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ASTR 502 : Teaching Earth and Space Science

DESCRIPTION | OVERVIEW | LEARNING GOALS | CLASS DETAILS | STANDARDS | SCHEDULE | HOMEWORK | OBSERVING

Fall 2017: Offered by the Physics and Astronomy Department with cooperation from the Houston Museum of Natural Science and NASA.

HURRICANE HARVEY

The class sessions are being reorganized because of Hurricane Harvey.
Contact Dr. Reiff for the Zoom login information.

DESCRIPTION

This course is designed for inservice and preservice teachers (grades 5-12), but Rice undergraduates considering a teaching career are also welcome. This class is an overview of the Earth and the solar system, their structure, evolution, and dynamics. It includes fundamentals of Earth and Space Science topics as taught in 6th grade, plus solar system content of "Earth and Space Science" and "Astronomy" Texas high school courses. Includes mathematics of solar system motion at level of algebra, logarithms and simple trigonometry, including Kepler's and Newton's laws. Includes instruction in use of Earth and solar system software. Observing sessions at Rice campus observatory and George Observatory TBD.

Special for 2017 - Total Solar Eclipse! The solar eclipse this year is the first day of classes so we will have special SUMMER sessions training you to observe safely! **Contact Dr. Reiff** for registration. Registration has been extended through Sept 8!

OVERVIEW

Goal: This course develops solar system concepts and skills in a manner consistent with the Next Generation National Science Standards and Texas Essential Knowledge and Skills proficiencies. It uses solar system examples to teach mathematical skills including exponential, logarithms and powers. It covers all the solar system material in the Texas High School Astronomy course, and the "Earth in Space" concepts from the new TX "Earth and Space Science" course, but presented at a level accessible by upper elementary and middle school teachers. (The remaining stellar and galactic astronomy concepts are covered in ASTR 403). The course uses materials from the "Space Update" program, involves student inquiry using software and web-based materials, and has some hands-on solar system observing labs.

Dates: August 21 - Dec 1, 2017, Mondays, 6:00 - 9 pm (with some additional dates/times observing on campus and at George Observatory)

Location: Herman Brown Hall 223, Rice campus (plus planetarium in BRK 250), plus campus observatory (BRK 400), HMNS planetarium and George Observatory as noted on schedule

LEARNING GOALS

As a result of this class, the student will be able to:
1. describe and distinguish the various types of solar system objects: planets, dwarf planets, comets, asteroids, Kuyper belt objects.
2. use Kepler's laws to calculate apogee and perigee from semimajor axis and eccentricity, or vice versa.
3. use Newton's laws as applied to planetary motion.
4. describe the principal theories of solar system formation, and explain how the planetary composition results.
5. use semi-log and log-log paper to plot planetary data, demonstrating knowledge of logarithms and exponentials.
6. calculate escape speed from solar system objects, and relate that to an object's ability to retain an atmosphere.
7. use albedo and greenhouse fraction to calculate planetarium equilibrium temperature.
8. find planet locations in the sky and be able to observe and demonstrate to others.
9. make sketches of planets using telescopic observations.
10. (Communication) research a planetary mission, a planet, or a mission to search for extrasolar planets, and make a powerpoint

presentation to class.

