

**AST 112: Alien Worlds Syllabus
Fall 2018**

Instructor: Dr. Kate Follette

Office: NSC A016

Office Phone: (413) 542-5938

Office Hours: **TBD**

Course Teaching Assistants and Graders:

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TA Help Session: Thursdays 7-9pm, NSC A120

Course Email: AmherstAST112@gmail.com

Course Website: <http://www.katefollette.com/teaching/courses/ast112f18>

Maximum Enrollment = 45

Class Meetings: 3-3:50pm MWF

Course Description

How did our solar system form? Are planets like Earth typical or rare? When, where, and how might we find life elsewhere in the universe? This course will provide an introduction to the formation and evolution of solar systems, including an exploration of the geology, chemistry and biology of the planets in our own solar system. We will discuss the origins, successes and limitations of techniques being used to discover planets around other stars (exoplanets), and the nature of planetary habitability. Our investigations will focus on understanding proportionalities, relative sizes, and visual representations of data, as well as evaluating the reasonableness of quantitative answers rather than on lengthy calculations.

Prerequisites

None

Required Texts/Materials*

Lecture Tutorials for Introductory Astronomy, Third Edition

Subscription to the Online *Mastering Astronomy* Interface

The Cosmic Perspective – Solar System (8th Edition) available as an e-text with Mastering Astronomy or in print from Amazon and other vendors

**If purchase of these texts is outside of your financial means for whatever reason, please let me know right away*

Goals and Expectations

Course Learning Goals

By the end of this course:

- Students will become comfortable with naked eye observations of the world around them and will be able to explain to their peers why certain celestial objects (sun, moon, planets, stars) vary in position and appearance on daily/weekly/yearly timescales by applying the basic principles of celestial motion
- Students will actively and consciously hone their skills at interpretation of graphs and tables, proportional reasoning, and order of magnitude estimation, and will be able to apply these skills to a range of phenomena
- Students will appreciate the dynamic nature of astronomical science and will be able to understand, interpret, and contextualize new solar system and exoplanet science results reported in the media.

What I Expect from You

1. This is not a course where you can succeed by reading the textbook. Most of the learning in this course will happen in real time during class. I expect that you'll come to **every** class on time and prepared to actively engage with the material and your classmates (except in the case of a serious illness or emergency).
2. That you respect both your instructor and your fellow students by listening when others are speaking.
3. That you work collaboratively with your classmates and aim to contribute equivalently (if not equally) to group discussions and assignments. At the same time, I expect you to follow the expectations laid out for individual work and abide by the college's honor code at all times.
4. That you participate actively and conscientiously. If you come to this class with a lot of prior knowledge about the subject, please take a step back and try not to overparticipate in class discussions. If you are less comfortable with the course material or format, challenge yourself to actively participate. **Active participation may take many forms.** For example:
 - Asking a clarifying question of me or a classmate
 - Explaining a concept to a classmate
 - Speaking up in a large group discussion
 - Coming to office hours

What You Can Expect from Me

1. I am here to help you learn. I will do my best to facilitate learning by providing opportunities for you to engage with the course material authentically, being open to and available for questions, and eliciting feedback on course content and structure regularly*.
2. That I will clearly communicate my expectations for acceptable coursework, and will grade fairly and anonymously
3. That I will be present, prepared and engaged at every class and office hour session (except in the case of serious illness, emergency or unavoidable travel).

*Throughout the course, I will be formally seeking your feedback on course structure, content, and design through periodic anonymous surveys. There is one area, however, in which I invite your feedback at any time. A welcoming classroom environment in which all students feel supported in their learning is very important to me. Recognizing that you each bring insights and experiences to the classroom that are different from my own, *I invite your feedback regarding course atmosphere at any point during the course* and in whatever form you feel most comfortable (e-mail, in person conversation, anonymous note). We all occasionally say things without thinking, and it is very important to me that if I ever use an example/analogy or make a comment that feels isolating or derogatory to you, that you feel comfortable telling me so that I can improve my practice. Similarly, if you feel isolated or denigrated by a comment made by one of your classmates, or you see or hear something you believe I should know about, please don't hesitate to contact me.

