Stars, Planets, Life

Class Times: Monday/Thursday 10:00am – 11:50am

Me
Hugh Crowl
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Office Hours: Tuesday 2pm-3:30pm, Wednesday 9:30am-11:00am, *or by appointment*

Texts: The Cosmic Perspective (7th/8th Edition), Bennett, et al.
Lecture Tutorials for Introductory Astronomy (3rd/4rd Edition), Prather, Slater, et al.
Supplementary Material will be assigned as needed

Course Homepage: Course materials will be posted at: https://crowl.bennington.edu/spl/

Course Overview: In the last thirty years, the study of life beyond our own planet has gone from science fiction to legitimate science. The course will initially focus on how stars form and evolve, starting from the formation of the universe, and continuing to a discussion of stars as both the synthesizers of heavy elements and the central energy source for stellar systems. From there, we will discuss current planetary formation theories, planet detection techniques, and the explosive discovery of planets outside our solar system in the past fifteen years. Finally, we will examine the conditions under which we think life evolves and whether any of the glut of planets we've discovered in the last year may support life.

Course Goals: After taking this course, you should have an understanding of the way that astronomers search for life beyond our solar system. You should also have an understanding of how physical processes in the universe inform our picture of the formation and evolution of life.

Slack: We will use Slack this term to communicate: http://benningtonphysics.slack.com/ Make sure to sign up for a Slack account and join the *#spring2022-spl* channel within the *benningtonphysics* workspace to get and discuss course material with me and your fellow students. I will use Slack as the primary way of communicating with you this term and you are encouraged to use it to ask question and discuss any issues you may be having. You can use your Bennington email address to sign up at the following link: https://join.slack.com/t/benningtonphysics/signup

Problem Sets: You will be assigned a problem sets regularly throughout the term. These problem sets will take different forms, but will usually contain a mix of qualitative short answer questions, quantitative problems, and longer-form essay questions. On the quantitative problems, you are encouraged to show your work and state any assumptions you make. This will help me to understand your reasoning and, where appropriate, award partial credit. In general, I do not accept late problem sets. Please see me in extraordinary circumstances. They will be due on the date indicated on the set.

A note on collaboration: Collaboration on problem sets is welcome and, in fact, encouraged. One of the best ways to learn something difficult is to work through it with other students. However, you should ensure that the work you turn in is your own. Distinguishing between these two different aspects of work can be challenging. One good rule of thumb is to work together to get to the right answer, but then write up the problem set on your own, using your own words. It may take some extra time, but it's a way to minimize the chance of plagiarism and also gives you another chance to really understand the material. If you have any questions, ***please ask.***

Observing: At one point during the term, you will be asked to go to one of the open public observing nights at Stickney Observatory (http://observatory.bennington.edu), look through the telescope, and make a sketch of what you see.

Planet Projects: As a way to synthesize what we have learned in this class, there will be a final project that will enable you to take a deeper dive into one of the newly discovered planetary systems outside our solar system. More details to follow after Long Weekend.

Class Participation: There is a huge amount of educational research showing that lecture alone is ineffective in ensuring a deep understanding. In the last couple decades, interactive lecturing has found its way into large lecture classrooms. We're really lucky here at Bennington that we don't need to figure out how to lecture to 200-person classes, but it still makes sense to employ many of the techniques used for those larger classes.

Voting Cards

I will give you a card at the beginning of the term, which allows you to represent one of four choices. Most days, there will be several opportunities to vote and confer with your neighbors. These discussions and participating in class voting are an important part of your class participation grade.

Lecture Tutorials

There will be several points throughout the term where you will, in class, work through conceptual exercises designed to help you gain a fuller understanding of the material. These serve as a good "check" of your understanding and allow you to more fully engage with the material.

Please note that *class attendance is mandatory*. Missing even one class can seriously affect your class participation grade. Missing more than 3 classes during the semester may lead to you failing the class. Please see me in extraordinary circumstances.

Tests/Quizzes: There will be approximately five in-class short tests through the term. You must inform me in advance of a test if you need to miss it. Tests cannot be "made-up" if we are not notified before the time of the test. Make-ups must be done before graded tests are returned to the class (typically the next class meeting).

Resources for Help: Building a quantitative understanding of astronomical principles can prove challenging. It is likely you will need help. There are a number of options for getting help:

- *Work with a classmate and/or Ask a question in Slack*: On all the non-quiz parts of this class, I expect you will collaborate (with one another, and with me!). You are strongly encouraged to work on the problem sets together in small groups (2-4 people tends to work best) and use Slack to ask questions of me and of the larger class group when your smaller group gets stuck. I will also check Slack regularly to offer help.
- *Come to Office Hours*: If you're having difficulty that Slack can't solve, please make a plan to attend my office hours. I have set office hours for Tuesday afternoons and Wednesday mornings, but I am happy to meet with you at other times that work for both of us. I am happy to either meet in person in my office (Dickinson 104) or over Zoom.
- *Go to the Math Tutors*: There are (free!) Math Tutors that are happy to help you with any troubles you've been having with the more mathematical side of things. While any of the tutors can help you with mathematical questions, the math tutor *Swagata Datta* is also a physics & astronomy student who will be particularly adept at helping with more physics-central things. You can contact them to set up appointments by emailing them at mathtutors@bennington.edu or join the Bennington Math Slack (email the math tutors to be added to the workspace).

Academic Accommodations: Bennington College provides reasonable accommodations to students with documented disabilities when such accommodations are requested and necessary to ensure equal access to College programs and facilities. If you believe you are entitled to an accommodation speak with Katy Evans, the Academic Services and Accommodations Advisor, about any disability-related needs. If approved, you will receive a memo detailing your specific accommodations; it is your responsibility to provide me with the memo and discuss the implementation of accommodations. Note that I will not be aware of your needs if you do not share this memo with me. Accommodations are not retroactive, so the sooner we meet to discuss your needs, the better. Also, students experiencing mental and/or physical health challenges that are significantly impacting their academic work are encouraged to speak with their faculty

advisor and member of Academic Services (academicservices@bennington.edu or 440-4400) about the impact and to connect with resources through health and psychological services (440-4426 or 440-4451).

Evaluation/Grading:

Problem Sets: 35% Tests/Quizzes: 30% Class Participation: 15%
Observing: 5% Final Project 15%

Tentative Schedule (likely to change)

Week of	Topic	Reading
February 14	Foundations, The Big Bang	Chapter 20
February 21	The Early Universe + Light	Chapters 5, 22-23
February 28	Light + Star Formation	Chapters 5, 15 & 16
March 7	Stellar Structure and Evolution	Chapter 17
March 14	Stellar Death	Chapter 18
March 21	Cosmic Recycling and Planet Formation	Chapters 19
March 28	Planet Formation/Our Solar System	Chapters 7 & 8
April 4	Discovery of Extrasolar Planets *(no class Monday)*	Chapter 13
April 11	Discovery of Extrasolar Planets (*no class Thursday*)	Chapter 13
April 18	The Kepler Revolution	Chapter 13
April 25	Extrasolar Planet Demographics	Supplementary Reading
May 2	Early Life on Earth (*no class Thursday*)	Chapter 24
May 9	Early Life on Earth	Chapter 24
May 16	The Search for Life in the Universe	Supplementary Reading
May 23	The Search for Intelligent Life	Supplementary Reading