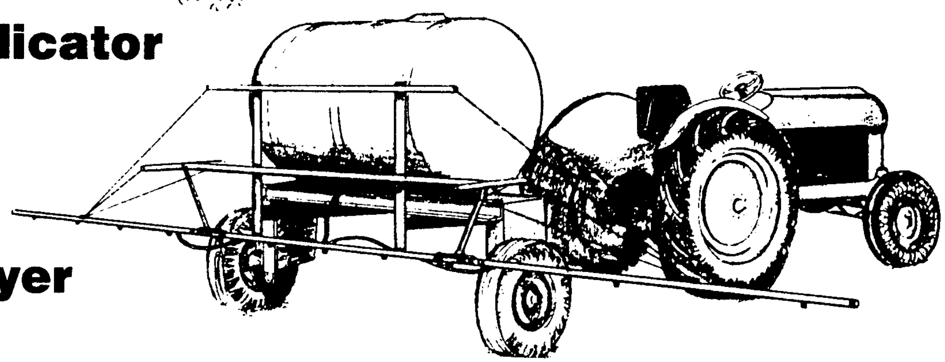
Types of Pesticide Application Equipment



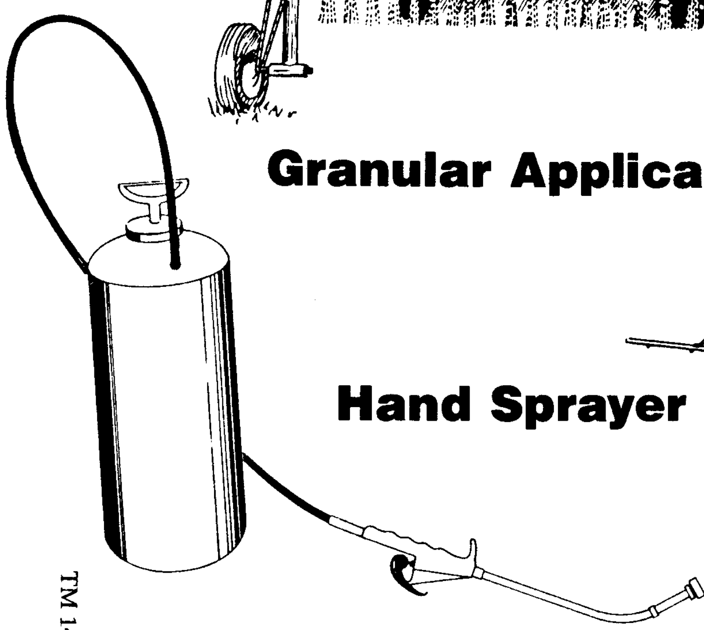
Granular Applicator



Air Blast Sprayer or Mist Blower



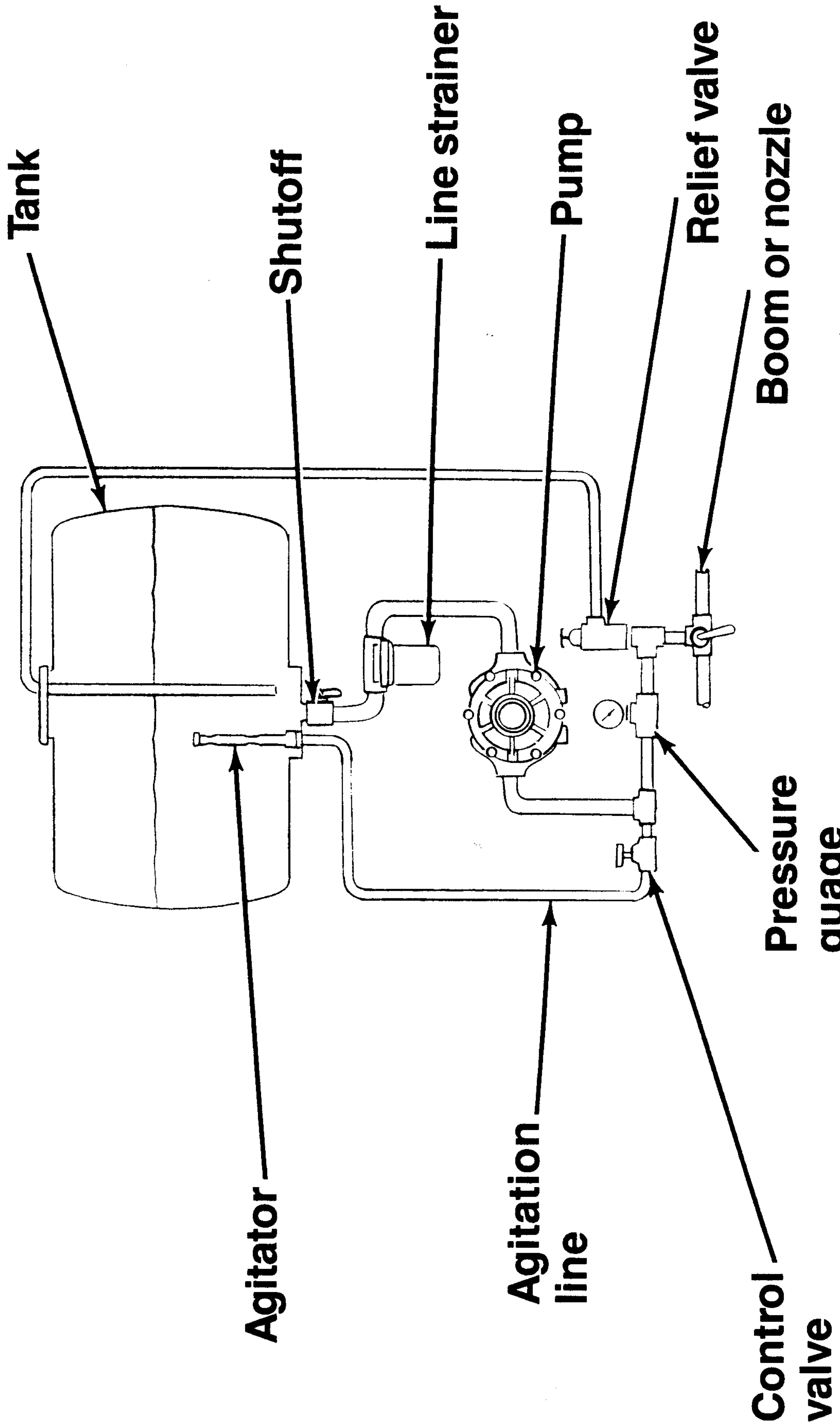
Low Pressure Field Sprayer

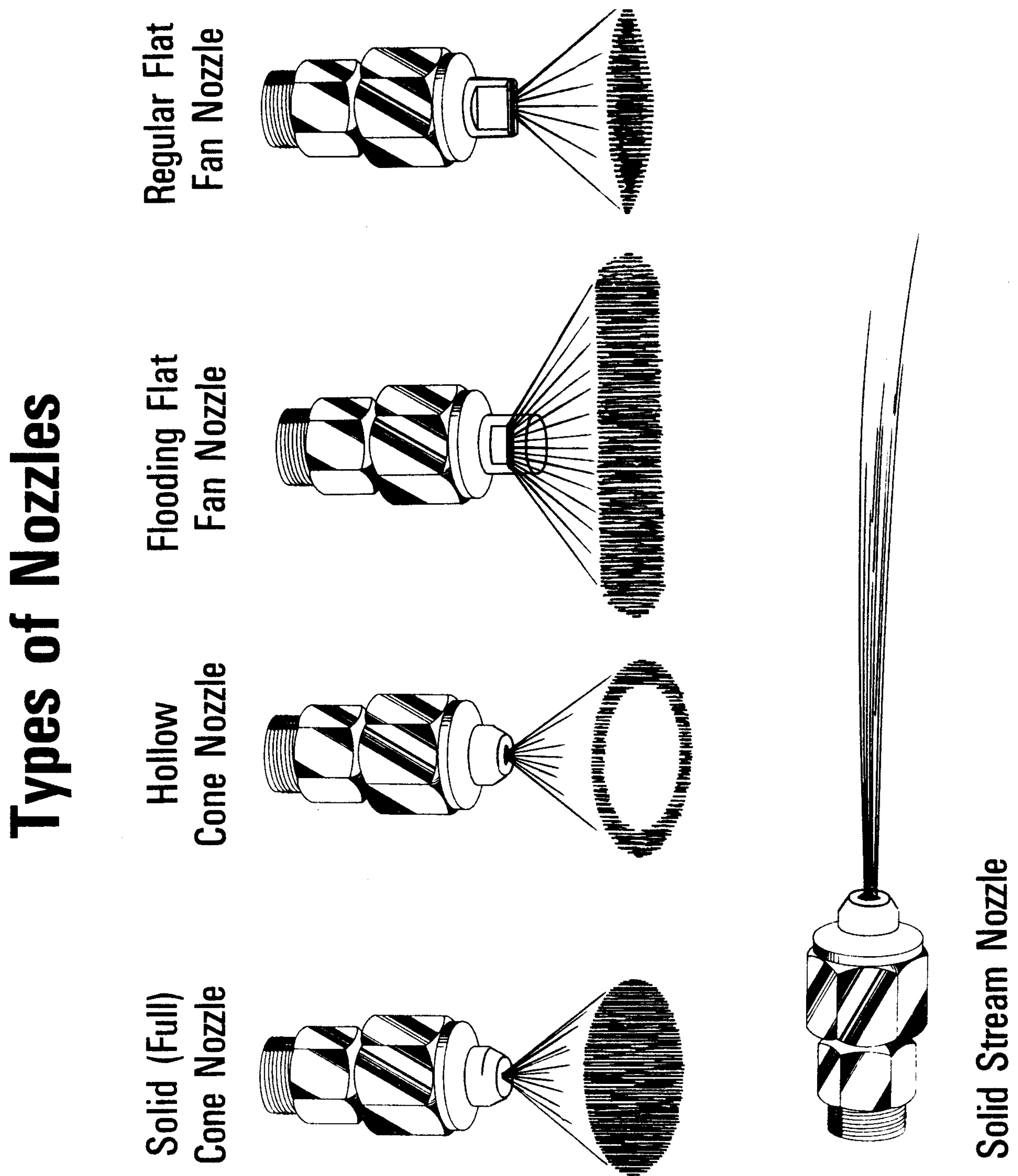


Hand Sprayer

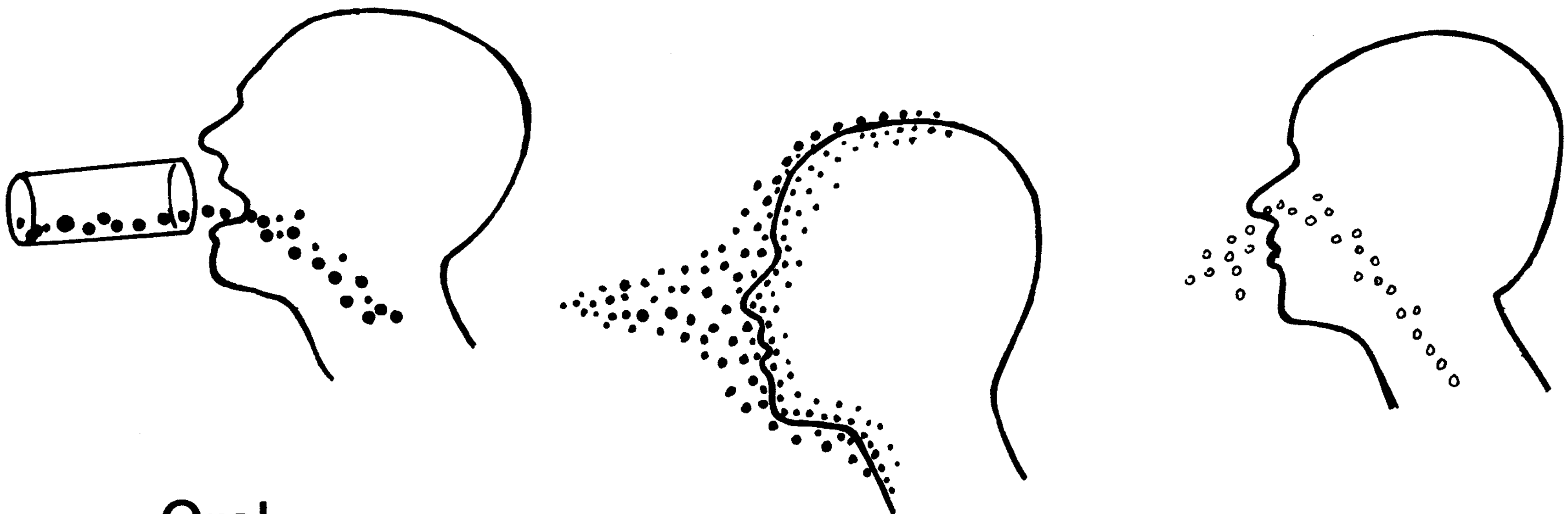
TM 14

Parts of a Sprayer




Types of Nozzles
Solid (Full) Cone Nozzle
Hollow Cone Nozzle
Flooding Flat Fan Nozzle
Regular Flat Fan Nozzle
Solid Stream Nozzle

