CORE CURRICULUM COMPONENT APPLICATION
Sam Houston State University

Revised October, 2012

PART I – Course Information

Course Type
☒ Existing/Restructured
☐ New Course Proposed Fall 2013
If new, have you submitted a Form B to the SHSU Curriculum Committee? ☐ Yes ☐ No

Course Prefix & Number: PHYS1311/1111

Texas Common Course Number (TCCN Matrix): PHYS1304/1104

Course Title: Solar System Astronomy

Course Catalog Description (Copy and paste from online catalog for existing courses):
The development of astronomy, the solar system, stars, galaxies, and cosmology are studied. Emphasis is placed on discovering astronomical phenomena through individual observational activities. The Sam Houston planetarium and observatory are also used in laboratory activities. No mathematics or physics prerequisites.

Course Prerequisites: none

Available Online?
☒ Yes, currently developed in online delivery mode
☐ Anticipated development in online delivery mode (Semester, Year:)
☐ No

Number of Sections to be Offered per Academic Year: 20

Estimated Enrollment per Section: 70

Course Level (freshman, sophomore): freshman

Designated Contact Person (for follow-up communication purposes): Dr. Scott Miller

E-Mail Address: stm009@shsu.edu

Phone: (936)294-3266

Approvals

Department Chair: _____ Signature 10/8/12 Date

Academic Dean: _____ Signature 10/19/12 Date

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

PART II – THECB Foundational Component Areas

See Appendix for full description of each component area.

Select Component Area: III. Life and Physical Sciences

In one paragraph, describe how the proposed course will fulfill the core and skill objectives of the component area: The proposed course is one that has been taught as a fundamental science course since humanity laid the foundation of science. The behavior of the universe, with specific focus on the solar system, will be explored through direct observation, interpretation of observations, and understanding of the empirical and physical laws that have been codified over the centuries.Following research-backed instruction and assessment paradigms, instructors will introduce the class to a number of activities that have been shown to foster critical thinking and teamwork. Both individuals and teams will be required to communicate their understanding of the material through various means, both in the laboratory setting and in the more traditional classroom setting. Given that mathematics is the language of science, students will also be required to hone their numerical and quantitative reasoning skills.

PART III – Course Objectives & Student Learning Outcomes (SLO)

Insert the applicable course objectives stated as student learning outcomes (e.g., Students completing the course will be able to...) that support the core component area objectives. Please reference the component rubric for additional information on core component area objectives.

Objective/SLO 1: Students completing the course will be able to describe, explain and predict natural phenomena using the scientific method.

How will the objective be addressed (including strategies and techniques)?
Students will be introduced to the concept of scientific modeling of observations through simple, commonly experienced phenomena, such as sunrise, sunset, seasons and lunar phases, and be asked to create conceptual models to explain these phenomena. Given that scientific models make testable predictions, students will see how models are supported or discarded based on their abilities to predict accurately. Further explorations into the behaviors of telescopic solar system objects, the empirical behaviors of thes objects, and the laws that govern them will lead to more robust scientific modeling that includes the application of mathematics. Finally, extrapolation of our understanding of the solar system to extrasolar polanets and other current topics will demonstrate to students the limitations of our modern scientific models.

Describe how the objective will be assessed: Assessments include, but are not limited to, personal response questions within the context of the lecture and/or lab class, embedded exam questions that require the students to apply their understanding to real situations or that present hypothetical scenarios (e.g. "If Earth rotated, but did not revolve, what would appear different about the motion of the Sun."), embedded questions that require the students to apply the laws governing the solar system to new or hypothetical scenarios (e.g. extrasolar planetary systems,

comets, obscure solar system objects), homework and/or laboratory exercises where students must demonstrate the ability to describe, explain, and predict, research-supported learning tools such as Lecture Tutorials (Prather et al) and Ranking Tasks, as well as other activities developed and tested by faculty.

Objective/SLO 2: Students completing this course will understand the interactions among natural phenomena.

How will the objective be addressed (including strategies and techniques)?
Within the solar system, there are multiple interactions, both gravitational and electromagnetic. These concepts are explored through a combination of straight lecture, homework exercises and/or in-class activities (e.g. professor-developed activities, published Lecture Tutorials, Ranking Tasks), covering such aspects of solar system astronomy as Newton's Law of Universal Gravitation, Kepler's Laws, and the interaction between electricity and magnetism, and more detailed laboratory exercises (e.g. determining the relationship between lunar phases and tides, understanding the relationship between distance and orbital period for the moons of Jupiter).

