# Physics 3150: Astrophysics I Syllabus, Fall 2025

https://www.nasa.gov/webbfirstimages

**Land Acknowledgement**

We acknowledge that the lands on which Memorial University's campuses are situated are in the traditional territories of diverse Indigenous groups, and we acknowledge with respect the diverse histories and cultures of the Beothuk, Mi'kmaq, Innu, and Inuit of this province.

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About the Instructor:

I have been a professor here at MUN for three years after a number of years teaching at the University of Toronto. I earned my doctorate at the University of Toronto where I developed a theoretical model for stellar winds in massive variable stars. I spent time as a postdoctoral researcher at the University of Bonn in Germany and at the East Tennessee State University before returning to Toronto. My research interests vary from modelling the physics of stars such as stellar evolution, stellar atmospheres, winds, etc.; to exploring issues in the Search for Extraterrestrial Intelligence; to how we measure the parameters defining our understanding of cosmology; to learning about cultural and Indigenous perspectives of astronomy; and to the ethics of how we explore space around us. Really I just want to explore things about

astronomy that are fun and can impact our learning. I am also passionate about science outreach and inclusion in science, physics, and astronomy.

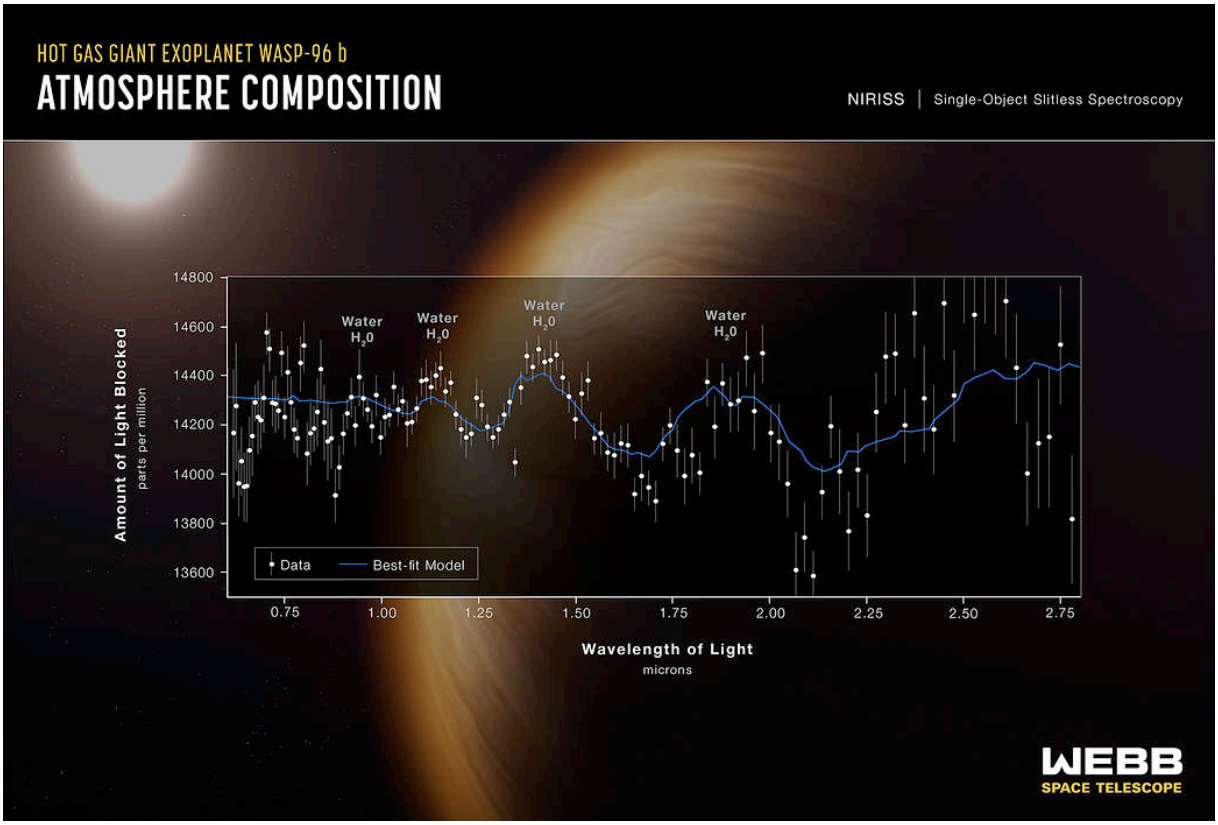
Course Description

**3150 Astrophysics I** covers macroscopic and microscopic physics related to stellar structure, energy production, and evolution. This includes stellar observables, gravity and other forces, the Virial Theorem, light and matter in stars, stellar spectra and classification, Hertzsprung-Russell diagrams and properties of main sequence dwarf stars, radiation in the stellar atmosphere, structural relationships and stellar models, energy sources and energy transport in stars, star formation and stellar evolution, nucleosynthesis, variable stars, Chandrasekhar's limit, and degenerate remnants.