Ways Pesticides Enter Body



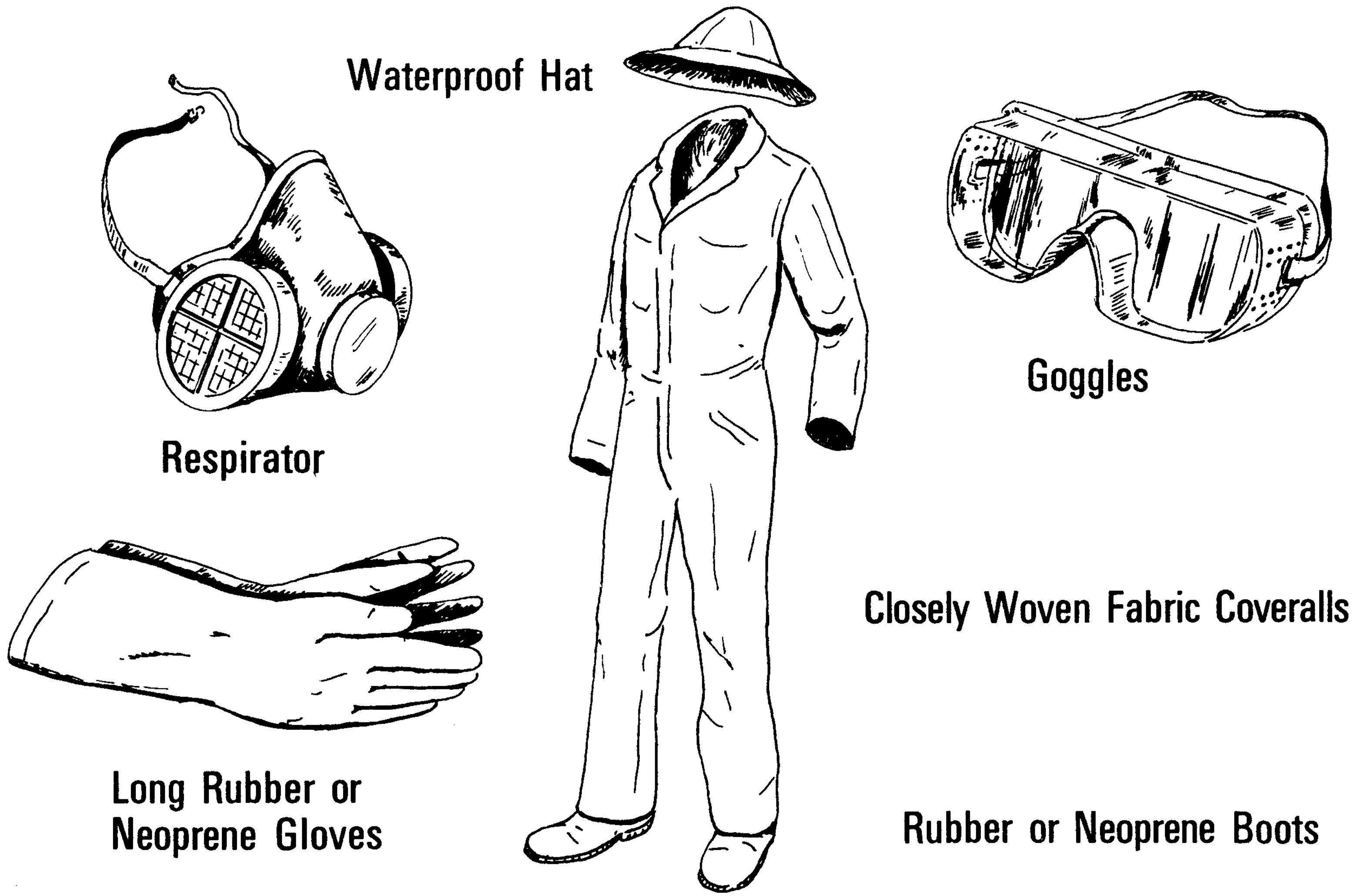
Oral

Dermal

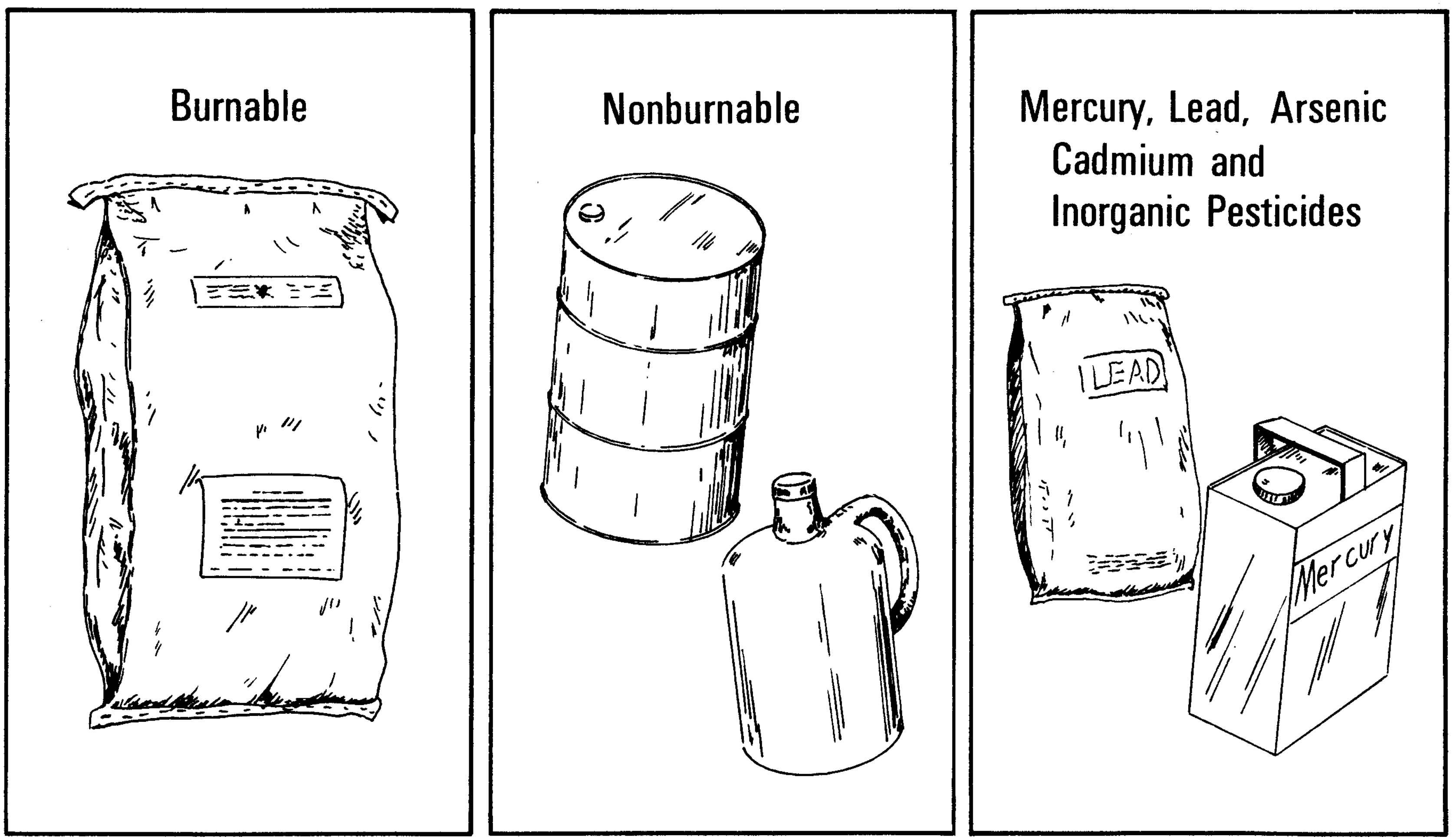
Inhalation

TM 17

Protective Clothing and Equipment

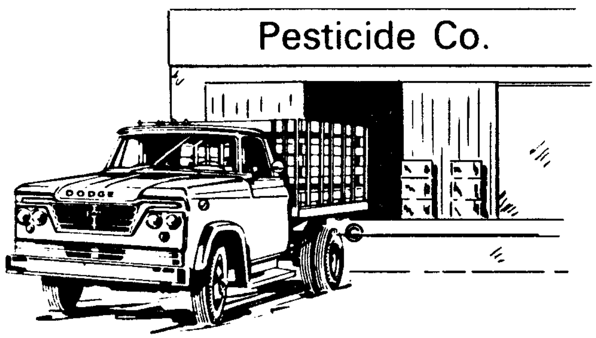


Container Classification



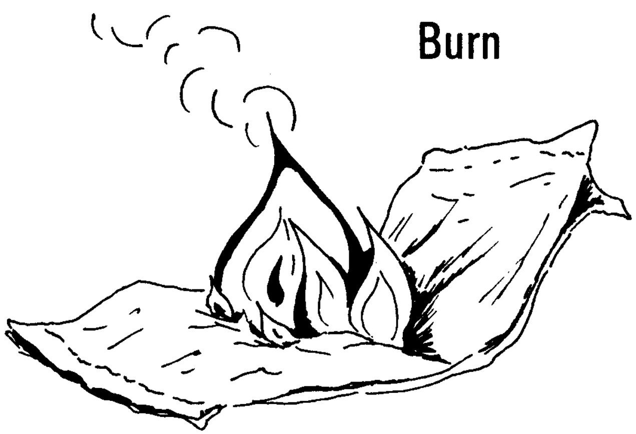
Disposal of Containers

Recycling

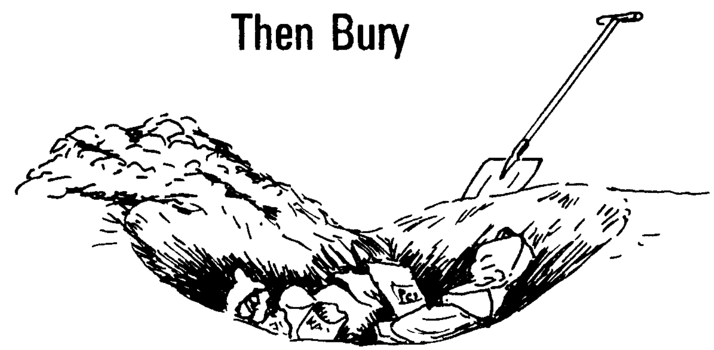


Break, Crush, or Cut Apart

Burn



Then Bury



Spray Record Sheet

Date and Time	Area or Target Treated and Pest	Equipment	Pesticide Name & Formulation, EPA Reg. Number, EPA Est. Number, & Rate (per acre, per 100 gallons, etc.)	Total Formulation Added To Tank or Hopper	Amount of Mixture Used	Amount Treated and Location	Additional Comments (Weather, applicator, severity of infestion, etc.)
5/12/73 3-5 PM	Smith's Alfalfa, Weevil	Lawrence Blower	Malathion Methoxychlor Double M, EC 3 qts./acre EPA Reg. #4625-329 EPA Est. #4625-NC-1	15 Gal.	50 Gal.	20 acres Fields across the road from Jones	NE winds at 4 mph, sunny 70°, driver KAP, Alfalfa Weevil
5/14/73 7-9 pm	Smith's Calves, Lice	Root-Lowell	Ciovap 5 1 oz./animal EPA Reg. #3765-153 EPA Est. #3765-Ak-1	4 Gal.	4 Gal.	500 Calves	Lice on Calves, Calves 5 weeks old, condition good, #47 sick, Helper KAP

CROP CHEMICALS

AG 150 - M

ASSIGNMENT SHEET #1--INTERPRET PESTICIDE LABELS

Name ______________________________ Score ______________

Read the label provided on the following page and answer the questions below.

1. What type of pest does this pesticide control?

2. Is this a short-term (nonpersistent) or residual (persistent) pesticide? Why?

3. What type of formulation is DeMetho?

4. Who was the manufacturer?

5. What is the percentage of active ingredients?

6. How much pesticide does this container hold?

7. What signal word is on this label?

8. What toxicity category does it represent?

9. What protective clothing would you wear?

10. Does this formulation go on as is or must it be diluted? If diluted, with what?

11. How should you store this container?

12. How do you dispose of this container?

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
(DANGER)

Poisonous by swallowing or inhalation. Do not breathe spray mist. Do not get in eyes. Avoid contact with skin. Use only when wearing the following protective equipment and clothing. Wear tightly-woven cotton overalls, waterproof hat, unlined neoprene gloves and boots. Wear safety goggles and/or face shield. Wear a mask or respirator jointly approved by the Mining Enforcement and Safety Administration and by the National Institute for Occupational Safety and Health. Before removing gloves, wash them with detergent and water. Always wash hands, face and arms with detergent and water before smoking, eating or drinking. For emergency assistance, call 000 000 0000

