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**Physics 1153
Descriptive Astronomy
Laboratory**

Course Guide

Independent Study in **Idaho**

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Physics 1153
Descriptive Astronomy Laboratory

Idaho State University
1 Semester-Hour Credit

Prepared by:
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Idaho State University

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Physics 1153: Descriptive Astronomy Laboratory   1 Semester-Hour Credit: ISU

Welcome!
Whether you are a new or returning student, welcome to the Independent Study in Idaho (ISI) program. Below, you will find information pertinent to your course including the course description, course materials, course objectives, as well as information about assignments, exams, and grading. If you have any questions or concerns, please contact the ISI office for clarification before beginning your course.

Policies and Procedures
Refer to the ISI website at **www.uidaho.edu/isi** and select *Students* for the most current policies and procedures, including information on setting up accounts, student confidentiality, exams, proctors, transcripts, course exchanges, refunds, academic integrity, library resources, and disability support and other services.

Course Description
Use of astronomical equipment, telescopes, cameras, etc. ISU students: With Phys 1152, satisfies Goal 5 of the General Education Requirements.

It is recommended that this course be taken in conjunction with or following Phys 1152.
Required: Internet access
5 graded lessons, 1 proctored exam
May submit 1 assignment per week.

Course Materials
Required Course Materials

Project CLEA software and online manuals:
http://www3.gettysburg.edu/~marschal/clea/CLEAhome.html
   Please note:
   Links to **Project CLEA** software and online manuals are available on the ISI course Blackboard site. For instructions on how to access Blackboard, see your *Registration Confirmation Email.*

1. Textbook for Physics 1152: Descriptive Astronomy
    (Companion course to Physics 1153: Descriptive Astronomy Lab)

o   Arny, Thomas T., and Stephen E. Schneider. *Explorations: An Introduction to Astronomy*. 6th ed. Boston: McGraw-Hill, 2010. Print. ISBN-13: 978-0-07-351217-4.

2. A computer with access to the internet and Microsoft Windows 3.0 or later (Windows XP or 32-bit Vista/7)

Please note:
The student should have already purchased the required textbook, *Explorations,* for Physics 1152. It will be important to the lab work required in Physics 1153.

Explorations textbook supplements are available through the following Web site:
www.mhhe.com/arny. Select the 6th edition.

Recommended Course Materials

Astronomy Interactives:
http://highered.mcgraw-hill.com/sites/0073512176/students_view0/astronomy_interactives.html#

Course Delivery

This course is available online. An electronic course guide is accessible through Canvas at no additional cost. Refer to your *Registration Confirmation Email* for instructions on how to access Canvas.

Course Introduction

In this course you will learn the general operation of an observatory through CLEA's VIREO (Virtual Education Observatory) simulations. You will use the virtual observatory to locate and study different astronomical objects. You will also use Internet resources to find star information.

Course Objectives

In this course you will learn about the tools and techniques that astronomers use to study moons, stars, and clusters. You will learn the importance of the Hertzsprung-Russell (H-R) diagram and how to use spectrometers and other observational tools.

Lessons

Overview

Each lesson includes the following components:
- lesson objectives
- reading assignment
- important terms
- lecture
- written assignment

Study Hints
- It is assumed you have taken or are concurrently taking Physics 1152.
- You will be given a brief overview for each lesson. Be sure you have studied the corresponding materials in the Physics 1152 textbook.
- Complete all assigned readings.
- Set a schedule allowing for completion of the course one month prior to your desired deadline. (An *Assignment Submission Log* is provided for this purpose.)
- Web pages and URL links in the World Wide Web are subject to change. If you cannot access a link that has been listed in this course guide, use your favorite search engine (such as Google) to locate the site. To seek assistance or provide any updated information, contact your instructor.

Exams

Overview
- For your instructor's exam guidelines, refer to the *Registration Confirmation Email,* sent to you upon registration for this course, and the *Exam Information* section in this course guide.