CLASS DETAILS

Instructor	Prof. Patricia Reiff (reiff@rice.edu), with special activities by Adjunct Prof. Carolyn Sumners of the Houston Museum of Natural Science. Office Hours by appointment. Course assistant/tutor: Franklyn Pacheco
Texts	"Field Guide to Stars and Planets", Pasachoff, ISBN 978-0395934319 "Space Update", Rice University, ISBN 9781931-523530. Also bring your laptop to class to install Space Update and Stellarium.
University Credit Hours	3 (sorry, no stipend) To register for credit, contact Patricia Reiff (reiff@rice.edu) at 713-348-4634. You must be registered as a Visiting, undergrad, or Master of Science Teaching student. Teachers wishing to participate as a Visiting Student, please bring ID and social security number to first class. Note: up to 9 credit hours taken as a Visiting Student can be applied towards your Master of Science Teaching degree. A few slots may be available for remote participants via zoom. A few slots may be available for teachers wishing only Continuing Education Credits at a special $150 rate. **Contact Dr. Reiff**
Grading Policy	Each homework is a variable number of points (4-10); each of the two quizzes is 20-24 points; the observing lab is 6 points; and the term report is 12 points. The final grade is calculated by dividing the number of points earned by the total number available (generally 120). Calculators are encouraged both for homework and for quizzes.
Absence Policy	The lectures will be recorded for later playback online. Because of the intense hands-on nature of some of the sessions, and the fact that we will observe through the campus telescope if weather permits, students should try to attend every class but no specific penalty for absences
Tuition/fees	Thanks to a generous discount from Rice University, the tuition for teachers is only $1200 for three hours of graduate credit, plus other University fees (roughly $140). A few tuition scholarships are available for inservice teachers. Remote participation via Zoom is possible. Participation as an auditor only (for CEU credits) is also possible for $150 fee. Contact Dr. Reiff.
Honor Code	Students may work together on homework but each student shall turn in their own paper. Quizzes must be pledged as individual work and are s ubject to the Rice Honor Code.
Students With Disabilities	Any student with a disability that requires accommodation should contact the instructor and the Disability Support Servies. We will attempt every reasonable accommodation.

Alignment with Texas Standards and High School Course requirements

SCIENCE TEKS

Grade Levels:	6-8 (general science) and 9-12 (IPC, Astronomy)
Strands:	Components of the Solar System, Changes and Cycles (seasons, tilt; phases of Moon), Conceptual Models, Major Earth processes and systems, Forces and Energy; Newton's and Kepler's Laws, Waves, The Sun

MATH TEKS

Grade Levels:	6-8 and 9-12
Strands:	Numbers, Operations, and Quantitative Reasoning, Patterns, proportions, algebraic reasoning, Geometric shapes, volumes, densities, Measurement; units, formulas, Linear and logarithmic functions, Graphing, Relationship between algebra and geometry

HIGH SCHOOL ASTRONOMY (TEXAS COURSE 112.48)

Knowledge and Skills: Scientific Processes, scientific methods, field and laboratory investigations, use of data to make inferences, communicate conclusions

Science Concepts: 1. Observe and record data about lunar phases and use that information to model the earth, moon and sun system; observe and record the apparent movement of the Sun and Moon during the day and the Moon, planets and stars in the nighttime sky

2. Units of measurement such as Light Year and Astronomical Unit; History of astronomy; planetary motion; Equation of gravitation; compare and contrast the scale, size, and distance of the Sun, Earth and Moon system, and the sizes and distances of the planets

3. The Sun: its energy sources; the Sun's effect on earth; the effect of rotation, revolution and tilt on the environment; the effect of the Moon on tides; the solar system (the remaining stellar and galactic astronomy concepts are covered in ASTR 503).

HIGH SCHOOL EARTH AND SPACE SCIENCE (TEXAS COURSE 112.36)

Knowledge and Skills: Scientific Processes, scientific methods, field and laboratory investigations, use of data to make inferences, communicate conclusions

Science Concepts: 1. The student knows that Earth's place in the solar system is explained by the star, planets, and minor bodies of a stellar system that accrete from a stellar nebula as explained by the nebular-planetesimal-protoplanet model.

2. The student can explain how the Sun and other stars transform matter into energy through nuclear fusion.

3. The student will explore the historical and current hypotheses for the origin of the Moon, including the collision of Earth with a Mars-sized planetesimal.

4. contrast the characteristics of solar system planetesimals such as comets, asteroids, meteoroids, and their positions within the Oort Cloud, the Kuiper Belt, and the asteroid belt

5. compare the terrestrial planets to the gas giant planets, including internal structure, atmosphere, size, density, solar orbit, presence of water, surface features, tectonic activity, temperature, and suitability for life; explore the historical and current hypotheses for the origin of the moon, including the collision of Earth with a Mars-sized planetesimal; compare recently-discovered extra-solar planets with planets in our solar system, and describe how such planets are detected. The student can describe the formation and structure of Earth's magnetic field, including its interaction with charged solar particles to form the Van Allen belts and auroras.