TO PHYSICIAN: De Metho is a reversible cholinesterase inhibitor. Do not use oximes such as 2 PAM. Give Atropine 2 mg. intravenously or subcutaneously. If in eye, instill one drop of Homatropine. Close supervision of the patient is indicated for at least 48 hours.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to wildlife and fish. Use with care when applying in areas frequented by wildlife or adjacent to any body of water. Keep out of lakes, streams or ponds. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from target area. Do not contaminate water by cleaning of equipment or disposal of wastes.

PHYSICAL OR CHEMICAL HAZARDS

Flammable! Keep away from heat and open flame.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

RE-ENTRY STATEMENT (IF APPLICABLE)

Do not enter area within 24 hours after application

CATEGORY OF APPLICATOR (IF APPLICABLE)

STORAGE AND DISPOSAL

STORAGE—Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited. DISPOSAL—Pesticide, spray mixture, or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies. Containers should be triple rinsed and offered for recycling, reconditioning, or disposed in approved landfill or buried in a safe place.
Consult Federal, State or local Disposal authorities for approved alternate procedures.

RESTRICTED USE PESTICIDE

FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION

DE METHO

INSECTICIDE

Emulsifiable Concentrate

ACTIVE INGREDIENT:	METHOMYL	24%
INERT INGREDIENTS:		76%
TOTAL:		100%

Net Content: 50 gallons

THIS PRODUCT CONTAINS 1.8 LBS OF DE METHO PER GALLON
DE METHO IS A REGISTERED TRADEMARK OF A-Z CORPORATION

KEEP OUT OF REACH OF CHILDREN
DANGER — POISON

STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED: Induce vomiting by giving a tablespoonful of salt in warm water. Repeat until vomitus is clear. Call a physician immediately.

IF INHALED: Remove to fresh air. Call a physician immediately.

IF IN EYES: Flush eyes with plenty of water for at least 15 minutes. Call a physician immediately.

IF ON SKIN: In case of contact, remove contaminated clothing and immediately wash skin with soap and water.

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

MFG BY A-Z CHEMICALS
PEST TOWN, VERMONT

ESTABLISHMENT NO. 1357-VT-1
EPA REGISTRATION NO. 1357-43

DIRECTIONS FOR USE
CONTINUED
SPRAY PREPARATION

Fill spray tank ¼ to ½ full of water. Add De Metho directly to spray tank and mix thoroughly, using mechanical or hydraulic means; do not use air agitation.

