

Week & Date **Syllabus for ASTR 1020, Introductory Astronomy 2nd Semester, Doug Duncan, Spring 2020**

***** be sure to read "About this Course" on the class Canvas website*****

Do assigned readings BEFORE TUESDAYS - there will be clicker questions on the reading.

Reading assignments are pink on this syllabus.

Homework will usually be assigned on Tues. and due the following Tues.

When possible I will assign it **the Sunday before, so you can ask questions in recitations.**

Read the textbook *Strategically!* Focus on answering the "Learning Goals."

Week 1 **Introductions. The amazing age of discovery in which we live.**

Jan. 13 **Review of scales of space and time. Review of "What is Science?"**

Thurs. Jan. 16 will be in the planetarium!

My goals for the course. What would *you* like to learn about?

What do I expect from you? Good news/bad news. Science vs. stories about science.

Bloom's Taxonomy of Learning

This is a "student centered" class. I'm used to talking (Public Radio career). Here *you* talk too.

Whitewater river analogy: If you don't want to paddle, don't get in the boat.

Learning Assistants - YOUR VERY USEFUL FRIENDS!

Grading. Cheating. Clickers and why we use them. Homework out/in **Tuesdays**. Tutorials. Challenges.

How to do well in the class. [Learning Goals - Review Questions - Test your Understanding]

Why we prefer to give "helpful hints", not answers. Why employers love to hire graduates of this class!

Read bottom of syllabus; "Statement of Expectations" for Arts & Sciences Classes"

Policy on laptops and cell phones. Participation and "points."

Registrations: Clickers, Mastering Astronomy.

Highlights of what the term will cover -- a bargain tour of the universe

The nature of science and astronomical discovery.

What science *isn't*. Cargo Cult Science and pseudoscience.

Science as a way of not fooling yourself (paper cup with hole question)

Steven Chew learning videos #1 and #2.

Numbers and estimation in astronomy. Proportions. Units.

What can we observe about the stars? Magnitude and color.

Homework #1: Mastering Astronomy Homework. #1b Good and Bad Science (on Canvas class website)

Due Jan. 21 at 12:30 pm.

-Register Mastering Astronomy, AND your clicker. MA class code: MADUNCANSPRING2020

Reading: Chapter 1, *The Cosmic Perspective*. Scale of earth in space, civilization in time.

Chapter 3, *The Science of Astronomy*

Chapter 2.1, 2.2, 2.3, **S1.2: Sky motions. These readings should be review from ASTR1010.**

LA-led Recitation: Estimation, scientific notation, ratios.

Do readings BEFORE TUESDAYS. Introductory clicker questions will be based on them.

Week 2 **Review Motions, Energy, and Gravity in the Universe**

Jan. 20

Different forms of energy. What is temperature? Four phases of matter.

PheT Gas pressure applet

Kepler's laws. *Why do things move that way?*

Scalars and Vectors. Position, velocity, acceleration. Newton's laws. *Derive Kepler's 3rd law*.

Homework #2a and 2b: Mastering Astronomy Tutorials: Energy, and The Nature of Science - Due Jan. 28

Reading: Chapter 4 *Motion, Energy, Gravity*

LA meeting: Good and bad science. Tutorial: Blackbody Radiation.

- Week 3**
Jan. 27 **Review Light and Spectra**
The wonderful nature of light!
 Properties of light. White light. Kirchoff-Bunsen laws.
 Black body spectra. $R^2 T^4$. B-V colors.
 Wave-like and particle-like experiments.
 Demo the Doppler Effect; invisible wavelengths of light, greenhouse effect
Thur - Steven Chew learning videos #3.
Homework #3. MA: Light and Spectra
 Reading: Chapter 5, *Light and Matter*
 LA meeting: Fiske Lobby Homework on Light and Spectra - if available
- Week 4**
Feb. 3 **Special Relativity: The Nature of Space and Time. Some review of The Sun, our Star.**
 "Thought experiment:" the clock in Bern, Switzerland and why space and time must be connected
 The paradox of "now"
 Special Relativity: Time and Distance change when moving rapidly
 Structure of the sun: photosphere, chromosphere, corona, core
 Fission and Fusion - energy sources
 Hydrostatic equilibrium ; Solar Seismology; Solar neutrinos
 Solar "Weather" and "Solar Storms" -- sun - earth interactions
 Summarize the 2017 "Great American Total Eclipse of the Sun!"
 Reading: Chapters 2 and 14, *Space and Time*, and *Our Star*
Homework #4. MA: Special Relativity, and The Sun
 LA meeting: Preparation for Nighttime Observing
- Week 5**
Feb. 10 **Surveying the Stars**
 Parallax and distances to stars
 Luminosities, Temperatures, Masses. The HR diagram
 Reading: Chapter 15, *Surveying the Stars*
Homework #5. MA Tutorial: The HR Diagram
Midterm 1 Thurs. Feb. 13
 LA meeting: Tutorial on Luminosity and Temperature, midterm practice
- Week 6**
Feb. 17 **Stars and their evolution I: Starbirth**
 Star clusters and the Hertzsprung-Russel (HR) diagram
 Nebulae; star formation
Tutorial on molecules and Radio Astronomy
 Energy sources, Gravity, Fission and fusion.
 Lives of Low Mass Stars. Lives of High Mass Stars. Binary Stars.
 Reading: Chapter 16, *Star Birth* and start Chapter 17, *Star Stuff*
Homework #6: Mastering Astronomy Stellar Evolution AND 6b Aliens and Life in the Universe
 LA meeting: tutorials: binary stars, and The HR Diagram
- Week 7**
Feb. 24 **Stars and stellar evolution II: Star Lives, Star Deaths!**
 red giants and synthesis of the elements
 white dwarfs and planetary nebulae
 supernovae
 neutron stars, pulsars, black holes
 gamma ray bursts and gravity waves
Homework #7: Mastering Astronomy: Stellar Evolution
 Reading: Chapter 17 and 18, *Star Stuff*, *The Bizarre Stellar Graveyard*
 LA meeting: HR Diagram discussion
- Week 8**
Mar. 2 **Discovery of our own Milky Way Galaxy and Its Structure.**
 The Shapley-Curtis debate
 Radio and infrared observations
 A modern picture of the Milky Way
 Reading: Chapter 19, *Our Galaxy*
Homework #8: Mastering Astronomy, "About our Galaxy"
 LA meeting: In the planetarium - where are we in space? ADVANCE SCHEDULE FISKE
March 5 in the planetarium. Explore the Milky Way and "Black Holes!"

