An Online Undergraduate Astronomy Lab Course

Gene Byrd

University of Alabama

Paper presented at the NSEUS national conference on Research Based Undergraduate Science Teaching: Investigating Reform in Classrooms, Bryant Conference Center, University of Alabama, Tuscaloosa AL May, 21-22, 2012

Introduction

Currently, major publishers a promoting "virtual astronomy" labs. Even the lab course which we teach at the Univ. of Alabama has (of necessity)y an element of "mass production" at set class times and few individual observations by students. An online undergraduate astronomy lab course taught since 2009 will be described. We will describe some individual self-paced elements which could be incorporated into regular on-campus labs. This is a companion to an online "lecture" astronomy course.

The Course Learner Objectives

Core curriculum learner objectives adopted by our Department were used in writing the course . They are:

Upon successful completion of this course the student will be able to:

- Utilize scholarly research methods.
- Apply the scientific method and critically evaluate scientific information.
- Share information and advise one another in obtaining and explaining observations
- Apply scholarly research methods to assist with the understanding of astronomical observational processes and topics including visual phenomena in the sky, as well as distance, temperature, mass, elemental composition determination of stars and galaxies.
- Construct and use simple laboratory equipment in astronomical observations
- Specific active objectives were newly written for each of twelve lab exercises..Here is an example for the first module in the course. Note how we relate objectives for the module to those for the whole course

Upon successful completion of this modules, the student should be able to:

- Become familiar with scholarly research methods. In this case watch for cycles like the daily cycle of astronomical objects due to the Earth's rotation.
- Use simple laboratory equipment in astronomical observations, in this case, the "Star and Planet Locator" a modern version of the ancient astrolabe and/or the *Stellarium* PC planetarium program.
- Recognize the scientific method and critically evaluate scientific information.
- Apply scholarly research methods to develop an understanding of astronomical observational processes and topics such as daily visual phenomena in the sky.
- Interpret cyclic data in terms of the rotation and spherical shape of the Earth as illuminated by the Sun.

While these objectives were very useful in composing the course, students may only passively read over the objectives. We address this difficulty in the experiment described in another paper at this conference..

Graded Items in the Course

Students submit for grading, (1) data calculations, drawings and photos in an

"observational notebook". (2) Class discussion among students,(3) open book multiple choice assessments and, lastly, (4) a closed book proctored multiple choice final exam.

The discussion area in this course is more lively than one might expect in an online course. Students introduce themselves, discuss material in the modules or even bring up astronomical items from the news or web. Students are graded in a small part by participation. This is easy to grade by separating messages by sender.

Students submit for grading prose answers, data calculations, drawings and photos in an "observational notebook Although everything is supplemented with simulations or web resources, non-virtual observations and experiments were used whenever possible. To identify stars and planets in the sky, students use a "classic" Edmund Scientific Co. paper "star wheel" (Fig. 1) and/or the free Stellarium PC planetarium software (Fig. 2). .It is interesting to see students divide into two groups, one liking the historically important star and planet finder versus pc planetarium users. Uploaded images from digital cameras and phones facilitate submitting and grading observations. Uploaded images from digital cameras and phones facilitate submitting and grading observations.