APPLICATION

Apply at the recommended rates when insects first appear. Unless otherwise noted, continue applications at 5- to 7-day intervals or as needed. Use sufficient water (5-15 gals per acre by air) to obtain thorough, uniform coverage. Apply the low rates on small plants, small worms and light infestations of insects. Use intermediate rates on larger worms and heavier infestations of insects. Use 1 to 3 applications of the highest recommended rate for controlling severe infestations. Thereafter, use the lowest rate possible to maintain control.

NOTICE TO BUYER

Seller warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. This warranty does not extend to use of the product contrary to label use directions, or under abnormal use conditions, or under conditions not reasonably foreseeable to seller; buyer assumes all risk of any such use. Seller makes no other warranties, express or implied.

Purchase of this material does not confer any rights under patents of countries outside of the United States.

CROP USAGE

CROPS (Method of application: A means Air, G means Ground)	INSECTS	PINTS PER ACRE	LAST APPLICATION DAYS: TO HARVEST	LAST APPLICATION DAYS: TO LIVESTOCK GRAZING/FEEDING
Alfalfa A G	Beet Armyworm, Lygus Bug	2-4		7
Beans (snap) G	Leafhoppers	1-2		3 [illegible]
	Mexican Bean Beetle	2	2	7 (hay)
Broccoli, Cauliflower A G	Diamondback Moth	1-2*	7	
	Cabbage Looper, Imp. Cabbageworm	2-4*	14	
Brussels Sprouts A G	Imp. Cabbageworm, Cabbage Looper	2-4*	14	
Cabbage A G	Diamondback Moth, Cabbage Looper, Imp. Cabbageworm	1-4*	2	
Celery A G	Cabbage Looper	4	14	
Corn (Sweet) A G	Earworm (Whorl as needed)	1 1/2-2	2 (ears)	3 (forage)
	Earworm (Ears 1-2 days or as needed)	1-2		
	Fall Armyworm, European Corn Borer (Ears 1-2 days or as needed)	2		
Cucumber G	Cabbage Looper	2-4	3	
Lettuce (Head) A G	Beet Armyworm	1-2	7	
	Cabbage and Alfalfa Loopers	2-4	10	
Melons G	Cabbage Looper	2-4	3	
Peanuts East of Miss. River G	Corn Earworm (up to 3 applications as needed)	1-4	21	Do not feed treated vines
Peppers A G	Green Peach Aphid	2	10	
Potato A G	Tuberworm, Cabbage Looper	2	14	
	Aphids	2-4		
	Leafhoppers, Flea Beetles (East of Miss. River)	2		
Squash (Summer) G	Cabbage Looper; Melonworm, Pickleworm (Southeast only)	2-4	3	
Tomato A G	Tomato Fruitworm, Aphids	2	2	
	Cabbage Looper, Beet Armyworm	over 2-4	2	
Tobacco (Except Shade) A G	Flea Beetle, Hornworm	1-2	7 (flue cured) 14 (air or fire cured)	
	Budworm (2-3 applications before Flower buds open), Cabbage Looper, Aphids	2		
Chrysanthemums G	Cabbage Looper, Corn Earworm, Beet Armyworm, Thrips (weekly)	1-2 pints per 100 gals		

*Add wetting agent

CROP CHEMICALS

AG 150 - M

ASSIGNMENT SHEET #2--CALCULATE SPRAY MATERIALS USING WETTABLE POWDER

Name ____ Score _______________________

Calculate the problems below and show your work.

1. How much wettable powder is needed to make 200 gallons of spray if recommended rate is 3 pounds per 50 gallons of water?

2. How many pounds of wettable powder are needed to make 100 gallons of spray if 3 pounds of 60% wettable powder is needed per acre and your sprayer applies 25 gallons per acre?

3. A farmer wants to spray a field of corn. The recommended strength of the spray is 0.5%. The wettable powder recommended is 50% and the spray tank holds 150 gallons. How much 50% WP is required for this mix?

$$\frac{\text{Gallons of spray wanted} \times \text{\% active ingredient needed} \times 8.3 \text{ pounds/gallon}}{\text{\% active ingredient in pesticide used}}$$

CROP CHEMICALS

AG 150 - M

ASSIGNMENT SHEET #3--CALCULATE SPRAY MATERIALS USING EMULSIFIABLE CONCENTRATE

Name ____ Score ____________________

Calculate the problems below and show your work.

1. How many quarts of 6EC are needed to mix 40 gallons if recommended amount is 2 quarts per acre and your sprayer applies 4 gallons per acre?

2. How many pints of 8EC are needed for 400 gallons of spray if recommended rate is 1/2 pint per 100 gallons of water?

3. A farmer wants to mix 200 gallons of 0.3% spray using 50% emulsifiable concentrate (4 pounds pesticide per gallon). How many gallons of concentrate will be needed?

$$\frac{\text{Gallons of spray wanted} \times \text{\% active ingredient} \times 8.3 \text{ pounds per gallon}}{\text{Pounds of active ingredient per gallon of concentrate} \times 100}$$

CROP CHEMICALS

AG 150 - M

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. Insects
2. Relatively short term; because it can be applied fairly close to harvest date and contains no other precautions on persistence
3. Emulsifiable concentrate
4. A-Z chemicals
5. 24%
6. 50 gallons
7. Danger (poison, skull and crossbones)
8. Highly toxic
9. Closely woven fabric coveralls
10. Diluted with water
11. In original container in a dry, locked pesticide storage area away from food, feed and livestock
12. Triple rinse, crush and bury in a safe place or in a local landfill, if legal

Assignment Sheet #2

1. 12 pounds
2. 12 pounds
3. 12.45 pounds or 12 1/2 pounds

Assignment Sheet #3

1. 20 quarts
2. 2 pints
3. 1.25 gallons

CROP CHEMICALS

AG 150 - M

UNIT TEST

Name ____ Score ______________________

1. Match terms associated with crop chemicals to the correct definitions. Write the correct numbers in the blanks.

_____a. Area, building , plant, animal or pest intended to be treated with pesticide

_____b. Causing injury to plant life

_____c. Through the mouth

_____d. Measurement of how much pesticide will be applied by the equipment to the site

_____e. Environmental Protection Agency

_____f. Maximum amount of pesticide which can legally remain on or in any food or feed crop at harvest or animal at slaughter

_____g. An unwanted organism

_____h. Pesticide which is more toxic to some types of plants or animals than to others

_____i. Pesticide that remains in the environment for a fairly long time

_____j. Risk of danger; chance that injury or harm will come to the applicator, other persons, plants or animals

_____k. Absorbed through the skin

_____l. Able to be combined with other pesticides and applied as a mixture without reducing their effectiveness

_____m. Any plant that interferes with human affairs

_____n. Lethal dose or amount of a pesticide which would kill half a large number of test animals if eaten or absorbed through the skin

_____o. Any living thing

_____p. Chemical or other substance that will prevent, repel, destroy or control a pest

1. Pesticide
2. Tolerance
3. Certification
4. Phytotoxicity
5. Hazard
6. EPA
7. Organism
8. Pest
9. Weed
10. Drift
11. Target
12. Short-term
13. Residual
14. Broad spectrum
15. Selective
16. Active ingredient
17. LD_{50}
18. Oral
19. Dermal
20. Inhalation
21. Formulation

______q.	Pesticide that breaks down almost immediately into non-toxic by-products	22.	Compatible
______r.	That part of a pesticide product which will kill or control pests or prevent damage by them	23.	Dilute
______s.	Breathed in through the lungs	24.	Calibration
______t.	To make a pesticide thinner or weaker by adding water, oil or other materials		
______u.	Mixture of one or more active ingredients with other materials needed to make a pesticide easy to store, handle, dilute and supply		
______v.	Recognition by certifying agent that a person is competent and thus authorized to use or supervise the use of restricted-use pesticides		
______w.	Pesticide which is toxic to a wide range of pests		
______x.	Movement of pesticide droplets or particles by wind and air currents		

2. List two functions of agricultural chemicals.

   a. ______________________________

   b. ______________________________

3. Name three main groups of pests.

   a. ______________________________

   b. ______________________________

   c. ______________________________

4. Match the pesticide with the pest it controls. Write the correct numbers in the blanks.

______a.	Nematode	1.	Herbicide
______b.	Spiders, ticks and mites	2.	Insecticide
______c.	Fungal diseases	3.	Fungicide
______d.	Plants; mainly weeds	4.	Bactericide
______e.	Rats and mice	5.	Nematicide
______f.	Flies and mosquitos	6.	Acaricide
______g.	Bacterial diseases	7.	Rodenticide

5. Select from the following list results of discontinued pesticide use. Write an "X" in the blank before each correct answer.

_____a. Yields would increase

_____b. Food would be more expensive

_____c. Food would be more available

_____d. Food would be of lower quality

_____e. Labor requirements would decrease

_____f. More of work force involved in agriculture

_____g. Exports would increase

6. Match the EPA classification of pesticides to the correct definition. Write the correct numbers in the blanks.

_____a. Pesticide use which will not cause excessive damage in the environment or endanger the applicator or other persons when applied according to label directions	1.	General use
_____b. Pesticide use which may cause damage in the environment or endanger the applicator or other persons unless label directions are followed	2.	Restricted use

7. Select from the following list resources necessary for man to exist. Write an "X" in the blank before each correct answer.

