ASTR 121 - The Solar System

Essential Information

● Instructor Contact
  ○ Name & pronouns: Dr. Andrea Goering (she/her) - please call me Andrea
  ○ Email: ayocom@uoregon.edu
  ○ Office Hours: Mondays 1:45pm and Fridays 1pm
  ○ Office Location: Willamette Hall, Room 361 and on Zoom
  ○ For a one-on-one, please contact me directly to make an appointment

● Classes
  ○ Class Times: MWF 3:00 pm - 3:50 pm, Willamette 100
  ○ Zoom Link (if needed): https://lanecc.zoom.us/j/99029106606

● Teaching Assistants
  ○ Cristien Arzate, cristien@uoregon.edu
    ■ Monday 11am, Science Library Drop-In center
    ■ Thursday 2pm, Willamette 318
  ○ Peter Zheng, pzheng@uoregon.edu
    ■ Wednesday 4-5pm, Willamette 250
    ■ Wednesday 5-6pm, Science Library Drop-In center

● Course Materials
  ● Textbook: Astronomy, by Fraknoi, Morrison, Wolff, et al., free online.
  ● Assignments: Our Canvas Page; Reading on Perusall (see Canvas)

Course Overview

ASTR 121 is an introduction for non-science majors to the contents, formation and exploration of the Solar System. The past 20 years has seen an explosion in our understanding of the Solar System, thanks to numerous NASA and ESA missions and probes. Studying other planets has provided tremendous insight into the understanding of how planet Earth operates and changes under humankind's influence.

This course traces the history of our developing knowledge of the Solar System in order to explore how the scientific method works and how civilization has gained from the progress of science and technology. The interplay between technology (telescopes, robotic space probes) and knowledge gained about the Solar System is a key theme to the course. In this course, you will learn about our exploration of the Solar System and how our knowledge of other worlds helps us to understand and cherish our own.

The class does not assume extensive prior knowledge of science, but it will require quantitative reasoning. Your chances of success in this course are high if you come to class with a desire to dig deeper into the causes of things you see around you. I hope you'll ask a lot of questions starting with "why," "how" and "what if" - because curiosity is what makes scientists tick.
I’m not a science major. Why should I take an astronomy course?

I think it’s important for students pursuing a variety of goals to learn astronomy, because:
- You will learn strategies for independent learning and study that will serve you well in other classes, and in your journey of lifelong learning.
- You will learn to communicate ideas well, and open your mind to new ways of thinking.
- Astronomy builds skills employers want: scientific reasoning and quantitative reasoning.
- Astronomy is part of our history and life. Learning astronomy is inspiring and contributes to a sense of purpose and belonging in our world - a sense of being an “Earthling.”

Learning Goals

You should leave this class with improved knowledge and skills:

1. **Science as a Process and a Skill:**
   - Explain how theories in astronomy are supported by specific observational data
   - Be able to use data, graphs, figures, and quantitative reasoning as tools to draw conclusions and support arguments.
   - Use patterns to formulate hypotheses about why things are the way they are.

2. **Solar System Science and Exploration:**
   - Describe how humans “read the sky” and use observational evidence to conclude that the Earth is not at the center of the Universe.
   - Describe the basic characteristics (size, structure, composition, surface features) and motions of objects in the solar system.
   - Compare and contrast solar system objects (terrestrial worlds, Jovian planets, and space debris) to form hypotheses about why they are the way they are.
   - Explain how the solar system formed and evolved over time, including theories about how planets, moons, and rings form.
   - Explain how we find planets around other stars, and what new questions have arisen from the burst of research on exoplanets in recent years.
   - Describe similarities and differences between the planets and explain how those developed as the result of specific physical laws.
   - Explain how theories in astronomy are supported by specific observational data, and discuss the goals, methods, and results of solar system exploration.