- Note: Make sure you keep copies of your lessons to use at the final examination, which is open book and notes.
- See *Grading* for specific information on lesson/exam points and percentages.

Grading

The course grade will be based upon the following considerations:

Each lesson will count 15% of the grade (75% total). The final exam will count 25%.

93 – 100%	= **A**	73 – 76.9%	= **C**
90 – 92.9%	= **A-**	70 – 72.9%	= **C-**
87 – 89.9%	= **B+**	67 – 69.9%	= **D+**
83 – 86.9%	= **B**	63 – 66.9%	= **D**
80 – 82.9%	= **B-**	60 – 62.9%	= **D-**
77 – 79.9%	= **C+**	Below 60	= **F**

The final course grade is issued after **all** lessons and the exam have been graded.

Acts of academic dishonesty, including cheating or plagiarism are considered a very serious transgression and may result in a grade of F for the course.

About the Course Developer

Dr. Bryan Barclay grew up on a dairy farm in South Eastern Idaho (West of Blackfoot). He received a bachelor's degree in mechanical engineering from Brigham Young University, then worked for Boeing, the commercial airline company, in Everett, Washington. While at Boeing he earned a master's degree in physics at the University of Washington.

After Boeing, he worked for Morton-Thiokol in Utah. Two years later, he began his teaching career at Salt Lake Community College. In another two years, he went back to graduate school and earned a Ph.D. in physics from Utah State University (USU) in 2001. While working on his doctorate, he taught math and physics part-time for USU and Weber State University. He is currently teaching for the College of Technology at Idaho State University as well as for the departments of mathematics and physics. His research involves astrophysics and the title of his dissertation is "Probing Void Structure Using Galaxy Number Count Techniques." He enjoys camping, bike riding, and playing his banjo. He is married and has three kids.

Contacting Your Instructor

Instructor contact information is posted on your Canvas site under *Course Rules.*

Assignment Submission Log

Project CLEA Web site: **http://www3.gettysburg.edu/~marschal/clea/CLEAhome.html**
The Web site link and the direct links listed below can be accessed through an Internet browser or through the course Blackboard site. For instructions on how to access Blackboard, see your *Registration Confirmation Email.*

Lessons	Reading Assignments	Written Assignments	Date Submitted
1	*VIREO Manual, The Virtual Educational Observatory,* pages 1–7 **ftp://io.cc.gettysburg.edu/pub/clea_products/manuals/Vireo%20Manual.pdf**	Online lab exercises: Heavens-above; SIMBAD; *The Virtual Educational Observatory* with worksheet	
2	*The Revolution of Jupiter's Moons Student Manual,* pages 1–14 **ftp://io.cc.gettysburg.edu/pub/clea_products/manuals/Jupit_sm.pdf**	Online lab exercises: *The Revolution of the Moons of Jupiter*	
3	*H-R Diagrams of Star Clusters Student Manual,* pages 1–7 **www3.gettysburg.edu/~marschal/clea/hrlab.html**	*H-R Diagrams of Star Clusters Student Manual* lab exercises, pages 8–17	
4	*Dying Stars and the Birth of the Elements Student Manual,* pages 13–23 **www3.gettysburg.edu/~marschal/clea/CLEAhome.html**	Online lab exercises: *Dying Stars and Birth of the Elements*; *Student Manual,* pages 24–28	
5	Astronomy textbook *(Explorations)* or the **Heavens-Above** Web site: **www.heavens-above.com/skychart.aspx**	Sky chart	
It is time to take the Final Exam.			