_____a. High paying job

_____b. Clean water

_____c. Food

_____d. Companionship

_____e. Clean air

_____f. Shelter

8. Name two ways pesticides are beneficial to the environment.

a. ____

b. ____

9. Name two ways improper use of pesticides can harm the environment.

a. ____

b. ____

10. Select from the following list facts contained on a pesticide label. Write an "X" in the blank before each correct answer.

_____a. Name of manufacturer

_____b. Active ingredients

_____c. Formulation

_____d. Pest controlled

_____e. Price

_____f. Storage and disposal precautions

_____g. Net content

_____h. Signal word

_____i. Directions for use

11. Match signal words found on labels with the correct toxicity level. Write the correct numbers in the blanks.

_____a.	Slightly toxic to relatively non-toxic pesticides	1.	Danger
_____b.	Moderately toxic pesticides	2.	Warning
_____c.	Highly toxic pesticides	3.	Caution

12. Match the herbicide classification with the correct description. Write the correct numbers in the blanks.

_____a.	Kills only part of plant to which it is applied; not translocated	1.	Selective
_____b.	Applied to soil before crop is planted	2.	Nonselective
_____c.	Absorbed by roots and foliage and translocated throughout plant; kills entire plant	3.	Contact
		4.	Systemic
_____d.	Kills all plants present if applied at an adequate rate	5.	Preplant
_____e.	Applied after emergence of the crops or weeds	6.	Preemergence
_____f.	Applied to soil prior to emergence but after crop planting	7.	Postemergence
_____g.	Used to control weeds without significant damage to crop		

13. Match the types of pesticide formulations to the correct description. Write the correct numbers in the blanks.

_____a. Very finely ground solid material which is suspended in a liquid; usually contains a high concentration of active ingredient which should be mixed with water

_____b. Dry preparation which may contain a fairly high concentration of active ingredient that dissolves in water to form a solution for application

_____c. Solution which contains a high concentration of active ingredient which should be mixed with water

_____d. Active ingredient is in the form of a gas or liquid which becomes gas when applied, and reaches the target as a gas

_____e. Ready-to-use dry mixture of a small amount of active ingredient and inert carriers with all particles larger than dust particles

1. Granule
2. Emulsifiable concentrate
3. Flowable
4. Wettable powder
5. Fumigant

14. Discuss the advantages, disadvantages and principal uses of granule and wettable powder formulations.

____

____

____

____

____

____

____

____

____

____

____

____

15. Arrange in proper sequence the procedure for mixing wettable powders. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Measure out correct amount of wettable powder

_____b. Start agitator

_____c. Finish filling the tank

_____d. Stir until well mixed

_____e. Fill tank one-half full of water

_____f. Add slurry to tank

_____g. Add powder to a small amount of water in a clean mixing bucket

16. Arrange in proper sequence the procedure for mixing emulsifiable concentrates. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Add EC directly into spray tank

_____b. Measure out correct amount of EC

_____c. Mix thoroughly using mechanical or hydraulic agitation

_____d. Fill tank one-fourth to one-half full with water

_____e. Finish filling tank

17. List four safety precautions when mixing and handling pesticides.

a. ____

b. ____

c. ____

d. ____

18. Calculate the following problem to determine the amount of wettable powder to use. Use the following formula and show your work.

$$\frac{\text{Gallons spray needed} \times \text{\% active ingredient wanted} \times \text{8.3 lbs per gallon water}}{\text{\% active ingredient in pesticide used}}$$

Problem: A local expert recommended using a 0.2% spray. You have on hand a 50% wettable powder of the right pesticide and you need 75 gallons of the spray. How much pesticide is needed?

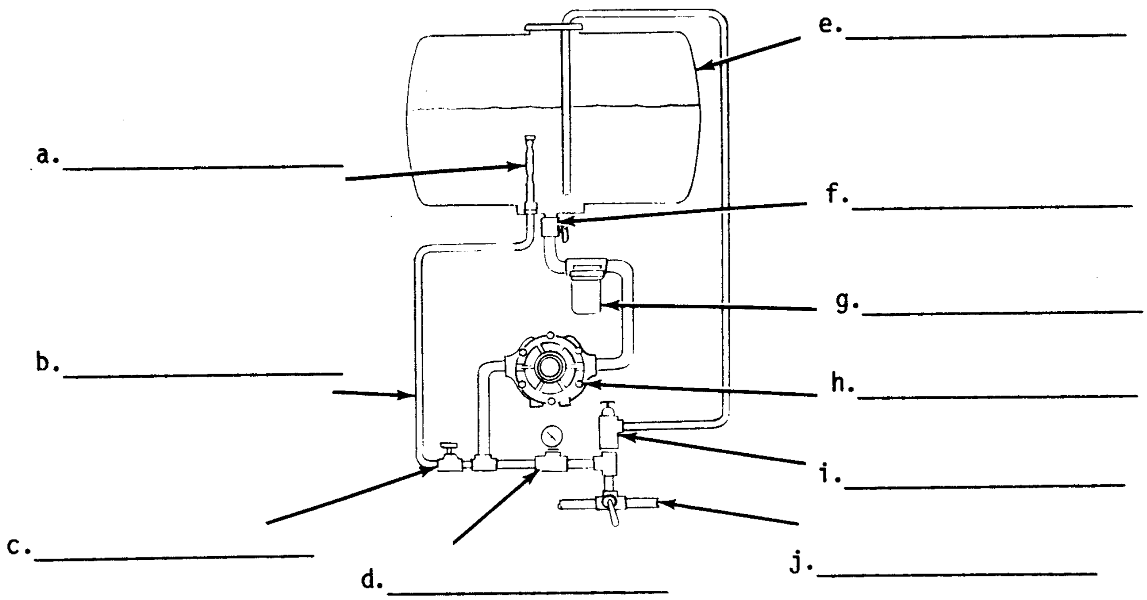
19. Calculate the problem below determining the amount of emulsifiable concentrate to use. Show your work.

    Problem: The label recommends using 3 pints per acre of 6EC. Your sprayer holds 60 gallons and applies 6 gallons per acre. How much 6EC is needed?

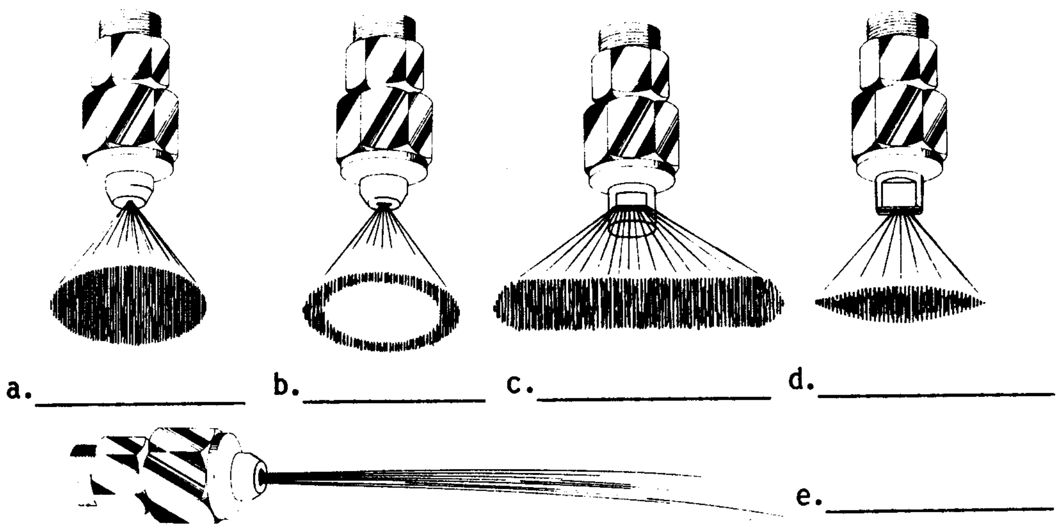
20. Match methods of pesticide application to the correct description. Write the correct numbers in the blanks.

_____a.	Uniform application to an entire specified area	1.	Band
_____b.	Saturation of the soil with a pesticide	2.	Broadcast
_____c.	Application to or in a furrow in which a crop is planted	3.	Directed
_____d.	Aiming the pesticide at a portion of a plant	4.	Drench
_____e.	Application along the side of a crop row	5.	Foliar
_____f.	Application to a small area	6.	In-furrow
_____g.	Application to a strip over or along each crop row	7.	Sidedress
_____h.	Application to the leaves of a plant	8.	Soil incorporation
_____i.	Application to the soil followed by use of tillage implements to mix the pesticide with the soil	9.	Spot treatment

21. Identify the parts of a sprayer. Write the correct names in the blanks.



22. Identify the type of nozzle by its spray pattern. Write the correct names in the blanks.



23. Name two climatic factors that affect pesticide application.

a. ______________________________

b. ______________________________

24. List four factors to consider when choosing the appropriate pesticide.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

25. Name the two causes of most pesticide poisoning.

a. ______________________________

b. ______________________________

26. List three ways pesticides enter the body.

a. ______________________________

b. ______________________________

c. ______________________________

27. List the most important routes of entry for:

a. Applicators______________________________

b. Small children ______________________________

28. List three steps to follow in case of a pesticide poisoning.

a. ______________________________

b. ______________________________

c. ______________________________

29. Name the local hospital or poison control center that serves your area that can provide emergency treatment for pesticide poisoning.

____

30. Select from the following list protective clothing and equipment needed for pesticide application. Write an "X" in the blank before each correct answer.