PR: PHYS 2053, 2750 (or 2056), and 2820
CR: 3160

My Take:

Astrophysics is the study of pretty much everything that exists beyond the atmosphere of the Earth and can include anything from objects in our Solar System to the physics of the Sun and stars, to the galaxy formation and evolution and cosmology. In Physics 3150, we will explore how astronomers observe the Universe around us using telescopes and focus on how we understand the lives and deaths of stars from the smallest M stars to massive stars and neutron stars and black holes; and fast radio bursts, supernovae, gamma ray bursts. This includes exploring some of the big questions of the current era of astrophysics - how do we find and understand planets orbiting other stars? what are some of the weirdest stars and related phenomena?



Learning Goals

1) Students will understand how astrophysics is studied and the methodologies used to observe astrophysical phenomena.
2) Students will develop critical thinking skills related to astrophysics.
3) Students will apply statistics, computer programming, order-of-magnitude analysis and mathematical methods to problems in astrophysics.
4) Students will develop communication skills related to writing and presentations for both specialized audiences and general audiences.

Code of Conduct

My goal for teaching is to support learning and curiosity. It is important to that we work together in an inclusive, respectful, and kind environment. Astrophysics and physics in the last century has made great advances from people working together in teams and communicating. It is my intent that we have a class where we work together and support each others learning. In this environment, discriminatory and inappropriate comments will not be tolerated.

Illness/Missed Classes

This has been a challenging few years thanks to Covid and it is not over. If you have any symptoms and/or feel unwell please do not feel it necessary to attend class and please let me know via email if possible. Similarly there are due dates for assignments but I am happy to honour extensions if there is need and I am contacted before the due date. I will also work to support make-up tests, etc if necessary. I will also note that if I, the instructor, have any symptoms I will try to shift lectures online instead of cancelling classes.

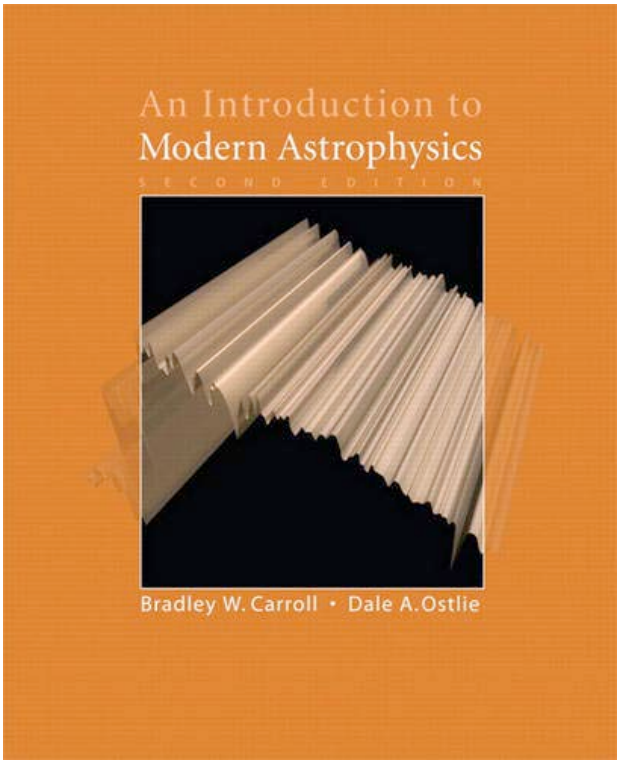
In the case of a class disruption or cancellation, and in the case of revisions to evaluation methods, the instructor or the Head of the department will notify all students registered in the course via the course shell in Brightspace. Any necessary revisions to the evaluation methods will be made in consultation with the students registered in this course. If a student demonstrates that they would be disadvantaged by the change, then, as per 6.7.4 of the University Calendar, accommodations will be made.

Accommodations

Memorial University of Newfoundland is committed to supporting inclusive education based on the principles of equity, accessibility and collaboration. Accommodations are provided within the scope of the University Policies for the Accommodations for Students with Disabilities (www.mun.ca/policy/site/policy.php?id=239). Students who may need an academic accommodation are asked to initiate the request with the Glenn Roy Blundon Centre at the earliest opportunity (www.mun.ca/blundon).

Student Wellness and Counselling Centre, Student Support and Crisis Management, MUN Chaplaincy, Sexual Harassment Office, The Circle: First Nations, Inuit and Métis Students Resource Centre, Disability Information Support Centre, International Students Resource Centre, Sexuality and Gender Advocacy, Student Parent Assistance and Resource Centre, Students Older Than Average, Intersections – A Resource Centre for Marginalized Genders, and specific departmental societies.

Course Outline - see associated document on Brightspace.




Readings

Required Textbook for both 3150/3151 - Carroll, Bradley W. & Ostlie Dale A. An Introduction to Modern Astrophysics, 2019 Cambridge University Press.