3. **Earth as a Planet:**
   - Explain why we experience seasons on Earth and how the sun moves across the sky at different times and at different latitudes.
   - Explain why we see the moon go through phases, how the moon causes ocean tides, and what causes us to see lunar and solar eclipses.
   - Describe what processes shape Earth’s crust, atmosphere, and climate.
   - Discuss the social, historical, and cultural context and impacts of astronomy.
   - Discuss our place in space and the prospects for life elsewhere in the Universe.
Andrea’s Teaching Philosophy

Research shows that people learn best through active learning, in which learners are active participants rather than passive observers. Our course design provides structured learning opportunities before, during, and after class to help you engage your brain and monitor your own understanding as you build your knowledge about astronomy.

Each learning opportunity has an essential role to play, and therefore they will all contribute to your grade. However, you will have choices about how to engage and will not be forced into a “one size fits all” solution. If you feel that any element of our course design presents a barrier to you or that you would benefit from different types of learning opportunities, please let me know.

Learning Opportunities and Assessments

Class Preparation:

- We will use Perusall as a way to engage with pre-class reading and videos. If you do not want to use Perusall, I can offer other ways to demonstrate your active engagement.
- It is essential to complete your first reading before class. However, you might read twice if needed. A “shallow” read before class and “deep” read after class can be highly productive. After two readings, more reading is unlikely to help you learn.

In-Class Activities: We will work together on interactive activities during class to guide you through new ideas. Most activities will be delivered through Canvas, so please bring a device.

Homework: Homework problems will build up from the activities. Some questions will be fairly simple, others will be challenging. You will have multiple attempts and should strive to understand each question by making mistakes and trying again. Please, work together!

Reflections: You’ll reflect on your learning, study methods, course work schedule, and how we conduct the course. This is your chance to give me feedback - use it!

Quizzes: Short, cumulative weekly quizzes will help you calibrate your understanding. They will consist of two parts. First, you will work on your own. Then, you will have the chance to work together in class. Your average score will count. Both parts are open-book and open-note, but you should strive to complete quizzes without these aids to maximize your learning.

Final exam: The final exam will also use the quiz format, but will be longer. It will cover everything in the course and will be done in class during our university-scheduled final exam time. To reward your growth throughout the term, your final exam score can replace any and all lower-scoring quizzes, homeworks, and other categories except projects, but can NOT replace missed quizzes and homeworks.
Mini-Projects: These will help us to connect course topics to the real world, hone your communication skills, and augment the learning we do in class. I will post prompts each week, but the format is up to you - this is an opportunity for you to be creative. You will engage in 3 project opportunities out of 9+ possible prompts.

Project topics will include:

- **Ancient Planets:** Put yourself in the shoes of ancient observers, by observing the motion of the Sun, Moon, and/or planets over time and sharing your findings.
- **Planetary Visits:** Explain the goals and findings of solar system exploration.
- **Scientist Spotlight:** Examine the role of astronomers who history and science textbooks may have forgotten, and modern-day astronomers whose work has not yet had a chance to show up in textbooks.
- **Astro Bite:** Relate astronomy in the news to our learning goals.
- **Astronomy in Society:** Apply your knowledge of astronomy to discussions in society, such as human habitation of Mars, Earth’s climate, and space exploration ethics.
- **Citizen Science:** Contribute to science research and report on your experience.
- **Science Storytelling:** Tell a story about our course topics using social media, a hands-on model, or a creative format (like a video, podcast, comic, infographic, short story, etc.). Your audience should be the general public, either adults or children.
- **Study Tools:** Learn about effective study practices and monitoring your own learning, then create study tools for the class to use or share artifacts of your own study process.