_____a. Unlined, neoprene gloves

_____b. Tightly woven fabric coveralls

_____c. Heavy, lined leather gloves

_____d. Unlined, neoprene boots

_____e. Sturdy canvas or leather boots

_____f. Tight fitting goggles or face shield

_____g. Pant legs on inside of boots

_____h. Waterproof hat

_____i. Waterproof suit when mixing highly toxic pesticides

31. Select from the following list ways to prevent exposure during application. Write an "X" in the blank before each correct answer.

_____a. Keep livestock out of spray area

_____b. Never eat, drink or smoke when handling pesticides

_____c. Do not wipe hands on clothing

_____d. Work in pairs when handling hazardous pesticides

_____e. Never blow out clogged lines with your mouth

_____f. Wear protective clothing and equipment

32. Name four methods for disposal of pesticides and pesticide containers.

a. ____

b. ____

c. ____

d. ____

33. List four reasons for keeping records of pesticide use.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

34. Describe proper pesticide storage site, building and conditions.

Site

____

____

____

Building

____

____

____

____

____

____

Conditions

____

____

____

35. Discuss regulations governing pesticide use.

____

____

____

____

CROP CHEMICALS

AG 150 - M

ANSWERS TO TEST

1.

a.	11	g.	8	m.	9	s.	20
b.	4	h.	15	n.	17	t.	23
c.	18	i.	13	o.	7	u.	21
d.	24	j.	5	p.	1	v.	3
e.	6	k.	19	q.	12	w.	14
f.	2	l.	22	r.	16	x.	10

2. Improve crop growth; Protect against crop pest

3. Answer should include three of the following:

   Insects; Mites, ticks and spiders; Bacteria, fungi and viruses; Nematodes; Vertebrate animals; Weeds

4.

a.	5	e.	7
b.	6	f.	2
c.	3	g.	4
d.	1		

5. b, d, f

6. a. 1 b. 2

7. b, c, e, f

8. Answer should include two of the following:

   Enable more food to be produced on same area; Control plant diseases, parasites, insects and weeds; Control animal diseases, parasites and insects; Preserve outdoor activities

9. Answer should include two of the following:

   Cause nature imbalance; Pollute streams and water supply; Pollute crops; Pollute soil; Injure desirable plants; Persistent residues in food chain

10. a, b, c, d, f, g, h, i

11. a. 3 b. 2 c. 1

12.

a.	3	e.	7
b.	5	f.	6
c.	4	g.	1
d.	2		

13. a. 3 b. 4 c. 2 d. 5 e. 1

14. Answer should include information from the following:

Formulation	Advantages	Disadvantages	Principle Uses
Granule	Ready to use; easy to apply; can be applied to target under dense foliage	Limited foliage use	Soil treatment
Wettable Powder	Relatively in-expensive; safer than emulsifiable concentrate to use on tender foliage; easy to measure	May be hazardous to applicator; requires mechanical agitation; difficult to mix; may clog nozzles; dusty	Fruits and vegetables, farm animals, field crops

15. a. 3 e. 1
b. 2 f. 6
c. 7 g. 4
d. 5

16. a. 3 b. 2 c. 4 d. 1 e. 5

17. Answer should include four of the following:

Follow all safety precautions stated on label; Use protective clothing and equipment; Rinse empty containers and measuring cups; Only mix compatible pesticides; Avoid splashes, spills and leaks; Wash all contaminated areas on clothing or equipment; Dispose of empty containers properly

18. 2.5 lbs per 75 gallons of water

19. 30 pints or 15 quarts or 3 gallons and 3 quarts

20. a. 2 e. 7 i. 8
b. 4 f. 9
c. 6 g. 1
d. 3 h. 5

21. a. Agitator e. Tank h. Pump
b. Agitation Line f. Shut off i. Relief Valve
c. Control Valve g. Line Strainer j. Boom or nozzle
d. Pressure guage

22. a. Solid cone c. Flooding flat e. Solid Stream
b. Hollow cone d. Regular flat

23. Answer should include two of the following:

Soil moisture; Rain; Humidity; Temperature; Light

24. Answer should include four of the following:

    Has directions on the label for the intended use; Is effective against the pest; Will not cause injury to the plant or other surface to which it is applied; Will cause the least damage to beneficial organisms; Will not move off the treated area and into environment to harm fish and wildlife; Works well in the machinery available; Is worth the cost; Toxicity to man, animals and other plants

25. Careless practices; Ignorance

26. Oral; Dermal; Inhalation

27. a. Dermal and inhalation
    b. Oral and dermal

28. Check to see if patient is breathing; Call doctor or take victim to doctor or hospital; Locate pesticide label and have available for doctor

29. Evaluated to satisfaction of instructor

30. a, b, d, f, h, i

31. a, b, c, d, e, f

32. Answer should include four of the following:

    Open burning; Burial; Recycling; Pesticide-approved incinerator; Chemical degradation; Soil injection; Encapsulation

33. Answer should include four of the following:

    Help in finding an error if an error is made; Provide information to trace residue and/or damage problems; Help save money; Allow one to compare the results obtained from different pesticides; Help to reduce pesticide misuse; Provide guide to buying specific amount of pesticide needed; Establish proof of proper use in damage suit

34. Answer should include the following information:

    Site: Separate from other equipment or material storage facilities; Not located on flood plain; Spill and drainage containment for large storage facilities
    Building: Fire resistant; Cement floor; Exhaust fan for ventilation; Well-lit; Locked door; Sufficient storage area
    Conditions: Keep products off the floor; Store containers so that the labels remain in good condition; Keep pesticides dry, cool and out of direct sunlight

35. Applicator must be licensed to apply restricted-use pesticides; Custom applicator license required if applying chemical to land farmed by someone else

SEED SELECTION

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UNIT OBJECTIVE

After completion of this unit, students should be able to select good quality seed, list factors to consider in selecting high quality seed and conditions that exist when good seed is not selected. Students should also be able to list the certifiable seed classes, list information required on certified seed tags and calculate pure live seed. This knowledge will be demonstrated by completion of assignment sheets, laboratory exercises and unit test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES AND COMPETENCIES

After completion of this unit, the student should be able to:

1. Match terms associated with seed selection to the correct definitions.
2. List four factors to consider in selecting high quality seed.
3. Select conditions that exist when good seed is not selected.
4. List two means of securing good seed.
5. Arrange in order the four certifiable seed classes.
6. Select information required on certified seed tags.
7. Name three types of seed treatment.
8. Select procedures to follow in handling and storing seed.
9. Calculate the value of pure live seed.
10. Compare seed lots.
11. Conduct a warm germination test.
12. Conduct a cold germination test.
13. Conduct a TZ germination test.

SEED SELECTION

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SUGGESTED ACTIVITIES

I. Suggested activities for instructor

A. Order materials to supplement unit.

1. Literature

a. *Idaho Bean Commission*, 415 S. 13th, P.O. Box 9433, Boise, Idaho 83707.

b. *Idaho Rules of Certification*, Idaho Crop Improvement Association, Inc., 1641 S. Curtis Road, Boise, Idaho 83705.

c. *Vegetable Grower's Seed Guide*, Asgrow Seed Company, Kalamazoo, Michigan 49001.

2. Films

a. *Certified Seed*, 13 1/2 minutes, available in Beta or VHS format; explains what certified seed is, how it is produced and what the benefits are to farmers who use it; available from University of Idaho District Extension Office; also available from Agricultural Communications Center, 10 Ag Science Building, Moscow, Idaho 83843 (208-885-6436); program #229; purchase price $25; rental price $10 for 14 days.

B. Make transparencies and necessary copies of materials.

C. Provide students with objective sheet and discuss.

D. Provide students with information and assignment sheets and laboratory exercises.

E. Discuss information and assignment sheets and demonstrate procedures outlined in laboratory exercises.

F. Review and give test.

G. Reteach and retest if necessary.

II. Instructional materials

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Transparency master

1. TM 1--Seed Label Requirements

E. Assignment sheets

1. AS 1--Determine Seed Value

2. AS 2--Compare Seed Lots

F. Answers to assignment sheets

G. Laboratory exercises

1. LE 1--The Warm Germination Test

2. LE 2--The Cold Germination Test

3. LE 3--The TZ Germination Test

H. Test

I. Answers to test

III. Unit references

A. Cooper, Elmer L., *Agriscience Fundamentals and Applications*, Delmar Publishers, Inc., Albany, New York 12212, 1990.

B. Delorit, R.J., et al., *Crop Production,* 5th edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1984.

C. Fridline, C.R., *Seed Production of Corn, Small Grains, and Soybeans*, Ohio Agricultural Education Curriculum Materials Service, Columbus, Ohio, 1977.

D. *Idaho Rules of Certification,* Idaho Crop Improvement Association, Inc., Boise, Idaho, 1983.

E. Murray, G., *"Plant Science 407: Crop Production"*, Class notes, Spring 1983, University of Idaho, Moscow, Idaho.

F. *Planting*, Vo-Ag I, Unit IV-F, Teaching Materials Center, Agriculture Education Department, Texas A & M University, College Station, Texas.

