# Development of a Studio-Style Introductory Astronomy Course


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## Abstract

I will present the development and implementation of a studio-style Introductory Astronomy course designed for non-science students. This course meets 3 times a week for 2 hours each time, permitting longer and more involved activities to be included. This approach allows for many different engaging pedagogies to be used in the course, including Lecture-Tutorials, hands-on and online labs, role-playing games, and card sorting. I will discuss how these different pedagogies are used to reach learning goals, create a student-centered active learning classroom, and benefit the TLU Department of Physics.


## Background/Motivation

This course was designed two years ago as a service course for non-science students in the TLU Department of Physics. Roughly 40% of TLU students participate in athletics and have frequent afternoon practices. In order to reduce the schedule crush of running from lab to practice, we decided to structure the course studio-style.

The course weeks for two hours three times a week. These longer meetings allow for more innovation and experimentation in class design. The course is designed to actively engage and immerse students in astronomy.

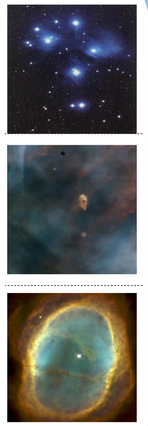
## Course Outline

| Week | Topic |
|---|---|
| Week 1 | Nature of Science, Numbers in Astronomy |
| Week 2-3 | Celestial Motion, Motion of the Sun and Moon, Seasons, Astronomy of Many Cultures |
| Week 4-5 | Geocentric and Heliocentric Models, Newton and Kepler |
| Week 6 | Solar System |
| Week 7-8 | The Pluto Debate, Telescopes, Nature of Light |
| Week 9-10 | HR Diagram, Life Cycle of Stars |
| Week 11 | Exoplanets and the Milky Way |
| Week 12 | Dark Matter and Galaxies |
| Week 13-14 | Hubble's Law and Cosmology |

The course outline is similar to other Introductory Astronomy courses, though more emphasis is placed on current research and advancements in astronomy.

## Card Sorts

One of the main goals of this course is to have students engage with material in different representations. One of the ways we do this is through card sorts. Students are given images and asked to represent topics in various ways.



**Galaxies**: The galaxy card sort is used twice in this course. First, to have students engage with the process of science and creating similar categories. And second, to explore the Hubble Tuning Fork.

**Stellar Evolution**: This card sort includes images of stars at various stages of their life cycle. Students are challenged to match the images to the stages of stellar evolution.

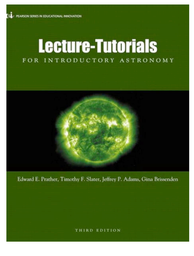

## Labs

We use the SkyNet University labs through the University of North Carolina at Chapel Hill. These labs allow students to use telescopes located across the globe to take and analyze their own images. The major theme of the labs is "Our Place in Space." Students collect images to understand how distances are measured in astronomy and how that relates to our understanding of our place in the Universe.




A few hands-on labs are also included. One involves explorations of the nature of light. Students engage with spectra, filters, and lenses to understand how light behaves.

## Lecture-Tutorials-Simulations

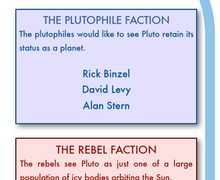



We use the Lecture-Tutorials for Introductory Astronomy developed by Praether et al. When introducing new topics, there is a short lecture, followed by group work on the tutorials for students to dive deeper into a topic. Often, the tutorials are supplemented with additional simulations supplied by the University of Nebraska – Lincoln. These get students to work with computers and engage in different visualizations of the concepts.

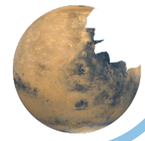
## Role-Playing Games

We include two role-playing games in this class, where students play the role of astronomers debating important topics. The first is *The Pluto Debate* written by Toni Crider (Elon). It is part of the Reacting to the Past consortium of games.

We are writing a second role-playing game that will be included next year. This game will have students enact the *Astronomy 2020 Decadal Survey* to decide funding priorities for the astronomy community over the next decade. Students will use *Astrobites* summaries of recently published papers to advocate for their assigned telescope.



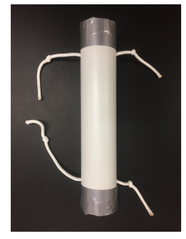


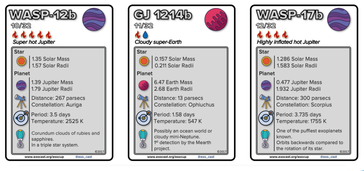


## Other Activities

The Exoplanetary Cup helps students learn about the variety of discovered exoplanets. Students advocate and compete in a March Madness-style competition to decide which exoplanet is the most interesting.

As part of our Nature of Science discussion, we use Mystery Tubes to introduce students to the idea of modeling and falsification. We also have a *Science Fact or Fiction* reading game where students decide on the validity of scientific articles.






## Learning Results

Enrollment has been high in both semesters this course has been taught. The studio style is attractive to students because it avoids an afternoon lab.

We use the Epistemological Beliefs Assessment for Physical Sciences (EBAPS) to assess students attitudes towards science. The results, shown at right, indicate that students are making positive shifts in their epistemological beliefs about science.