Lesson 1
Navigating with the Virtual Observatory
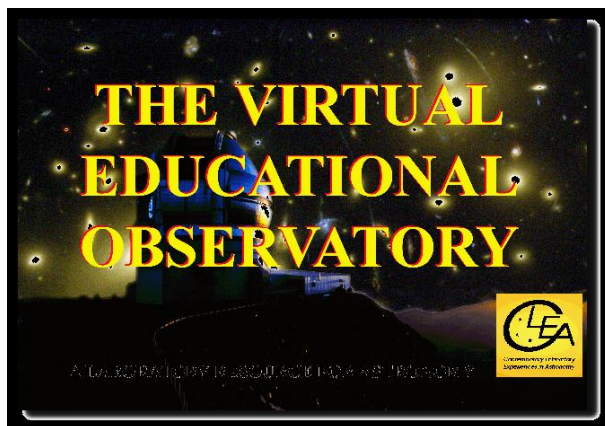
Lesson Objectives

1. Learn how a typical observatory works.
2. Familiarize yourself with VIREO operations.
3. Use the virtual observatory to locate objects and observe the effect of the Earth's rotation.
4. Use Internet resources to find star information.

Lesson 1 Project CLEA Lab Manual and Software Access

Download the *VIREO Manual* and the software for Lesson 1.

Download Instructions

1. Go to the Project CLEA home page: **http://www3.gettysburg.edu/~marschal/clea/CLEAhome.html**
   a) Scroll down and click on **VIREO—THE VIRTUAL EDUCATIONAL OBSERVATORY**
   b) Now click on Word 2003 Format or PDF Format to download the *VIREO Manual.*
   c) **NOTE:** You can also access the *VIREO Manual* on the course Blackboard site or through an Internet browser, via this direct link:
      ftp://io.cc.gettysburg.edu/pub/clea_products/manuals/Vireo%20Manual.pdf

      To access the course Blackboard site see your *Registration Confirmation Email*.

2. Next, on the Project CLEA home page, click on ***VIREO.exe*** to download the software needed for the lab (see the photo-icon above). (See the *Written Assignment* section in this lesson.)

Reading Assignment

VIREO Manual, The Virtual Educational Observatory, pages 1–7
tp://io.cc.gettysburg.edu/pub/clea_products/manuals/Vireo%20Manual.pdf

Important Terms

Polaris	tracking control	right ascension	declination	slew rate	magnitude

Lecture

CLEA software simulations allow you to be the operator of a virtual observatory. Observatories may have several telescopes and imaging systems. The objective of a telescope is to gather as much light as it can from a celestial object (star, moon, galaxy, etc.) then magnify it to enhance and resolve greater details of the image. This observatory can also simulate infrared cameras, radio telescopes, and CCD (Charge Coupled Devices) cameras. It also has spectrometry, astrometry, and photometry tools. In this lab you will open the observatory, choose a telescope, and align the telescope by inputting an object's celestial coordinates. The coordinates you will use are **right ascension (RA)** and **declination (dec)** (see your textbook for definitions of these coordinates). You will control the **slew rate** (rate of telescope motion) as you align the finder scope to see the desired image. Due to the Earth's rotation, the object will move out of the telescope's view in a few minutes. The tracking control will keep the telescope fixed on the object by continually adjusting for the Earth's motion.

We will focus on the North Star (Polaris). We will use the **Heavens-Above** Web site and the **SIMBAD** astronomical database to locate and show the motion of stars relative to Polaris. Polaris is 390 **ly** (light years) from us. This star is in close alignment with the Earth's rotational axis and therefore moves very little. It is also the last star in the tail of the Little Dipper (Ursa Minor). Most other stars will rotate around a fixed point near Polaris.

Written Assignment

Lab Exercises to Submit for Grading (100 points)

The lab exercises below for Lesson 1 can be accessed through the Blackboard site for this course or on an Internet browser. To access Blackboard, see your *Registration Confirmation Email.*

First, access the sky chart on the **Heavens-Above** Web site:

www.heavens-above.com/skychart.aspx

This is what the night sky would look like if you lived near the North Pole. For this exercise complete the following steps:

1. Change the other options so they look like this:

2. Advance the time in intervals of 2 hours (in the *Hour* box for military time). When you want to go past 24 hours you will have to advance the day by 1 then start over at 1 in the *Hour* box. Click on *Submit* to see the changing location of the stars around the pole.
3. Record the direction the stars rotate around the pole (clockwise or counter clockwise) as **Item 1** in the worksheet at the end of this lesson.
4. Use an Internet browser and find the celestial coordinates of Polaris. Record the coordinates as **Item 2** (enter the 'right ascension' first, followed by 'declination').