### Grade Breakdown

<table>
<thead>
<tr>
<th>Assignment</th>
<th>When?</th>
<th>Percent of Grade</th>
<th>Out-of-class time per week</th>
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</thead>
<tbody>
<tr>
<td>Pre-Class Preparation</td>
<td>3x / week</td>
<td>10%</td>
<td>2 - 4 hours (1 hr / class)</td>
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<tr>
<td>In-class Activities</td>
<td>3x / week</td>
<td>10%</td>
<td>N/A (in class)</td>
</tr>
<tr>
<td>Homework</td>
<td>Weekly</td>
<td>25%</td>
<td>1 - 2 hours</td>
</tr>
<tr>
<td>Mini-Projects</td>
<td>3-4 required; 9 offered</td>
<td>5%</td>
<td>~ 30 minutes</td>
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<tr>
<td>Quizzes</td>
<td>Weekly</td>
<td>20%</td>
<td>~ 20 minutes</td>
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<tr>
<td>Final Exam</td>
<td>Week 11</td>
<td>30%</td>
<td>-</td>
</tr>
<tr>
<td>Weekly Reflections</td>
<td>Weekly</td>
<td>2% extra credit (0.5% each)</td>
<td>~ 20 minutes</td>
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</table>
**Grade scale:** A: 90%, B: 80%, C: 70%, D: 60%. I use plus/minus: plus for grades ending in 7, 8, or 9 and minus for grades ending in 0, 1, and 2. I do not curve class grades, as I believe each of you is capable of meeting my expectations, especially with the Late and Life Happens Policies.

**Late Policy:** Late work will be considered for no penalty. Most assignments will have a grace period of 1 week; quizzes **will not**. If an assignment is still open, you’re welcome to submit late work. If it is closed, you can email me to request an extension. This *can* apply to quizzes if you have extenuating circumstances. Try to stay on top of things; once behind, it is very difficult to catch up. If I notice you are not completing course work, I might reach out to you personally, to ensure that you are ok and not falling behind. A floor of 50% will be applied to all assignments. That way, an “atomic zero” cannot ruin your grade.

**Life Happens Policy:** Because “life happens,” I will drop about 10-15% of your lowest-scoring assignments in each category from your final grade. This will likely be 1 homework, 1 quiz, and 2-3 in-class activities and pre-class assignments.

**Changes to Syllabus:** I might change things here and there throughout the term. I will let you know if there are changes by telling you in class, making an announcement in Canvas, and modifying this syllabus page on Canvas. If something isn’t working, and we could make a change during the term to make it work better, we’ll do it!

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**Weekly Routine**

The **total out-of-class time** is about 8 hours. You should spread this time out in a regular cadence to get the most out of your effort. Here’s my suggested routine.

<table>
<thead>
<tr>
<th>To Do</th>
<th>M</th>
<th>T</th>
<th>W</th>
<th>R</th>
<th>F</th>
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<tbody>
<tr>
<td>HW Due</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Quiz</td>
</tr>
<tr>
<td>Office Hours</td>
<td>Cristien, 11am, Drop-in ctr</td>
<td>Peter, 4pm, Wil 250</td>
<td>Cristien, 2pm, Wil 318</td>
<td>Andrea, 1pm, Wil 361 or Zoom</td>
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<tr>
<td>Andrea, 1:45-2:45, Wil 361 or Zoom</td>
<td>Peter, 5pm, Drop-In ctr</td>
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ASTR 121, Spring 2022: Syllabus - 5
### Tentative Class Schedule

The numbers below the day’s topics are the chapters and sections from *OpenStax Astronomy*.

Weekly homework is due Mondays at midnight. Quizzes will be on Fridays at the start of class.