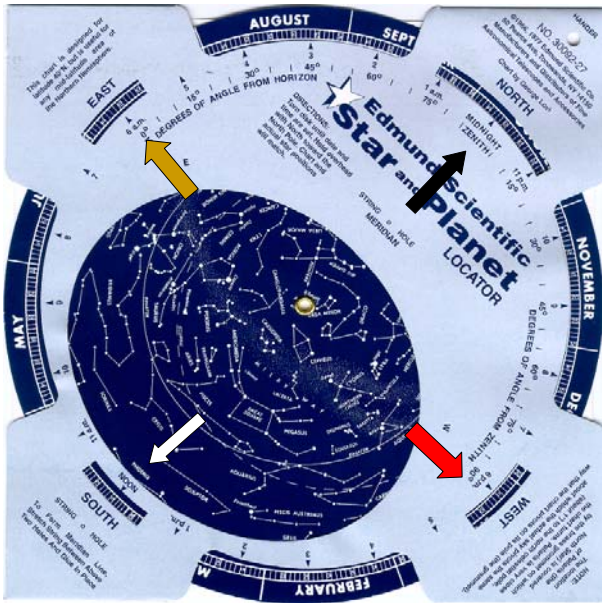
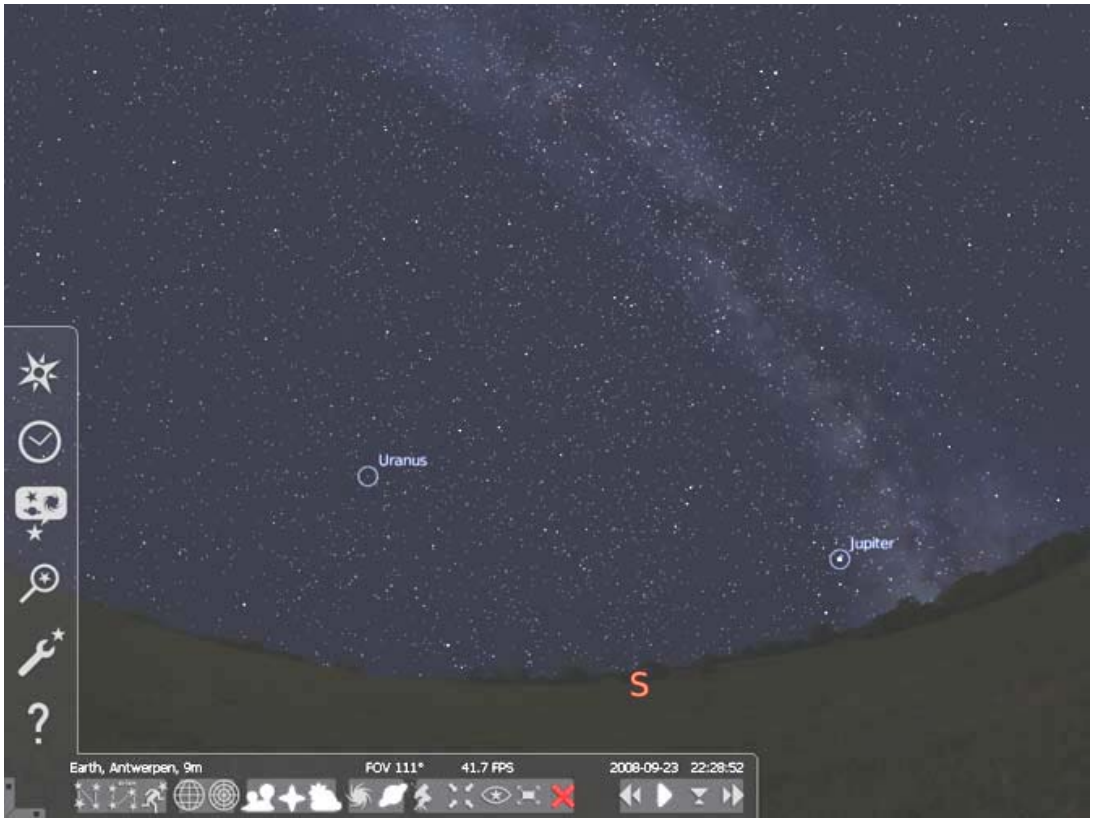


Figure 1. Star and planet locator.



Figue 2. Stellarium screen image.

A lens telescope kit is used to explore optics and the functions of a telescope. (Fig. 3) A simple but steady home-made telescopic mounting has been developed.(Fig. 4) With their camera, the star maps and the kit telescope, the students are expected to observe and photograph the Moon, planets and bright stars. (Fig. 5)With their cameras and a diffraction grating, students photograph, and try to identify and submit spectra of different sources. (Fig. 6). A “pin-hole” protractor is used for table-top angular size vs distance and stellar parallax experiments.This simple device described in Byrd,and Dupke, (1997) is used widely with the initial article being republished twice in Europe.., The set up constructed by a students is shown in (Fig. 7)..The parallax part of this exercise has proved difficult for students.