Describe how the objective will be assessed: Research-based methods of assessment for understanding interactions among natural phenomena will be employed. These include embedded exam questions where students are asked to apply their understanding to both real scenarios and hypothetical scenarios (e.g., determining the gravitational attraction between two imaginary objects, or determining the orbital period for a hypothetical comet). Other direct assessments include Lecture Tutorials (either published or professor-created), Ranking Tasks (either published or professor-created), in-class activities, laboratory exercises and summative reports, and/or homework questions requiring students to demonstrate their understanding of the interactions.

Objective/SLO 3: Students completing this course will understand the implications of scientific principles on the physical world and on human experiences.

How will the objective be addressed (including strategies and techniques)?
The laws of physics (gravity, orbital mechanics, the interaction of light with matter, the variables that allow Earth to be habitable) govern everything we do, so the implications are innumerable. Practical aspects of these physical laws include recognizing the relationship between sunlight angle and season, understanding how a planet's mass and temperature affect its ability to maintain an atmosphere, applying Kepler's Laws to place artificial satellites in geosynchronous orbits, understanding how the interaction of the solar wind with Earth's magnetic field can sometimes lead to widespread power outages and other technological problems, how the opacity of certain materials (e.g. carbon dioxide) to infrared radiation leads to the greenhouse effect, both here and on other planets. Because of the scope of the course, the examples are almost limitless, and different professors will likely choose to highlight different examples of this learning outcome, depending on their personal expertise.

Describe how the objective will be assessed: Personal response questions and/or embedded exam questions that allow students to demonstrate their understanding of the implications of scientific principles are the most immediately direct assessment of this learning outcome. For instance, to divine whether a student understands how the mass and temperature of a planet affect its ability to maintain an atmosphere, one could create a hypothetical scenario and ask students to determine which of an array of planets might have an atmosphere. Open-ended laboratory explorations (e.g., one that employs the exoplanet.org database that allow students

to determine for themselves the most likely habitable planets; or a laboratory exercise that allows students to explore the coverage of sea ice over time and to relate this to seasonal variations, global solar irradiation or other observables), along with in-class activities (e.g. published and professor-created Lecture Tutorials, and/or published and professor-created Ranking Tasks),

Objective/SLO 4: N/A

How will the objective be addressed (including strategies and techniques)?
N/A

Describe how the objective will be assessed: N/A

Objective/SLO 5: N/A

How will the objective be addressed (including strategies and techniques)?
N/A

Describe how the objective will be assessed: N/A

PART IV – THECB Skill Objectives

Address each of the THECB skill objectives required within the component area. Explain how the skill is addressed, including specific strategies to address the skill(s). *Address ALL skill objectives associated with the selected Component Area. (See Appendix)*

1. Critical Thinking Skills: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information

How will the skill be addressed (including specific strategies, activities, and techniques)?
The array of topics in which to foster critical thinking skills in this course is vast, as the development of our understanding of the solar system has relied on centuries of critical thinking. For instance, the discovery of the planet Neptune occurred because of careful analysis of the motion of Uranus and the creative thinking required to explain its motion. Students can easily be guided through the same critical thinking steps that astronomers have used since the dawn of time. Fortunately, a number of research-driven critical-thinking strategies and activities have been developed in the field of Astronomy Education Research over the past decade, and instructors will employ those most compatible with their own personalities. Guided inquiry can be achieved through Lecture Tutorials, specially-developed laboratory exercises that go beyond the "cookbook" approach, professor-created in-class activities, group work (within lecture and/or lab), and/or appropriate questions that students must wrestle with outside of the classroom. Students' critical thinking skills can be honed through the application of known information to new or unfamiliar scenarios (e.g., a new planet has been discovered with a set of given properties. Describe how objects in its sky will appear to move. Determine whether it should have an atmosphere or a magnetic field. Do you expect cratering on its surface? Why?)

2. Communication Skills: to include effective development, interpretation and expression of ideas through written, oral and visual communication

How will the skill be addressed (including specific strategies, activities, and techniques)?
Within the context of lecture and lab, students will have many opportunities to communicate their ideas. Lecture tutorials, ranking tasks, and other in-class activities require written and/or visual communication (e.g., diagrams must be drawn by students to indicate where an object would experience the greatest gravitational attraction, students are required to explain their reasoning for drawing the diagram as they do; diagrams and physical models must also be created and described verbally or in writing to explain the phases of the moon or seasons). Students must also be receivers of visual communication, developing the ability to interpret diagrams and graphs. In lab and some lectures, teamwork is appropriate, so students must interact with other members of their teams, through oral and/or written communication. Personal response (also called think-pair-share) questions can be employed, and these also require

oral/written communication as students attempt to justify their answers to their peers. Laboratory group work requires a high level of communication as groups attempt to discover and explain the underlying laws and concepts. Writing is required by each individual to convey understanding to the instructor. Homework sets may have free-response questions where students express their understanding in writing, as well.