Where to Go To Find What and When

On the Course Website:

- Course assignments
- Lecture slides
- Handouts

On the Mastering Astronomy Site:

- Mastering Astronomy homework assignments

On the Course Moodle Site:

- Your grades, as they become available
- Solutions to course assignments
- Announcements for the course (which you should receive by e-mail when they are posted)

Course Content and Structure

The content of this course will be divided into four units – Celestial Motions, The Solar System, Exoplanets, and Astrobiology. Please see the course calendar and course outline documents for more specifics about lecture topics and due dates. Both documents are subject to change if it becomes necessary.

In-Class Exercises and Participation

Class time on Mondays and Wednesdays will consist of a combination of lecture, small group work, and discussions. You will often complete exercises from the required *Lecture Tutorials for Introductory Astronomy* course textbook during class time. These exercises will usually be preceded by a short lecture or demonstration, and both myself and a TA will circulate as you complete them in order to field questions.

These tutorials were designed by a team of astronomy education scholars to encourage you to engage with the material at a deeper level and to confront common misconceptions that could trip you up on homeworks and exams. The tutorials have been demonstrated to improve students' understanding of astronomy concepts in controlled studies. They are very important, however they will be neither collected nor graded, so it is imperative that you complete them diligently and ask questions when you don't understand the answers. Many exam problems will be derived from lecture tutorial questions.

In-Class Labs

Each Friday class session will involve an in-class lab that you will complete in a group of 3. You will be assigned two groupmates to work with during the second week of class based on your answers to a questionnaire, and these groups will be the same throughout the semester. If you have any issues with your groupmates, please schedule a meeting to brainstorm potential solutions with me.

Please exchange contact information with your groupmates so that you can arrange times to meet up should you need to complete any portion of an assignment outside of class hours. You should also notify them if you will miss a lab so that they don't wait for you and miss valuable class time.

Each group hands in one copy of each lab. Labs are designed to be completed in class, however groups work at different paces and some labs are more involved than others. If you have not completed the lab by the end of the Friday class period, you may bring it home over the weekend and hand it in at the start of class on the following Monday. You should arrange to meet up with your lab partners in such cases to complete the work together rather than breaking it up or having one person complete it all.

Assignments and Grading

The best way to hone the skills that we'll be developing in this class is through practice. The purpose of course assignments is therefore to allow you to learn by practicing and receiving feedback on your work. **Homework sets involve a substantial amount of work, and have a proportionately large influence on your final grade (40%).**

The course involves frequent small assignments rather than a small number of large assignments. The course schedule will help you to keep track of due dates. However, as a general rule, there are three types of assignments with regular deadlines:

1. **Mastering Astronomy assignments** are due **weekly at 11:59pm on Sundays**. They are designed both to introduce you to the material for the following week and to review difficult concepts from the material of the previous week. They open with suggested readings from the textbook. You should complete these readings first in order to be maximally prepared for both the Mastering Astronomy assignment and for class the following week. Mastering assignments are posted one week ahead of the due date.

2. **Observing assignments** are due **biweekly at the start of class on Wednesdays**. These assignments involve outdoor naked eye observations. We live in New England where it is often cloudy. Plan ahead and complete these assignments early. An observing assignment deadline involving nighttime observations will only be postponed if there are ***fewer than three clear nights*** during the two weeks preceding the deadline.
3. **Prelabs** are due weekly at the **start of class on Fridays**. They are designed to allow you to engage deeply with the material from the previous week and are often critical to the successful completion of the in-class lab. If you arrive at a Friday class without a completed prelab, you will be subject to the usual late work penalty (see below) and also will not be allowed to pair with a student who has completed the prelab. You may be asked to complete the lab alone if no other students are in the same boat.

Submitting Assignments

All on-time assignments should be submitted in class to the assignment inbox. Only late assignments will be accepted by e-mail, and assignments should never be left in my mailbox or under my door. Illegible assignments will not be graded. Please type your answers if you are worried about the legibility of your handwriting.

During the second week of class, you will be given an exoplanet name to use in lieu of your real name on all assignments, exams, etc. in the course. This is to help in unbiased assignment grading and to ensure your anonymity when assignments and exams are returned. All assignments, including labs, should be labeled with your exoplanet name and NOT with your real name.

Grading and Collecting Assignments

Assignments will be returned using the assignment outbox, which includes a hanging file labeled with your exoplanet name. This outbox will be available at every class session, during office hours, and during TA help sessions.