Figure 3 Studying lens optics from the telescope kit.

Figure 4: The assembled telescope and foil box mount. This inexpensive mount is very steady.

Figure 5— A .waxing gibbous moon with an ordinary digital camera, considerably zoomed in and cropped.Naïve students not familiar with camera settings have better luck with photos of the moon at dusk. Such students can photograph right planets and stars.

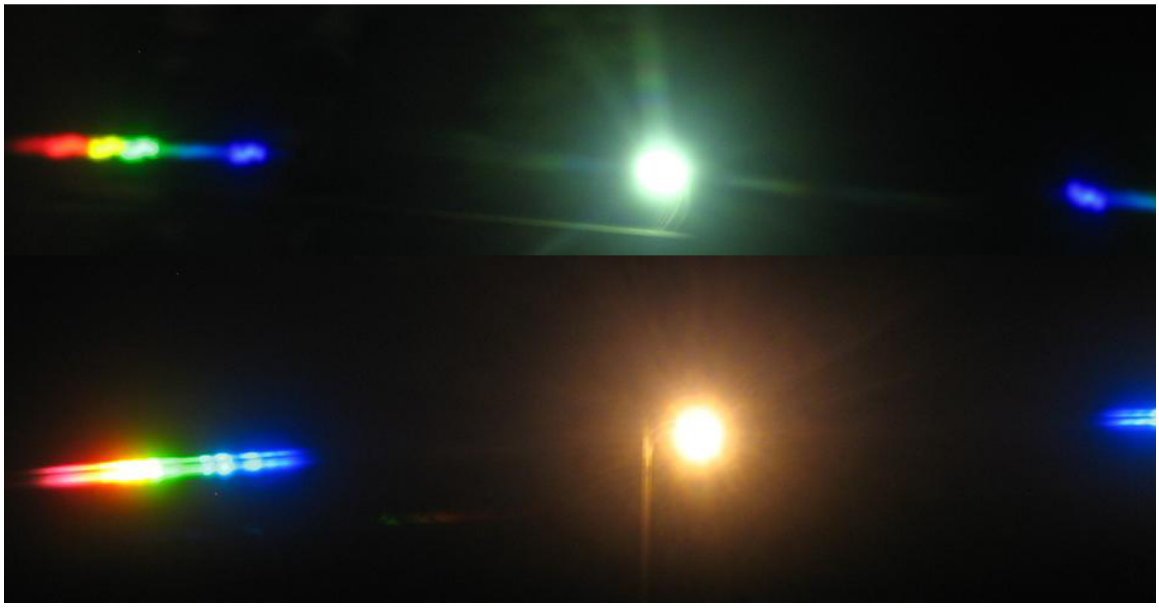


Figure 6—Street light spectra photographed with digital cameral and grating “glasses”.

Better students try micro/macro observations such as the Fig. 8 demonstration of the shape and phase of the moon. Another is the pin-hole measurement of the angular and physical size of sun.