Now go to the **SIMBAD** astronomical database at **http://simbad.u-strasbg.fr/simbad/sim-fcoo**.

1. Enter the celestial coordinates for Polaris (enter the right ascension [RA] first, followed by the declination [dec].
2. In the *define a radius* box enter '5 arc min.' This will locate everything within a 5 arc min. radius of the entered coordinates, then click 'submit.'
3. Copy the *table of objects* for **Item 3** of this lab. You can do this by clicking 'Ctrl' and 'Print screen' keys at the same time. Then open a Word document and push 'Ctrl' 'V' at the same time.
4. Now click on *plot list of objects*. Click on each of the objects to find which one is Polaris. Print out this map and identify Polaris as **Item 4.**

Now click on the **VIREO** software icon. (See #2 in the *Reading Assignment* section in this lesson.)

1. Click on *File* and *Login.*
2. Click *OK.* (You don't have to enter your name if you don't want to.) You should see the icon shown at the beginning of this lesson.
3. Go to 'File: Run Exercise' and choose 'Photoelectric Photometry of the Pleiades.'
4. Now click on 'Telescopes' and access the 0.4 meter scope.
5. Next click on the top of the switch next to the word 'OPEN.' This will simulate the opening of the dome.
6. Click on the telescope panel control that says 'off.' This will open the telescope controls.
7. Next click on 'tracking.'
8. Then go to 'slew' in the upper left, go to 'set coordinates' and put in the coordinates of Polaris (from **Item 2**). Click on 'yes' and the telescope will move (slew) to your coordinates (this may take a couple of minutes).
9. Every telescope has a finder scope to help you locate the star in a larger field of view. Under 'View' move the slider down to 'telescope' and some bright images should appear. The nearest bright star is Polaris as it would appear in a telescope.
10. Under 'telescope' you see 15 arc min. This is the width of sky the telescope observes. Twenty-four hours of right ascension is a full circle (15 degrees per hour), each hour is broken into 60 minutes of arc, so 15 arc min. is about 3.5 degrees of the night sky in width.
11. If the red circle is right on the star, move it off to a dark region of space by clicking the N (north) or S (south) buttons. Click on 'tracking' and watch the display for a couple of minutes. The image will shift position because the Earth is rotating.
12. Record the direction Polaris shifts (right or left) as **Item 5.**
13. Now click 'tracking' again. This feature moves a telescope automatically to stay focused on the same object while the Earth moves. Below 'Instrument' 'Photometer' should be highlighted. Below that 'Access' should be highlighted; if it is not, click on 'tracking' and make sure the 'View' slider is on 'telescope.'
14. Make sure your red circle is not on Polaris, then click 'Access' to access the photometer control.
15. Click on the 'Start' button in the upper right. This will take a measurement of the sky.
16. Now move the red circle so that it is centered on Polaris.
17. Go back to the photometer control, move the slide to 'object' and click 'start' again. The first time it took a reading of the background sky; this second time it took a reading on Polaris and compared the two.

18. Now in the upper left is the object number and above the red numbers is 'magnitude.' Record the object number and magnitude of Polaris as **Item 6** for this lab.
19. You may want to play around with the telescope by accessing a bigger scope and moving it around to different objects.

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Item #	Description	Record Data Here
1	Direction of rotation around Polaris	
2	Coordinates of Polaris	
3	Table of objects near Polaris	Attach copy of table to this worksheet.
4	Map of Polaris and nearby objects	Attach copy of map to this worksheet (make sure you mark which one is Polaris).
5	Direction of Polaris shift	
6	Object number and magnitude of Polaris	