G. *Seed Selection*, Vo-Ag II, Unit IV, Oklahoma State Board for Vocational Technical Education, Stillwater, Oklahoma.

H. *Vegetable Grower's Seed Guide,* Asgrow Seed Company, Kalamazoo, Michigan, 1982.

SEED SELECTION

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INFORMATION SHEET

I. Terms and definitions

   A. Seed--Plant embryo and stored food surrounded by a seed coat

   B. Breeder seed--Seed or vegetatively propagated material that is controlled by the originator; initial source of seed for that variety

   C. Foundation seed--Second link in the certified seed chain; produced from breeder seed and handled in such a way as to ensure genetic identity and varietal purity

   D. Registered seed--Third link in the certified seed chain; seed produced from foundation seed or recertified registered seed; used to produce certified seed

   E. Certified seed--Seed which is guaranteed by a state agency to meet certain minimum requirements in respect to purity, germination and other characteristics; may be progeny of foundation, registered or reregistered certified seed

   F. Common seed--No minimum requirements in respect to purity, germination percentage and other characteristics; not inspected by state agency

   G. Inert matter--Percentage by weight of chaff, broken seeds, stems and soil particles

   H. Hard seed--Seed which remains hard at the end of the prescribed test because it has not absorbed water due to an impermeable seed coat

   I. Pure live seed--Amount of seed when planted that has potential to produce plants

II. Factors to consider in selecting high quality seed

   A. Purity

   (Note: Good seed should be free from noxious weeds, inert matter, dirt, chaff and seeds of other crops or other varieties.)

   B. Viability

   (Note: Viability is determined by germination percentage and vigor index, if present. Generally, 85% germination is considered minimum. Check date on seed. If it is more than one year old, it should be retested for germination percentage. Refer to Idaho Rules of Certification for exact requirements of certified seed.)

C. Free of disease

(Note: The great loss in using diseased seed is not in the cost of the seed, but in the cost of control measures or loss in crop produced from the disease.)

D. Free of insects

E. Size and plumpness

(Note: Large, plump and well developed seeds contain more plant food to give the young plant a good start.)

III. Conditions that exist when good seed is not selected

A. Low germination percentage

B. Large amount of inert matter

C. Has large amount of other crop seed

D. Infested with weed seed

E. Lacks resistance to or harbors disease

F. Lacks resistance to or is infested by insects

G. Lacks adaptability to certain climatic and growing conditions

H. Fails to remain viable from harvest to planting time

IV. Means of securing good seed

A. Home grown

B. Reliable seed dealers

V. Certifiable seed classes

(Note: Potatoes are not classified using this system.)

A. Breeder seed

(Note: Breeder seed has the strictest requirements of classes for pest control, isolation, genetic purity and handling to prevent contamination of seed lot.)

B. Foundation seed

(Note: Foundation seed is first to get into the hands of the grower; distribution is usually only to "select" growers in an area; progeny of breeder seed.)

C. Registered seed

(Note: Progeny of either foundation or recertified registered seed; requirements of this class are not as strict as breeder and foundation.)

D. Certified seed

(Note: Progeny of either foundation, registered or reregistered certified seed; this class has the lowest requirements of certifiable classes, but are still quite strict.)

VI. Information required on certified seed tag (Transparency 1)

A. Common name of seed represented

Example: UI 114 - Bean

B. Percent by weight of purity

C. Percent by weight of weed seeds

D. Number of seeds per pound of noxious weeds

E. Percent germination

F. Date

VII. Types of seed treatment

A. Chemical

(Note: Most chemical seed treatments are general fungicides to control seed or soil-borne fungal seedling diseases.)

B. Pelletizing

(Note: Pelletizing seed is done mainly to make the seed size more uniform for ease of planting. Pelletizing also enhances germination, and chemicals may be added during process to aid in pest control. Some seed treatments are harmful to the inoculant.)

C. Inoculation

(Note: Legumes are able to fix atmospheric nitrogen through a symbiotic relationship with rhizobium bacteria. Inoculation is coating of the seed with this bacteria to ensure its presence in the soil.)

VIII. Procedure to follow in handling and storing seed

A. Purchase foundation, registered or certified seed for planting

B. Select clean seed

C. Control weeds

D. Prevent seed from mixing

E. Store in a cool, dry place

F. Treat seed for insects and disease

G. Protect from rodents

H. Test seed for germination

I. Inspect seed during storage

J. Make sure seed moisture is favorable for storage before harvesting home grown seed

IX. Determining the value of pure live seed

A. Using the prices and labels from two different lots of Common Bermuda grass seed, the better seed can be selected by the number of pounds of pure live seed that are in each lot and the cost per pound of each lot

1. Label information

Lot 1		Lot 2	
Germination	85.00%	Germination	80.00%
Inert matter	1.33%	Inert matter	2.45%
Weed seed	.02%	Weed seed	.02%
Other crop seed	2.78%	Other crop seed	3.78%

2. Determine purity content

Lot 1		Lot 2	
Inert matter	1.33%	Inert matter	2.45%
Weed seed	.02%	Weed seed	.02%
Other crop seed	2.78%	Other crop seed	3.78%
Non-purities	4.13%	Non-purities	6.25%

Lot 1	Lot 2
100.00%	100.00%
- 4.13%	- 6.25%
95.87% pure seed	93.75% pure seed

3. Cost--Lot 1 is $65.00 cwt, and Lot 2 is $62.00 cwt.

4. Determine value of different lots

Formula

$$\frac{\text{Price per unit}}{\text{purity \%} \times \text{germination \%}} = \text{Price paid per hundred pounds of pure live seed}$$

Lot 1

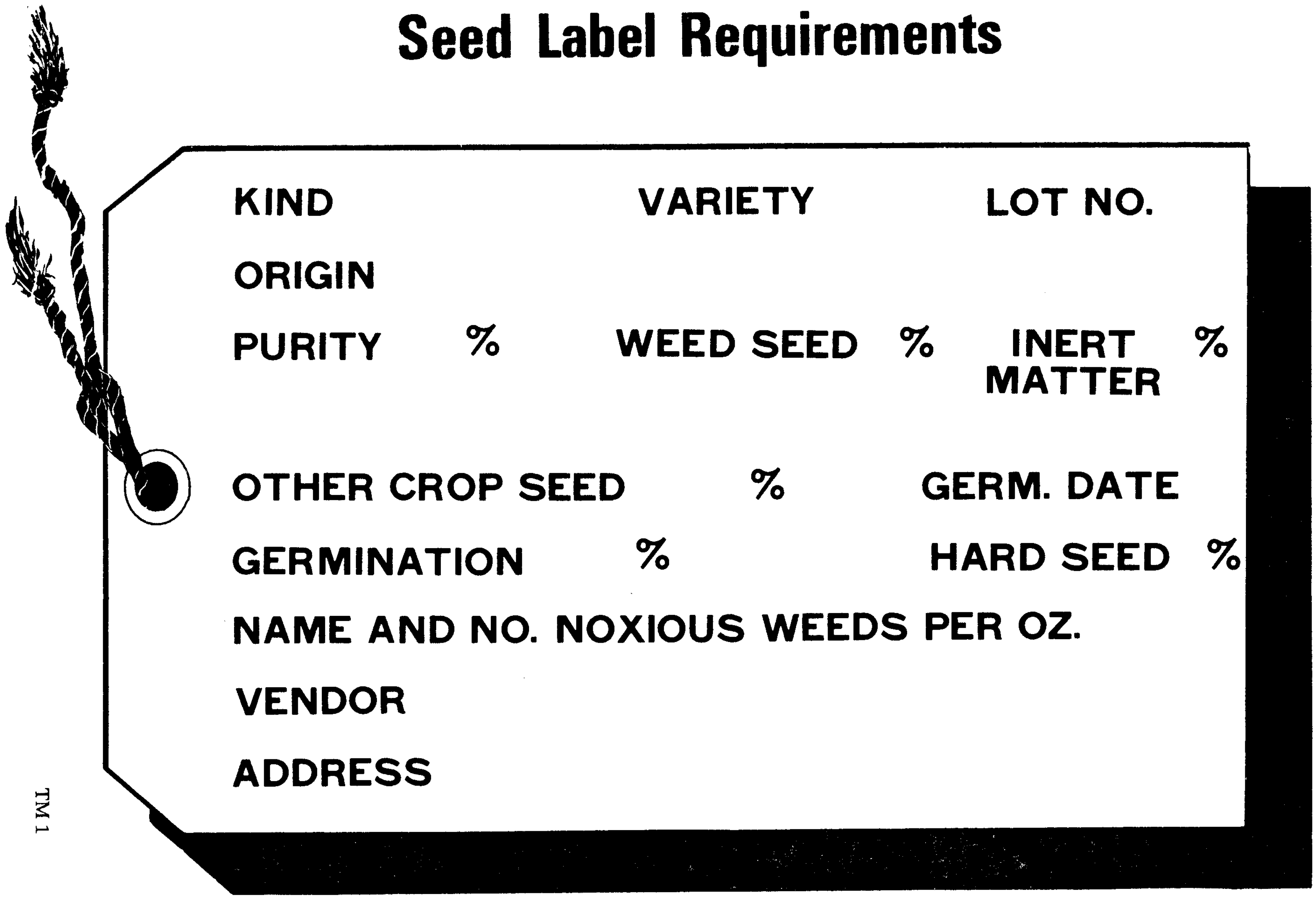
$$\frac{\$65.00}{.9587 \times .85} = \$80.24 \text{ per hundred pounds}$$

Lot 2

$$\frac{\$62.00}{.9375 \times .80} = \$84.00 \text{ per hundred pounds}$$

(Note: The seed cost of Lot 2 is more expensive for pure seed, even though the price per hundred weight is slightly lower than Lot 1. Before buying seed, the seed label should be studied. It is the "key" to the best seed buy.)