3. Empirical and Quantitative Skills: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

How will the skill be addressed (including specific strategies, activities, and techniques)?
Mathematics is the language of science, and solar system astronomy is no exception. The laws governing the solar system are easily presented in this language, which is used most extensively within the context of labs, where students have more time to wrestle with the manipulation of equations. However, there are many mathematical relationships that can be explored in lecture via published lecture-tutorials that guide students through the physical laws, ranking tasks, which require the application of mathematical thinking to a variety of situations, in-class published or professor-developed activities that allow students to personally explore relationships between observables (e.g. that the distance to an object is inversely proportional to the parallax angle, or that the force of gravity is proportional to the product of the masses involved) . More involved laboratory activities include student exploration of the empirical relationships between, for example, the orbital periods of Jupiter's moons and the distance from the planet in order to establish the mass of Jupiter, or to observe the changing phases of the moon over time along with its altitude and time observed in order to establish the underlying motions.

4. Teamwork: to include the ability to consider different points of view and to work effectively with others to support a shared purpose or goal

How will the skill be addressed (including specific strategies, activities, and techniques)?
The most intensive teamwork will occur during the laboratory hours for the class, when students will work in groups of 4 or 5 to explore the problem for the week. Students will have to look at data, interpret data, cooperate to carry out specific tasks (e.g., attempt to create a physical model of a "mystery" object presented in the first lab session so that it behaves in the same fashion as the mystery object, thus exploring the nature of science and modeling), discuss and prepare results, discuss what conclusions can be drawn, etc. In the lecture setting, teamwork will be used on a less regular basis as students wrestle with in-class activities that are designed to reinforce concepts in class. These activities may include Lecture Tutorials, Ranking Tasks, personal-response questions, and professor-developed exercises, depending on the personality of the professor.

5. **Personal Responsibility**: to include the ability to connect choices, actions and consequences to ethical decision-making

How will the skill be addressed (including specific strategies, activities, and techniques)?
N/A

6. **Social Responsibility**: to include intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities

How will the skill be addressed (including specific strategies, activities, and techniques)?
N/A

PART V – SHSU Core Curriculum Committee Requirements

1. Using a 15-week class schedule, identify the topics to be covered during each week of the semester. Provide sufficient detail to allow readers to understand the scope and sequence of topics covered.

Week 1	Sizes/Scales of the universe (no lab)
Week 2	Scientific Method/Celestial Motion (Scientific Method Lab)
Week 3	Seasons (Motions and Appearances in the Sky Lab)
Week 4	Lunar Phases (Seasons Lab)
Week 5	History/of astronomy through Kepler (Lunar Phases Lab)
Week 6	Kepler's Laws (Kepler: Orbit of Mercury Lab)
Week 7	Newton/Tides (Kepler: Moons of Jupiter Lab)
Week 8	Light/Telescopes (Tides Lab)
Week 9	The Formation of the Solar System (no lab)
Week 10	Sun (Solar Phenomena Lab)
Week 11	Terrestrial Planet properties (no lab)
Week 12	Jovian (Atmospheric Retention Lab)
Week 13	Stellar Debris and Kuiper Belt Objects
Week 14	Exoplanets (Exoplanets research lab)
Week 15	Special Topics/Current Events (no lab)

2. Attachments (Syllabus Required)

Syllabus Attached? ☒ Yes ☐ No

Other Attached? ☒ Yes ☐ No If yes, specify: Addendum statement and examples of various assessment methods described in this application.

Appendix: THECB Component Area Descriptions and Skill Requirements

I. Communication (Courses in this category focus on developing ideas and expressing them clearly, considering the effect of the message, fostering understanding, and building the skills needed to communicate persuasively. Courses involve the command of oral, aural, written, and visual literacy skills that enable people to exchange messages appropriate to the subject, occasion, and audience.)

II. Mathematics (Courses in this category focus on quantitative literacy in logic, patterns, and relationships. Courses involve the understanding of key mathematical concepts and the application of appropriate quantitative tools to everyday experience.)

III. Life and Physical Sciences (Courses in this category focus on describing, explaining, and predicting natural phenomena using the scientific method. Courses involve the understanding of interactions among natural phenomena and the implications of scientific principles on the physical world and on human experiences.)

IV. Language, Philosophy, and Culture (Courses in this category focus on how ideas, values, beliefs, and other aspects of culture express and affect human experience. Courses involve the exploration of ideas that foster aesthetic and intellectual creation in order to understand the human condition across cultures.)