We aim to return assignments within 1-2 weeks, however the graders for this class are also busy students and sometimes schedules make this impossible, so please be patient. If we are unable to return an assignment before an exam, I will post the solutions for you to study from.

Grade Breakdown

Pre-Lab Exercises (weekly) - 20%

In-class Labs (weekly) – 15%

Mastering Astronomy exercises (weekly) – 10%

Observing assignments (biweekly) – 10%

Midterms - 10% x 2

Final - 15%

Participation - 10%

Late Work Policy

Completed assignments are an important foundation for our in-class work, therefore it is very

important that they be handed in on time.

All late coursework (assignments and labs) will be subject to a 10% per day penalty up to 10 days after the official due date or until solutions are posted, whichever comes first. **Late coursework must be scanned and e-mailed to AmherstAST112@gmail.com.** Please do not hand it in in class or by any other means. Scans can be made using the library copy machines or you can take a clear, well-lit picture. If your assignment constitutes multiple pages and you choose to take pictures of the pages, you will need to stitch the pictures together into a single document before submitting. I suggest using Mac Preview or Adobe Acrobat.

Illness, Injury, Etc.

There will likely be times during the semester when you are under the weather, overwhelmed by other coursework, or something else is going on in your life that prevents you from handing in an assignment, attending a class, or completing an observation. For this reason, your lowest-scoring prelab, mastering astronomy assignment, and observing assignment of the semester will all be dropped before calculating your final grade

Except in cases where you are going to miss three or more consecutive classes or assignments, you do not need to clear absences, missed assignments, etc. with me. In fact, I would strongly prefer that you **not** do so, as responding to and keeping track of inquiries of this nature is extremely time consuming. Instead, please abide by the following general policies:

- 1) **If you miss class**, download and review the lecture slides from the course website and reach out to a classmate for their notes. Complete any lecture tutorials on your own. Plan to attend office hours or the next TA help session if there is material that you need help understanding. Please do not email me or the TAs asking what was covered in the class session. This information is available in the class slides.
- 2) **If you are going to miss handing in an assignment**, give it to a classmate or friend to hand in or bring it to the Physics and Astronomy Department Office (NSC Co25) and leave it with Alice Simmoneau.
- 3) **If you are unable to complete a homework on time** for any reason, decide on your own whether to submit it late for the 10% per day penalty or not complete it at all. Recall that your lowest assignment of each type will be dropped from your grade to allow you some flexibility in case of illness, etc.
- 4) **If you miss an in-class lab**, please reach out to your lab partners before class to let them know that you won't be there. There are two designated lab makeup days during the semester during which you can complete a missed lab. However, you may wish to print out and look over the lab before those dates as each takes place after the relevant midterm.

Collaboration

Collaboration makes for richer and more efficient learning, therefore you are encouraged to collaborate on the homework sets. However, homework also provides you with an opportunity to receive individualized feedback on **your** work. You should make a first attempt at the

problems yourself before collaborating with anyone else in order to maximize your own learning. If and when you collaborate with someone, **you must specify on the assignment who you worked with and on which problems you collaborated** and you should be sure that your solutions are not identical (which indicates copying, not collaboration). Solutions should be written individually, and any explanations **must** be in your own words.

Academic Dishonesty

Academic dishonesty is a serious offense. If I or a TA suspect a student of academic dishonesty, I will ask that student to schedule a meeting with me one-on-one. If at the conclusion of this meeting I am convinced that that student knowingly engaged in academic dishonesty, it will result at a minimum in a grade of zero on the assignment in question and reporting of the incident to the dean.

Some examples of things that constitute academic dishonesty:

- (1) Fabrication of data or observations
- (2) Copying another student's answer to any portion of an assignment
- (3) Bringing another student's clicker to class in their absence and answering for them
- (4) Copying text for an assignment or exam directly from a book, website, video, etc.
- (5) Using solutions posted on any external website or distributed by a previous student in the course to complete your assignment

If you have any questions about what is and is not allowed, please see me at office hours to discuss.