Reference Text - Ryden, Barbara & Peterson, B.M. Foundations of Astrophysics, 2020, Cambridge University Press.

Additional readings -
There will be readings posted to Brightspace. These readings will vary from popular science articles to some professional research journal articles. The goals of the articles is to present some very recent science and discoveries.

Assessments

| Type | Value |
|---|---|
| **Assignments** | 20% |
| **Colleague Points** | 10% |
| **New research Friday presentation** | 5% |
| **Poster Presentation** | 10% |
| **Midterm** | 25% |
| **Final Exam** | 30% |


**Assignments**:
Throughout the course there will be four assignments. Ideally assignments will be submitted via Brightspace. Assignments may consist of questions where you calculate a result analytically, explain an idea, or use computational methods/software to learn a concept.

**Colleague Points:**
Instead of participation I suggest that we have "Colleague Points" to motivate collaboration and support for each other. There are many ways to earn these points including sharing notes. This will be evaluated at the end of term where students will be asked to submit a short document with two lists. The first list should describe the ways you supported others in the class and the second list should describe the ways you were supported and by whom. This works best if you keep a journal

**New research Friday Presentation:**
For 6-8 Friday classes of the term we will discuss some new discoveries in astronomy (like things reported in the news) and do some team research on the discovery to understand what it means and some questions raised. The discovery will be introduced and discussed by a small group of students (3-5 people, depending on the number of students in the class) and we will apply different physics and math knowledge to the topic.

**Poster Presentation:**
Near the end of term, each student will prepare a "research" poster where you will present an open questions and review some of the recent research in trying to answer the questions. Poster structures and details to follow, but topics are completely open from cosmology to stars to planets to SETI and so on.

<u>How to succeed:</u>
I define success in this course as doing your best and putting in an earnest effort in this course. My take on how to succeed in this course is to work together as a group and to support each other. Every student is capable of success in this course and every person has their own skills and talents. Astrophysical sciences advances by working together and I think that is one way to do succeed in the course. I also think it is important to communicate any issues, ideas, etc., and I will do my best to respond to any email/message within one business day.

<u>Academic Integrity (University Regulation 6.12).</u>
Students are expected to adhere to those principles which constitute proper academic conduct. A student has the responsibility to know which actions, as described under Academic Offences in the University Regulations, could be construed as dishonest or improper. Students found guilty of an academic offence may be subject to a number of penalties commensurate with the offence including reprimand, reduction of grade, probation, suspension or expulsion from the University. For more information regarding this policy, students should refer to the University Regulations for Academic Misconduct (Section 6.12) in the University Calendar.

Memorial University offers a broad range of supports including: Memorial University Libraries, The Commons (QEII Library), The Glenn Roy Blundon Centre, The Writing Centre, Centre for Innovation in Teaching and Learning, Information Technology Services, Academic Advising, and specific departmental help centres.

Statement about AI/ChatGPT

There is a lot of talk about using ChatGPT or other AI search engines to do school work for you. Original work, completed wholly by you, is expected to be submitted in this course. The use of an artificial intelligence tool like ChatGPT is not permitted. I reserve the right to include questions that might ask you to use an AI tool for an assignment where you would be asked to analyse the response for accuracy and to build upon it, but the usage of AI will be specific.

Method of Instructional Continuity

In the case of a class disruption or cancellation, and in the case of revisions to evaluation methods, the instructor or the Head of the department will notify all students registered in the course via the course shell in Brightspace. Any necessary revisions to the evaluation methods will be made in consultation with the students registered in this course. If a student demonstrates that they would be disadvantaged by the change, then, as per 6.7.4 of the University Calendar, accommodations will be made.

Course Calendar

| Date | Topic | Items Due | Relevant Chapters | Notes |
|---|---|---|---|---|
| **10 - 12 September** | Laws of Motion, The viral theorem | | Chs 1, 2 | Chapter 1 will not be covered in class |
| **15 - 19 September** | Light and Matter | | Ch 3, 5 | |
| **22 - 26 September** | How astronomers observe | | Ch 6 | |
| **29 September - 3 October** | Binary Stars/ Exoplanets | | Ch 7, 8 | |
| **6 - 10 October** | Atmospheres of Stars | | Ch 8, 9 | |
| **15 - 17 October** | Interiors of stars | | Ch 10 | (Oct 17 will follow Monday schedule |
| **20 - 24 October** | The Sun | Exam 1 | Ch 11 | |
| **27 - 31 October** | Star formation/ ISM | | Ch 12 | |
| **3 - 7 November** | Evolution of sun-like stars | | Ch 13, 14 | |
| **10 - 14 November** | Evolution of massive stars | | Ch 14, 15 | (November 12 will follow Tuesday schedule) |
| **17 - 21 November** | Stellar explosions | | Ch 15 | Lectures may be recorded or by guest lecturer |
| **24 - 28 November** | Stellar remnants | | Ch 16 | |
| **1 - 5 December** | Black Holes and Gravitational Waves | | Ch 17 | |