SCHEDULE : FALL 2017 (Being reorganized because of Hurricane Harvey)

DATE	MATERIAL
Mon Aug 21 ONLINE ONLY	Online only - observe the partial (or total) solar eclipse and make sketches or photographs. Watch the online solar eclipse briefing and write up a list of four things you learned.
Mon Aug 28 6:00-9:00 pm, ONLINE ONLY	Class overview; installation of Space Update DVD; Install Stellarium; Overview of the Solar System. Use this link to watch the video of this class. Start on **Homework 1**. (**BRING A LAPTOP**)
Mon Sept 4 No Class - LABOR DAY	We will decide whether to go ahead and have class this evening or reschedule.
Tuesday Sept 5 6:00-9:00 pm, HBH 223	Celestial coordinates; Seasons; Ecliptic, orbits. Activity: Stellarium. Start on homework: **Homework 2**)
Mon Sept 11	Planetarium show: Celestial coordinates; the solar system; phases of the moon;

at HMNS (TBD)	seasons
Mon Sept 18 BRK 230 (6-9 pm)	More on Celestial coordinates; sidereal and solar rotation and revolutions, galactic coordinates. Turn in homework 1 and 2. Start **Homework 3**.
Mon Sept 25 HBH 223 (6-9 pm)	Kepler's Laws 1&2: ellipses (semimajor axis, eccentricity, periapsis, apoapsis), speeds of planets (Homework: ellipse activity)
Mon Oct 2 HBH 223 (6-9 pm)	Kepler's Laws 3: periods and semimajor axes; logarithms; plotting orbits. (Activity: orbits; Homework: plotting periods versus distance for Saturn's moons)
Mon Oct 9 HBH 223 (6-9 pm)	More on Kepler's Laws; The Sun; Formation of the Solar System
Mon Oct 16 HBH 223 (6-9 pm)	The Moon (Activity: lunar size and distance); Review for Quiz; Observing, observatory
Mon Oct 23 HBH 223 (6-9 pm)	Review and quiz 1. Use the topics and terms sheet to review. You may use a double-sided handwritten cheat sheet.
Saturday, October 28 George Observatory, 3- 10 pm	Observe the Moon Night and "Astronomy Day"
Mon Oct 30 HBH 223 (6-9 pm)	Inner planets: Mercury, Venus, Earth
Mon Nov 6 HBH 223 (6-9 pm)	Earth as a planet: Albedo, temperature and greenhouse effect; ice ages
Mon Nov 13 HBH 223 (6-9 pm)	Mars and Asteroid Belts, comets
Mon Nov 20 HBH 223 (6-9 pm)	Outer planets (Jupiter, Saturn, Uranus, Neptune)
Mon Nov 27 HBH 223 (6-9 pm)	Dwarf planets (Pluto, Eris, etc...); Extrasolar planets; Class presentations.
Thursday, Nov 30 HBH 223 (6-9 pm)	(Optional) Class presentations (if needed); Review for Quiz 2 (will be takehome)

HOMEWORK (Fall 2017 (tentative))

- **Homework 1** (due Sept 14): Space Update / Sky Tonight Software.
- **Homework 2** (due Sept 14): Stellarium activity.
- **Homework 3**: (Due Oct 12) Plotting the Moon. Due date may be extended to Nov 9 if Sept 14-28 is cloudy.
- **Homework 4**: (Due Oct 5) Solar System Algebra and Exploring Ellipses Activities
- **Homework 5**: (Due Oct 19) Plotting the moons of Jupiter or Saturn: logarithm plots
- **Homework 6**: (Due Nov 16) Solar system - view from the top
- **Homework 7**: Observing Project
- **Homework 8**: (Due Nov 30) Public Education Project (Write up a paragraph on what you participated in, e.g. Astronomy Day or Public Observing night)
- **Homework 9**: (Due Nov 23) Albedo and Temperature, Greenhouse effect
- **Homework 10**: (Due Nov 30) Solar System Mission Report (counts as 12 points, including presentation)

OBSERVING PROJECT