Office Hours and Help Sessions

Attendance at Office Hours and TA Help Sessions are by far the best ways to get your questions about assignments, grades, and course content answered. Students consistently say in course evaluations that they wish they'd gone more often, so please take advantage of these free help sessions as often as you can. You can come to discuss specific problems both on upcoming and graded assignments, but also just to check your understanding of a tricky topic, or to say hello.

There will be two types of weekly help sessions:

My office hours – 1 hour per week. Day/Time TBD based on office hours poll.

Weekly TA help sessions – 7-9pm on Thursday evenings in NSC A0120

There will also be periodic observing assignment help sessions. These will take place sometime in the week before observing assignments are due, with the day/time varying depending on the weather forecast. A TA will lead students to the Book and Plow farm for nighttime observing or will be available at a location TBD on campus for daytime observing, depending on the nature of the assignment. Dates and times will be announced via Moodle.

Exams

There will be three exams for this course. The midterms will take place on the evenings of

October 4 (Celestial Motions unit) and November 15 (Solar System and Exoplanets unit). The final will be comprehensive and will cover all four units, with an emphasis on the final Astrobiology unit. The final will be scheduled by the registrar to take place during finals week. I will announce the date/time when it is assigned.

The exams will include two parts:

- 1) a collaborative multiple choice section in which you will work with a group of 2-3 classmates to choose the best answers
- 2) a short answer section that you will complete individually

Midterms will take place in the evening from 7-10pm, though I don't anticipate that they will take the full three hours. If you have conflicts with the assigned dates/times (e.g. another exam scheduled at the same time, a sporting event), you must contact me at least 1 week in advance to make alternate arrangements.

I am happy to work with students on testing accommodations, however I need to be informed at least 1 week in advance so that I can make arrangements to meet your specific needs. It is your responsibility to reach out to discuss arrangements by e-mailing the course e-mail or seeing me after class or at office hours. Don't assume that because your accommodations are listed in AC data I will automatically know what you need.

Class Participation

Technology Usage Policy

Data that we will discuss in class over the course of the first several weeks suggests the following:

- 1) That students who use cell phones during class receive grades that are up to a full letter grade lower than their peers who do not use them in class.
- 2) Students who use technology in class score lower on assessments that measure their comprehension of the material, and *their peers who are within view of their screens score even lower yet.*

At the same time, there are legitimate reasons why students may need to use laptops or cell phones in class. You are all adults and may choose for yourselves whether or not to use technology on any given day. However, due to the effect on your peers, those wishing to use cell phones, tablets, or laptops **must sit in the designated portion of the classroom (location TBD)**. If I or a TA notice you using technology in another part of the classroom, we will ask you to move. This is very disruptive to the class, so please make your own adult decision about where to sit for a given class session and stick to it.

Clickers

This class will use clickers, and it will be your responsibility to obtain one from Academic Technology Services in Seely Mudd room 110 before the Wednesday, September 12 class. Please bring your clicker to every class. If you forget your clicker, please notify the TA before

leaving class. You will still receive the attendance part of the participation grade for that day (see below).

Given the importance of not only class attendance but **engaged** class attendance to your success in this course, participation is given significant weight in your final grade, and can make the difference between two letter grades at the end of the semester.

Points for Clicker Questions

Your participation will be tracked through periodic in-class clicker questions. Your clicker grade will reflect the proportion of questions that you answered correctly, however you may answer up to 25% of them incorrectly (or not at all, in the case of non-attendance) without penalty. In other words, the formula to compute the clicker portion of your participation grade each day will be:

$$\text{Clicker grade: } \frac{\text{number of clicker questions answered correctly}}{0.75 * (\text{total number of clicker questions})}$$

This means that you can also gain several extra percentage points towards your course grade by attending all of the class sessions and answering all of the questions correctly. This is the only form of extra credit that will be offered this semester.

Note that in cases when I ask a difficult question, the class will often be divided in their answers. In such cases, I will always have you discuss the question with a partner and then re-vote, and it is the second vote that will count toward your participation grade.

I also occasionally ask questions about material that we have not yet discussed at the start of class to get a feeling for people's first instincts, and then will ask the same (or a similar) question again at the end of class. Here too, the second time I ask the question will be the one that counts toward your grade.

You will still get questions wrong occasionally, even after discussion with a partner. Keep in mind that you can get up to one in four questions wrong without penalty, so don't sweat missed answers. If you find that you are consistently receiving poor grades on the clicker questions, come see me at office hours to discuss techniques for preparing for class.