Seed Label Requirements



TM 1

SEED SELECTION

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ASSIGNMENT SHEET #1--DETERMINE SEED VALUE

Name ____ Score ______________________

Pure live seed is used as a method of determining seed values by comparing purity and germination in relation to price. In determining seed values use the following formula:

$$\frac{\text{Price per unit}}{\text{Purity X Germination}} = \text{Price per unit of pure live seed}$$

Lot A		Lot B	
Germination	80.0%	Germination	94.0%
Inert matter	4.5%	Inert matter	3.0%
Other crop seeds	.3%	Other crop seeds	.3%
Weed seeds	.2%	Weed seeds	.2%
Price per bu. of 60 lbs: $5.00		Price per bu. of 60 lbs: $5.50	

Using the preceding information, answer the following questions.

1. How many pounds of pure seed in
   a. Lot A
   b. Lot B
2. How many pounds of pure live seed in
   a. Lot A
   b. Lot B
3. What is the difference between pure seed and pure live seed?
4. How much per bushel will pure live seed cost in
   a. Lot A
   b. Lot B

SEED SELECTION

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ASSIGNMENT SHEET #2--COMPARE SEED LOTS

Name ____ Score ____________________

Pure live seed is used as a method of determining seed values by comparing purity and germination in relation to price. In determining seed values use the following formula:

$$\frac{\text{Price per unit}}{\text{Purity} \times \text{Germination}} = \text{Price per unit of pure live seed}$$

Obtain at least two seed labels from different lots of the same crop (wheat, beans, etc.). Fill in the needed information from the seed label.

Kind of Seed and I.D. No.	Cost/Bu or Lb	Germi-nation %	Weed Seeds %	Inert Matter %	Other Seeds %	Purity %	Price/Unit Pure Live Seed

SEED SELECTION

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ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. a. 57 pounds

   b. 57.9 pounds

2. a. 45.6 pounds

   b. 54.4 pounds

3. Pure live seed considers germination percentage and purity, while pure seed considers only purity.

4. a. $6.58/bushel

   b. $6.06/bushel

Assignment Sheet #2

Evaluated to satisfaction of instructor

SEED SELECTION

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LABORATORY EXERCISE #1--THE WARM GERMINATION TEST

Name ____ Score _______________________

I. Equipment

A. Adequate supply of corn, bean, wheat and oat seeds

B. A roll of paper towels or strips of absorbent cloth 12 inches wide and 12 to 16 inches in length. The length of cloth strips can be determined by the number of seeds to be tested

C. A bucket, tub or other suitable container to hold the paper or cloth rolls containing the seeds

II. Procedure

A. Select a predetermined number of seeds to be tested (10, 20, 50 or 100)

B. Place the seeds between moistened layers of paper towels or cloths. Seeds should be spaced 1 inch apart for easier counting later

C. Roll up the moistened towels or cloths and place in a suitable container. Keep rolls moist throughout the test period and the temperature at 60^{o}-70^{o}F

D. Mark each roll with an identifying number or letter

E. Check each roll for germination after three days. Count and record the number of seeds that show root or stem sprouts or both. Repeat the above procedure after five days

F. At the end of seven days, count all seeds showing strong stem and root sprouts

G. Calculate the germination percentage by dividing the number of germinated seeds by the total number used in the test (and multiplying by 100)

SEED SELECTION

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LABORATORY EXERCISES #2--THE COLD GERMINATION TEST

Name ____ Score ______________________

I. Equipment

A. About one gallon of soil-sand mixture (75% soil, 25% sand) is needed for each test to be made

B. A roll of heavy-duty paper towels (made specifically for germination tests) or strips of absorbent cloth 12 inches wide and 2 to 4 feet long

C. Adequate supply of corn and bean seeds. If a comparison between warm and cold germination tests is to be made, the seeds for both tests should come from the same lot

D. A refrigerator where the temperature can be kept at 50^{o}F

II. Procedure

A. Select the seeds to be tested

B. Place the seeds on the paper towels or cloth strips about one inch apart. Sprinkle the moistened soil-sand mixture over the seeds, barely covering them. Cover the seed and soil mixture with another paper towel and roll up. Place in a suitable container and keep rolls moist throughout the test period

C. For one week, place the seed and soil-sand mixture in a refrigerator set at 50^{o}F

D. Remove from the refrigerator to a warmer area of 65^{o}-70^{o}F for one week to permit germination

E. Count the germinated seeds and calculate germination percentage

F. Observe results and make conclusions

SEED SELECTION

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LABORATORY EXERCISE #3--THE TZ GERMINATION TEST

Name ____ Score ______________________

I. Equipment

A. Adequate supply of corn and bean seed. For comparison purposes, seeds from the same lots used in the warm and cold germination tests should be used

B. Small supply of 2, 3, 5-triphenyl tetrazolium chloride. This can be obtained from the Idaho Crop Improvement Association

II. Procedure

A. Soak seeds in warm water at a temperature of 85^{o}- 100^{o}F for about two hours. (A longer period will do no harm.) This soaking will soften the seeds and activate the enzymes inside them

B. Cut the seeds to be tested lengthwise through the center to expose the full length of the germ. Seeds are easily cut with a sharp single-edged, safety razor blade

C. Place halves of the sectioned seeds in a 1.0% solution of TZ. Then warm the solution to 85^{o}- 100^{o}F or leave at room temperature (75^{o}F). Leave the seed halves in the solution two hours at 85^{o}- 100^{o}F or four hours at 75^{o}F

D. Remove seed halves from the solution and examine with a magnifying lens for color changes. All actively respiring parts of the germ become red or deep pink. The endosperm and all dead parts of the germ do not change color. When the entire germ of the seed turns red, the seed is alive and capable of germinating

SEED SELECTION

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UNIT TEST

Name ____ Score _______________________

1. Match terms associated with seed selection to the correct definitions. Write the correct numbers in the blanks.

_____a.	Seed which is guaranteed by a state agency to meet certain minimum requirements in respect to purity, germination and other characteristics	1. Seed
		2. Breeder seed
_____b.	Plant embryo and stored food surrounded by a seed coat	3. Foundation seed
		4. Registered seed
_____c.	Second link in the certified seed chain, produced from breeder seed and handled in such a way as to ensure genetic identity and varietal purity	5. Certified seed
		6. Common seed
_____d.	Percentage by weight of chaff, broken seeds, stems and soil particles	7. Inert matter
_____e.	Amount of seed when planted that has potential to produce plants	8. Hard seed
		9. Pure live seed
_____f.	No minimum requirements in respect to purity, germination percentage and other characteristics; not inspected by a state agency	
_____g.	Third link in certified seed chain; seed produced from foundation seed or recertified registered seed	
_____h.	Seed which remains hard at the end of the prescribed test because it has not absorbed water due to an impermeable seed coat	
_____i.	Seed or vegetatively propagated material that is controlled by the originator; initial source of seed for that variety	

2. List four factors to consider in selecting high quality seed.

a. ____

b. ____

c. ____

d. ____

3. Select from the following list conditions that exist when good seed is not selected. Write an "X" in the blank before each correct answer.

_____a. Lacks resistance to or is infested by insects

_____b. Has small amount of inert matter

_____c. Lacks viability

_____d. Infested with weed seed

_____e. Has large amount of other crop seed

_____f. Is adapted to local growing conditions

_____g. Resistant to local disease

_____h. Low germination percentage

4. List two means of securing good seed.

a. ____

b. ____

5. Arrange in order the certifiable seed classes. Write a "1" before the first step, a "2" before the second step, and so on.

_____a. Foundation seed

_____b. Registered seed

_____c. Certified seed

_____d. Breeder seed

6. Select from the following list information required on certified seed tags. Write an "X" in the blank before each correct answer.

_____a. Date

_____b. Common name of seed

_____c. Vigor index

_____d. Latin binomial name of seed

_____e. Percent by weight of weed seeds

_____f. Germination percentage

_____g. Number of noxious weeds

_____h. Number of common weed seeds

7. Name three types of seed treatment.

a. ______________________________

b. ______________________________

c. ______________________________

8. Select from the following list procedures to follow in handling and storing seed. Write an "X" in the blank before each correct answer.

_____a. Make sure seed moisture content for storage is correct prior to harvesting

_____b. Inspect seed during storage

_____c. Test seed for weed content

_____d. Protect from rodents

_____e. Treat seed for insects and disease

_____f. Store in a warm place with high humidity

_____g. Prevent mixing of seed

_____h. Control weeds

_____i. Select clean seed

_____j. Purchase common seed for planting

9. Using the following information, calculate the cost per bushel of pure live seed for both seed lots. Show all work.

	Lot A	Lot B
Germination	95.0%	80.0%
Inert matter	4.5%	3.0%
Other crop seeds	3.0%	.3%
Weed seeds	.2%	.2%
Price per bu of 60 lbs:	$6.00	$5.50

Cost per bushel________________________ Cost per bushel________________________

SEED SELECTION

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ANSWERS TO TEST

1.

a.	5	d.	7	g.	4
b.	1	e.	9	h.	8
c.	3	f.	6	i.	2

2. Answer should include four of the following

   Purity; Viability; Free of disease; Free of insects; Size and plumpness

3. a, c, d, e, h

4. Home grown; Reliable seed dealers

5. a. 2
   b. 3
   c. 4
   d. 1

6. a, b, e, f, g

7. Chemical; Pelletizing; Inoculation

8. a, b, d, e, g, h, i,

9. Lot A = $6.84 per bushel of pure live seed

   Lot B = $7.12 per bushel of pure live seed