

Astronomy 104

Our Exploration of the Solar System

LEARNING PHILOSOPHY AND GOALS (Mathieu)

As in all fields of study, there is far more astronomical knowledge than can be learned in an introductory course. Attempting to teach as much as possible in a semester serves no one well. And indeed, it misses the point. The question is not how much I teach, it is how much you learn in a lasting way.

One of my most important roles as your professor is to select and prioritize knowledge in a way that best benefits your growth. For introductory courses, I have a very practical guide in that process. I ask myself the question, “Is this concept or information something that I want you to be able to teach your family 10-20 years from now?”.

I hope you take a moment to think about this goal, and perhaps to embrace it for yourself. There is more depth to this question than first meets the eye. Perhaps most important is the recognition that true learning allows one to be a teacher, and that this is a noble goal. Furthermore, true learning is lasting, either explicitly as knowledge or implicitly as wisdom. And finally, some things are more valuable to learn than others. Which brings me back to my most important responsibility as your professor, although ultimately what is and is not important is your decision.

And yes, I am speaking from personal experience! I have two children at West High School. My son Dylan is a junior and my daughter Cory is a freshman. I am deeply grateful to those professors of mine who helped me to learn so that I could teach my children. Admittedly, they don't always want to hear it

So, my specific **learning goals** for you, with sample **objectives**, in Astronomy 104 are:

1) To perceive the sky and the Solar System as a part of your environment to which you are connected – physically, historically, and culturally/personally.

- a) See the sky at given time and be able to draw a 2-D picture of you-Sun-Earth-Moon/planets.
- b) Understand motions in the sky, including stars, Moon, Sun, and planets.
- c) Understand the size scales of the Solar System, relative to the Earth and to the nearest star.
- d) Recognize the role of astronomy in human history and culture.

2) To have a unified understanding of the evolution of the Solar System and Earth's place in the story.

- a) Understand flow of energy as the driver of all evolution, including the 2nd law of thermodynamics.
- b) Understand basic geophysical processes.
- c) Understand basic atmospheric physics, with an emphasis on the greenhouse effect.
- d) Understand the condensation sequence, and the challenges to it of recently discovered exoplanets.
- e) Understand the origin of the Solar System, and an introduction to life on Earth.

3) To obtain a deep understanding of Newtonian laws of motion and gravity.

- a) Be able to qualitatively explain daily events involving forces and motions.
- b) Understand the launch of a rocket.
- c) Understand satellites and interplanetary travel in terms of orbits.

4) To obtain a modest understanding of the electromagnetic spectrum and emission/absorption of light.

- a) Understand thermal radiation, especially in the infrared.
- b) Understand emission/absorption of spectral lines, especially in relation to quantum mechanics.
- c) Understand the Doppler shift, including radar.

5) To understand the energy sources of the Sun and the Solar System.

- a) Understand $E=mc^2$, nuclear fusion, and the difference between fusion and fission.
- b) Understand the affects of solar radiation on the Earth, including the seasons.
- c) Be able to describe solar activity, Solar System weather, and its impact on the Earth.

6) To understand the scientific “way of knowing”, with an emphasis on the role of uncertainty.

- a) Understand the history of astronomy, and through it the historical process of science.
- b) Make a measurement of something, and be able to discuss whether it is “right”.
- c) Be able to pose, analyze, and solve a physical problem.
- d) Be able to use mathematics effectively, for example to predict an orbital event or “weigh” a distant object.