Points for Attendance

Engaged, respectful communication with your peers is crucial to the success of in-class activities. In particular, explaining your thinking and listening to others' explanations in turn is extremely important. If you arrive at class on time, listen, are respectful, and participate, you will always receive 5 participation points for each class you attend

Due to their negative impact on the learning environment, the following things will negatively impact the attendance portion of your daily participation grade:

- 1) Being late to class or leaving early - 1 point

- 2) Being very late to class or leaving very early (>5 min) – 2 points
- 3) Failing to abide by the device usage policy – 1 point per incident
- 4) Disrespecting a fellow student – 1-5 points, depending on the severity
- 5) Failing to participate in group discussions, pair activities, etc. – 1 point per incident
If working in groups is prohibitively difficult for you, please make an appointment to speak with me and we will make alternate arrangements.

Other Stuff

Email

My office hours, TA help sessions, and class time are by far the best times to get your questions about the course answered. Except in a small number of specific cases, noted below, all emails regarding this course should be directed to AmherstAST112@gmail.com and **not** to my personal e-mail. The purpose of this division is consistency and organization. The course e-mail is maintained by both myself and your TAs and is checked once per weekday and once on Sunday evening. Please wait at least 24 hours for a response before e-mailing again.

Exceptions for which you should e-mail me personally:

- 1) You need to report a classroom climate issue
- 2) You need to report an issue with a TA

If you have an issue that you would like to discuss with me alone that is not included on the list above, please e-mail AmherstAST112@gmail.com stating simply that you'd like to make an appointment with me, and we can discuss it in person.

All e-mails regarding the course should contain a descriptive subject line.

Accommodations for Disabilities

If you have any kind of disability, whether apparent or non-apparent, learning, emotional, physical, or cognitive, and you need some accommodations or alternatives to lectures, assignments, or exams, please feel free to contact me to discuss reasonable accommodations for your access needs.

I look forward to working with you this semester in Astronomy 112!

Course Outline

(subject to change)

Class No.	Date	Topic	Lecture Tutorials	Due in class (unless otherwise specified)	Textbook Sections
1	Wed 9/5	Size and Scale in the Universe	Sun Size		1.1, 1.2, 1.4
2	Fri 9/7	Lab #1 – Astronomy vs. Astrology			3.4-3.5
N/A	Sun 9/9			Mastering Astronomy #1 (11:59pm)	1.1-1.4, 2.1
3	Mon 9/10	History of Planet Discovery		Lab #1	1.3, 2.1
4	Wed 9/12	Intro to the Night Sky – Daily Motions	Position and Motion	“Prelab” #1 – Parts III-VII	1.3, 2.1
5	Fri 9/14	Lab #2 – Intro to Observing		Prelab #2	2.1
N/A	Sun 9/16	Orientation to the Night Sky (Optional, but highly recommended) 8:30pm-10pm, NSC Roof Backup day in case of clouds = Mon 9/17		Mastering Astronomy #2 (11:59pm)	2.1-2.3, S1.2
6	Mon 9/17	Intro to the Night Sky – Yearly Motions	Seasonal Stars Ecliptic	Lab #2	S1.2
7	Wed 9/19	Seasons	Seasons	Observing Asst #1	2.2
8	Fri 9/21	Lab #3 – Motion of the Sun		Prelab #3	2.3
N/A	Sun 9/23			Mastering Astronomy #3 (11:59pm)	S1.2, 2.2-2.3, 3.2-3.3
9	Mon 9/24	Ancient Observations of the Sun, Moon, Earth and Planets	Observing Retrograde Motion	Lab #3	3.2-3.3