- Week 9**
Mar. 9 **Galaxies and the Foundation of Cosmology**
Types of galaxies
Measuring cosmic distances
Hubble's law - the universe is expanding!
Homework #9: Mastering Astro. with tutorials: "Cosmic Distances" and "Hubble's Law"
Reading: Chapter 20, *Galaxies and the Foundation of Modern Cosmology*
LA meeting: Galaxy Classification exercise.
Thurs. Mar. 12 is midterm #2
- Week 10**
Mar. 16 **Galaxy Evolution**
Roles of density and angular momentum
Role of environment
Starbursts and Quasars
Homework #10: Mastering Astro. "Galaxy Evolution"
Reading: Chapter 21. *Galaxy Evolution*
LA meeting: Distance Ladder Tutorial
- Week 11**
Mar. 23 **Spring Break. No classes.**
- Week 12**
Mar. 30 **Spacetime and Gravity. Building Blocks of the Universe**
Einstein's second revolution
A new view of gravity. Testing General Relativity.
Particles. Quantum Mechanics. The Uncertainty Principle
From the smallest quantum to the largest scales in the universe - cosmology.
Homework #12: Mastering Astro. "Gravity and the Quantum Universe"
Reading: Chapters S3 and S4. *Spacetime and Gravity, and Building Blocks of the Universe*
LA meeting: Discussion of S3 and S4. Tutorial "Making Sense of Expansion"
- Week 13**
Apr. 6 **The Birth of the Universe. The Big Bang and the Beginning of Time and Space**
Tutorial: The Big Bang
Hubble's discovery of the Expanding Universe
The accidental discovery of primordial radiation (seeing the beginning of the universe with a TV!)
The Big Bang Theory; testing models of the early universe
Adding "Inflation" to the original Big Bang Theory
The latest observations and What We Still Don't Know
Apr. 7 is at Fiske Planetarium
Homework #13: Mastering Astronomy
Reading: Chapter 22: *Birth of the Universe*
LA meeting: Cosmology tutorial: "Hubble's Law"
- Week 14**
Apr. 13 **Dark Matter, Dark Energy, and the Fate of the Universe**
Tutorial: Dark Matter
Dark matter is found in other galaxies just like in the Milky Way (review rotation curves)
Dark matter between galaxies: X-rays and gravitational lenses
Overall structure and fate of the universe
Homework #14: Mastering Astronomy
Reading: Chapter 23: *Dark Matter, Dark Energy, and the Fate of the Universe*
LA meeting: Tutorial - Dark Matter
- Week 15**
Apr. 20 **Extra-solar planets and Life in the Universe**
The remarkable diversity of life on earth
Evolution of life on earth
Life in the Solar System?
Detecting Extra Solar Planets. Searching for life on them.
Reading: Chapter 24: *Life in the Universe*
Homework #15: Mastering Astronomy (There is no HW 14)
LA meeting: Doppler Detection of Extra-Solar Planets

Week 16

Finish extra-solar planets and Life in the Universe

Apr. 27

Science and Pseudoscience. Science as a way of trying not to fool yourself.

No Reading

LA meeting: Review for Final

FINAL!

Saturday, May 2, 1:30-4:30

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

If you have a conflict with any class activities due to religious or other reasons, please tell us well in advance. Last minute requests cannot be accommodated. Plan ahead! See full details about religious holidays at http://www.colorado.edu/policies/fac_relig.html

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (including sexual assault, exploitation, harassment, dating or domestic violence, and stalking), discrimination, and harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website.

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.