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Friday</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Welcome to ASTR 122!</td>
<td>Reading the Sky 2.1 - 2.2</td>
<td>The Science of Astronomy 2.3 - 2.4</td>
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<td></td>
<td>Reading: Syllabus</td>
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<tr>
<td>3/28 - 4/1</td>
<td><strong>Welcome to ASTR 122!</strong></td>
<td><strong>Reading the Sky</strong> 2.1 - 2.2</td>
<td><strong>The Science of Astronomy</strong> 2.3 - 2.4</td>
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<tr>
<td>Week 2</td>
<td>Earth and Sky 4.1 - 4.2</td>
<td>Motions of the Moon: Phases and Eclipses 4.5, 4.7</td>
<td>Tides 4.6</td>
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<tr>
<td>4/4 - 4/8</td>
<td><strong>Earth and Sky</strong> 4.1 - 4.2</td>
<td><strong>Motions of the Moon: Phases and Eclipses</strong> 4.5, 4.7</td>
<td><strong>Tides</strong> 4.6</td>
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<td>Week 3</td>
<td>Planetary Motion 3.1 - 3.4</td>
<td>Solar System Bodies 7.1 - 7.2</td>
<td>Origin of the Solar System 7.3 - 7.4</td>
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<tr>
<td>4/11 - 4/15</td>
<td><strong>Planetary Motion</strong> 3.1 - 3.4</td>
<td><strong>Solar System Bodies</strong> 7.1 - 7.2</td>
<td><strong>Origin of the Solar System</strong> 7.3 - 7.4</td>
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<tr>
<td>Week 4</td>
<td>Planet Earth 8.1 - 8.2</td>
<td>Earth’s Climate 8.3 - 8.4</td>
<td>Cosmic Influences on Earth 8.5</td>
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<td>4/18 - 4/22</td>
<td><strong>Planet Earth</strong> 8.1 - 8.2</td>
<td><strong>Earth’s Climate</strong> 8.3 - 8.4</td>
<td><strong>Cosmic Influences on Earth</strong> 8.5</td>
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<td>Week 5</td>
<td>The Moon 9.1 - 9.3</td>
<td>Origin of the Moon 9.4</td>
<td>Mercury 9.5</td>
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<td>Week 6</td>
<td>Venus 10.1 - 10.3</td>
<td>Mars 10.4 - 10.5</td>
<td>Contrasting Worlds 10.6</td>
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<tr>
<td>5/2 - 5/6</td>
<td><strong>Venus</strong> 10.1 - 10.3</td>
<td><strong>Mars</strong> 10.4 - 10.5</td>
<td><strong>Contrasting Worlds</strong> 10.6</td>
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<td>Week 7</td>
<td>Giant Planets 11.1 - 11.3</td>
<td>Moons of the Outer Worlds 12.1 - 12.3</td>
<td>Planetary Rings 12.4 - 12.5</td>
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<tr>
<td>5/9 - 5/13</td>
<td><strong>Giant Planets</strong> 11.1 - 11.3</td>
<td><strong>Moons of the Outer Worlds</strong> 12.1 - 12.3</td>
<td><strong>Planetary Rings</strong> 12.4 - 12.5</td>
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<td>Week 8</td>
<td>Asteroids &amp; Comets 13.1 - 13.3</td>
<td>Pluto &amp; Charon 12.4</td>
<td>Kuiper Belt and Oort Cloud 13.4</td>
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<td>5/16 - 5/20</td>
<td><strong>Asteroids &amp; Comets</strong> 13.1 - 13.3</td>
<td><strong>Pluto &amp; Charon</strong> 12.4</td>
<td><strong>Kuiper Belt and Oort Cloud</strong> 13.4</td>
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<tr>
<td>Week 10</td>
<td>No Class</td>
<td>Searching for Exoplanets 14.4, 21.4</td>
<td>Exoplanet Discoveries 21.5 - 21.6</td>
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<tr>
<td>5/30 - 6/3</td>
<td><strong>No Class</strong></td>
<td><strong>Searching for Exoplanets</strong> 14.4, 21.4</td>
<td><strong>Exoplanet Discoveries</strong> 21.5 - 21.6</td>
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</tbody>
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**Final Exam:** Monday, June 6, 2:45 - 4:45. Cumulative.
Effective Study Skills

- Repeated re-reading is one of college students’ favorite study techniques, but research shows that beyond two readings of the textbook, additional reading is unlikely to lead to learning gains.
- Regularly review the activities, homework, and quizzes, and make note of topics you struggle with. Focus your study time on those.