Class No.	Date	Topic	Lecture Tutorials	Due in class (unless otherwise specified)	Textbook Sections
10	Wed 9/26	Heliocentric and Geocentric Cosmologies	Planetary Positions (supp.)		3.2-3.3
11	Fri 9/28	Lab #4 – Solar System Models		Prelab #4	
N/A	Sun 9/30			Mastering Astronomy #4 (11:59pm)	3.2-3.3, 4.4
12	Mon 10/1	Kepler's Laws	Kepler's Second Law Kepler's Third Law	Lab #4	3.3
13	Wed 10/3	Newton's Laws	Newton's Law and Gravity	Observing Asst #2	4.4
N/A	Thu 10/4	Midterm #1 7-10pm			
14	Fri 10/5	Lab Makeup Day			
N/A	Mon 10/8	NO CLASS – FALL BREAK			
15	Wed 10/10	Planet Formation	Temperature and Formation of our Solar System		8.1-8.2, 7.2
16	Fri 10/12	Lab #5 – Galilean Moons		Prelab #5	
N/A	Sun 10/14			Mastering Astronomy #5 (11:59pm)	7.2, 8.1-8.2, 9.1-9.2
17	Mon 10/15	Planetary Internal Structure and Energy	Earth's Surface Features (supp.) Planet Surface Features (supp.)	Lab #5	9.1
18	Wed 10/17	Planetary Surfaces as a Geological Record	The Moon's Crater History, Craters: The Order of Events	Observing Asst #3	9.2
19	Fri 10/19	Lab #6-7: Tour of Solar System		Prelab #6	7.1, 9.3-9.5, 10.3-10.5, 11.1-11.3, 12.1-12.5

Class No.	Date	Topic	Lecture Tutorials	Due in class (unless otherwise specified)	Textbook Sections
N/A	Sun 10/21			Mastering Astronomy #6 (11:59pm)	9.1-9.2, 10.1-10.2, 10.6
20	Mon 10/22	Tides and Orbital Interactions			4.5
21	Wed 10/24	Planetary Atmospheres			10.1-10.2
22	Fri 10/26	Lab #6-7: Tour of Solar System		Prelab #7	7.1, 9.3-9.5, 10.3-10.5, 11.1-11.3, 12.1-12.5
N/A	Sun 10/28			Mastering Astronomy #7 (11:59pm)	10.1-10.2, 10.6
23	Mon 10/29	Earth's Atmosphere	Greenhouse Effect	Tour of Solar System Poster (5pm, submit on Moodle)	10.6
24	Wed 10/31	Tour of Solar System Presentations		Observing Asst #4	
25	Fri 11/2	Lab #8 – Scale Models of Extrasolar Systems		Prelab #8	
N/A	Sun 11/4			Mastering Astronomy #8 (11:59pm)	13.1-13.4
26	Mon 11/5	Radial Velocity	Motion of Extrasolar Planets	Lab #8	13.1-13.4
27	Wed 11/7	Transits	Detecting Exoplanets with the Transit Method		13.1-13.4
28	Fri 11/9	Lab #9 – Selection Biases		Prelab #9	
N/A	Sun 11/11			Mastering Astronomy #9 (11:59pm)	13.1-13.4, 24.1-24.2
29	Mon 11/12	Direct Imaging + Astrometry		Lab #9	Supplemental material
30	Wed 11/14	Microlensing	Detecting Exoplanets with Gravitational Microlensing	Observing Asst #5	Supplemental material

Class No.	Date	Topic	Lecture	Tutorials	Due in class (unless otherwise specified)	Textbook Sections
N/A	Thu 11/15	Midterm #2 - 7-10pm				
31	Fri 11/16	Lab Makeup Day				
N/A	Mon 11/19	NO CLASS – THANKSGIVING BREAK				
N/A	Wed 11/21	NO CLASS – THANKSGIVING BREAK				
N/A	Fri 11/23	NO CLASS – THANKSGIVING BREAK				
32	Mon 11/26	History of Life on Earth				24.1
33	Wed 11/28	Life in the Solar System				24.2
34	Fri 11/30	Lab #10 – Exoplanet Activity			Prelab #10	
N/A	Sun 12/2				Mastering Astronomy #10 (11:59pm)	24.1-24.4
35	Mon 12/3	Habitability and Life in Other Solar Systems			Lab #10	24.3
36	Wed 12/5	SETI and the Search for Life			Observing Asst #6	24.4
37	Fri 12/7	Lab #11 – The Drake Equation			Prelab #11	24.4
N/A	Sun 12/9				Mastering Astronomy #11 (11:59pm)	24.1-24.4
38	Mon 12/10	Biosignatures			Lab #11	Supplemental material
39	Wed 12/12	The Future				
N/A	TBD	Final Exam				