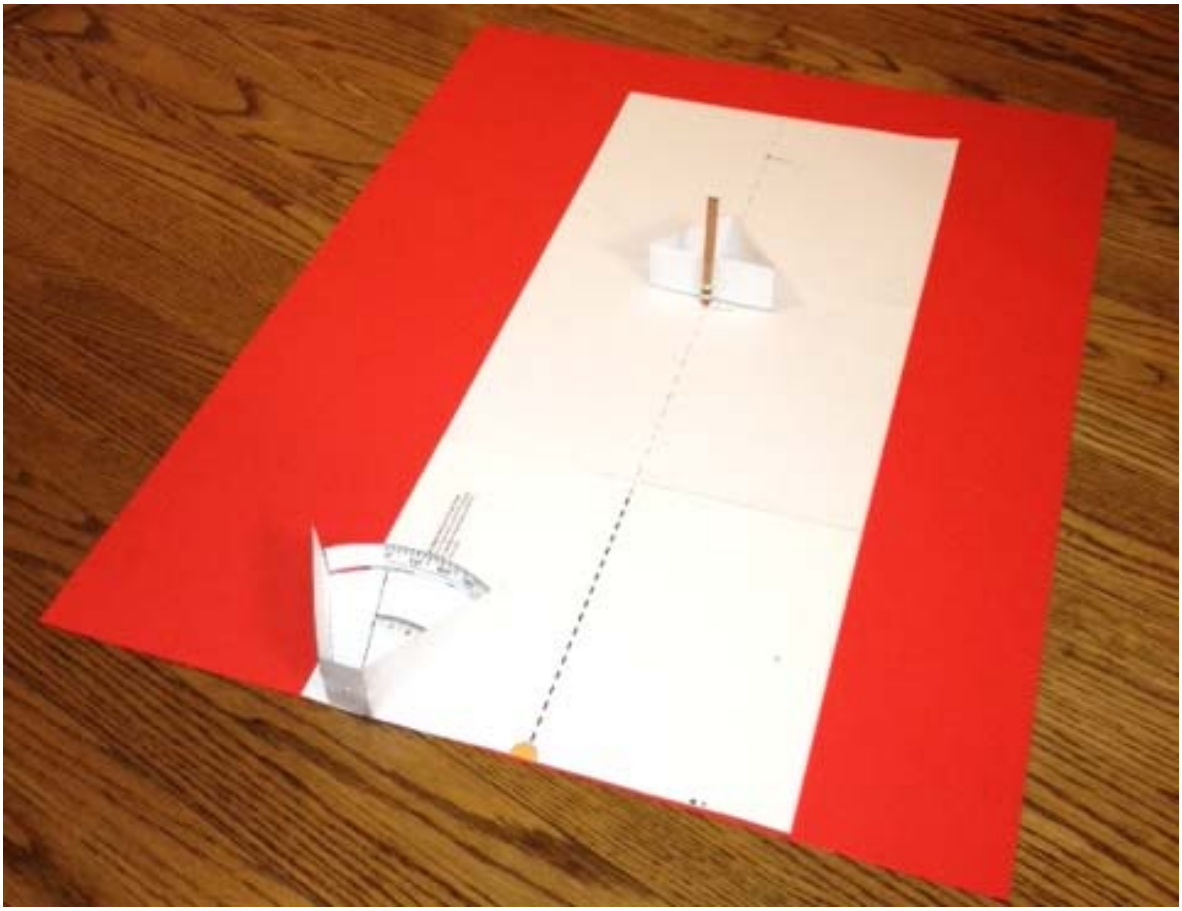


Figure 7—Pinhole protractor (left) and parallax set up.(whole picture)

Figure 8—Micro/Macro Cosmos. Matching the 3rd quarter moon on a sunny clear morning with a golf ball. Note the "craters." This is dependent on weather and is attempted by the better students

Conclusions

The University of Alabama online undergraduate astronomy lab course has been successfully taught since 2009. It enables students working full time off campus to complete the Natural Science core curriculum requirement.. Compared to the lecture, it was more of a challenge to create an online lab course. It turns out that astronomy is well suited for an online lab with the online format facilitating independent, "non-virtual" observations. The on-line self paced nature of the course permits as good as or perhaps better observational experience than our ordinary on campus astronomy lab course. Some exercises are difficult without an instructor beside the student. Also as in all self paced courses procrastination is a problem.. Some elements of this lab course, such a submission of digital photographs could easily the integrated into a conventional lab course.

Correspondence concerning this article should be addressed to
Gene Byrd, Department of Physics & Astronomy, University of Alabama, Tuscaloosa, AL 35487-0324. E-mail: byrd@bama.ua.edu

References

Byrd, G. and Dupke, R. 1997, ``Classroom Activity: Pinhole Protractor," The Universe in the Classroom (The Astronomical Society of the Pacific), No.39, Third Quarter, p.3