Here are 6 science-backed strategies for effective learning. Practice them throughout the term!

- **Spaced Practice**: Put specific time aside to study throughout the week. Take breaks every 30-60 minutes, and after a session take a break and enjoy a healthy reward (a snack, a walk).
  - **Try it!** Get out your calendar. Look at the due dates for all of your classes, and consider other obligations. Block off specific times to prepare and study for classes.
- **Interleaving**: Switch between topics (or even classes) as you study, and review both old and new material in each session.
- **Elaboration**: Ask yourself questions about how and why things work, answer the questions on your own, then find the answers in your class materials.
- **Concrete examples**: Find concrete examples of topics, then make sure you understand how the specific features in the example help to illustrate the more general idea.
- **Dual Coding**: Represent ideas in multiple formats, for example in words + images, or auditory + movement.
- **Retrieval practice**: Put everything away, and then try to write, sketch, or verbally list everything you can remember about the topic you are studying. After this, go back to your materials and check for gaps or errors.

**Specific Tips based on the strategies:**

- **Retrieval Maps**: A retrieval map is a concept map made from memory to answer specific questions, or to describe distinct ideas. Start by sketching out everything you remember from memory, then look back to your notes to fill in the gaps.
- **Rubber Ducky Method**: Make a list of questions. Then answer them by explaining the concepts involved to a friend, your roommate, your cat, or a rubber ducky. Include dual coding by drawing as you talk, or include concrete examples.
- **Boxing Technique**: In the boxing technique, you hide key ideas in the lecture slides by drawing a box over it, then you later try to fill in the blanks.
- **Flashcards**: Apply dual coding by making sure your flashcards include both words and images. Shuffle them within and between topics as you study (this is interleaving).
Policies and Support Services

Maintain a Climate of Respect
It takes everyone to maintain a climate of respect so we have a physically, emotionally, and intellectually safe environment. In our class we welcome and celebrate the diverse perspectives and identities of all students, including but not limited to ability/disability, age, culture, ethnicity, gender identity, language, race, religion, sexual orientation, and socio-economic status. If you feel intimidated or unsafe about expressing yourself in class, please let me know.

COVID-19 Safety Plan
Consult UO’s COVID-19 Safety Resources and comply with all policies. If you test positive for Covid-19 or feel symptomatic, do not come to class - attend on Zoom, and consult https://coronavirus.uoregon.edu/covid-exposure. If you do not feel safe attending in person, you are welcome to attend via Zoom, but I cannot guarantee an equal experience.

Accessible Education
Feel free to contact me if you need accommodations and I will be glad to work with you. You can consult the Accessible Education Center (http://aec.uoregon.edu/) to enable better accessibility by informing me of necessary accommodations and adjustments to class design.

Accommodations for Religious Observance
Visit https://registrar.uoregon.edu/calendars/religious-observances for the observance form.

Mandatory Reporting
I am a mandatory reporter of child abuse and an assisting employee for discrimination or violence reporting. Students experiencing sex or gender-based discrimination, harassment or violence should call the 24-7 hotline 541-346-SAFE [7244] or visit safe.uoregon.edu for help. Students experiencing all forms of discrimination or harassment may find support through the Title IX office or the Dean of Students: investigations.uoregon.edu/how-get-support.

Mental Health and Wellness
Mental health is a critical factor in your overall well being. Support resources include trained clinicians through University Counseling Services (counseling.uoregon.edu) and from peers at the Duck Nest (in the EMU, health.uoregon.edu/ducknest).

Basic Needs
Resources are available for food, housing, healthcare, childcare, transportation, technology, finances, and legal support: https://blogs.uoregon.edu/basicneeds/food/

Academic Misconduct
The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students should not give or receive outside help on assignments without express permission. Info about plagiarism: https://researchguides.uoregon.edu/citing-plagiarism