V. Creative Arts (Courses in this category focus on the appreciation and analysis of creative artifacts and works of the human imagination. Courses involve the synthesis and interpretation of artistic expression and enable critical, creative, and innovative communication about works of art.)

VI. American History (Courses in this category focus on the consideration of past events and ideas relative to the United States, with the option of including Texas History for a portion of this component area. Courses involve the interaction among individuals, communities, states, the nation, and the world, considering how these interactions have contributed to the development of the United States and its global role.)

VII. Government/ Political Science (Courses in this category focus on consideration of the Constitution of the United States and the constitutions of the states, with special emphasis on that of Texas. Courses involve the analysis of governmental institutions, political behavior, civic engagement, and their political and philosophical foundations.)

VIII. Social and Behavioral Sciences (Courses in this category focus on the application of empirical and scientific methods that contribute to the understanding of what makes us human.
Courses involve the exploration of behavior and interactions among individuals, groups, institutions, and events, examining their impact on the individual, society, and culture.)

Required Skill Objectives

Foundational Component Areas	Skill Objectives					
	Critical Thinking	Communication	Empirical & Quantitative	Team Work	Social Responsibility	Personal Responsibility
Communication	✓	✓		✓		✓
Mathematics	✓	✓	✓			
Life and Physical Sciences	✓	✓	✓	✓		
Language, Philosophy & Culture	✓	✓			✓	✓
Creative Arts	✓	✓		✓	✓	
American History	✓	✓			✓	✓
Government/Political Science	✓	✓			✓	✓
Social and Behavioral Sciences	✓	✓	✓		✓	

Submit completed, signed form to Core Curriculum Committee - Box 2478 or Fax 4-1271

Course Syllabus

PHYS 1311/1111 --- Solar System Astronomy/SS Lab

4 Credit Hours

Fall 2012

Instructor Information:
Prof. David Pooley
316 Farrington
(936) 294-1600
dave@shsu.edu
Physical Office Hours: = T/Th 3:30 p.m. -- 4:30 p.m. or whenever I'm in my office (generally not MWF)
Virtual Office Hours: = IM or videochat whenever I'm online gchat / AIM / FaceTime / Skype: profpooley
If you need help and I'm not online or in my office, please send me an email.

Meeting time and place:
Lecture portion: 12:30 – 1:50 p.m. in Farrington 105
Lab portion: See your own schedule. Labs are held in Farrington 211 or 205 at varying times during the week.

Introduction
Welcome to Solar System Astronomy! This course has many goals, given below, but the foremost aim is that you learn basic astronomy. Please understand that it is your responsibility to actively engage and participate in your own learning of astronomy. It is my responsibility to find ways to help you in that endeavor.

Course Description
We will learn about the development of astronomy and its methods. We will study the planets of the Solar System, the Sun, and exoplanets (planets around other stars). We might also discuss the possibility of other forms of life in the universe or other topics of student interest.

Goals
The main objective of this course is to cover many of the areas of modern astronomy at an elementary level using only the most basic mathematics. Specifically...

You will gain *factual knowledge* about astronomy;

You will learn the terminology, classifications, and methods of modern astronomy;

You will learn fundamental principles of science;

You will understand the scientific method and how to use it to *describe, explain, predict, test,* and validate scientific concepts;

You will gain a broader understanding *of interactions among natural phenomena* and of the *impact of scientific activity* on our lives;

You will see *how scientific advances have changed our understanding* of the Universe;

You will get a sense of the ``big picture;"

You will comprehend the relative scales of our Solar System and the vastness of space;

You will be introduced to the wonder and beauty of the Universe and our role in it.

To help you meet these goals, I will employ a combination of lectures, lecture tutorials, homework assignments, laboratory explorations, and assessments. I hope that you find them enjoyable and challenging.

Texts and Other Materials
The following are required for this course.
*Understanding Our Universe (*Palen, Kay, Smith, & Blumenthal)
Lecture Tutorials for Introductory Astronomy (Prather, Slater, Adams, & Brissenden) --- You need a new one. A used tutorial book will not work.

Assignments and Assessments
READING --- Carefully studying the text and/or websites provided in class is REQUIRED. The lectures are designed to focus on the more difficult aspects of astronomy. You are accountable for all material, concepts, and interrelationships presented in the lectures, lecture tutorials, and reading. Therefore, it is crucial to your success in this course that you complete the assigned readings before class. Otherwise, the lectures or lecture tutorials won't make much sense. Be aware that the homework, quizzes, and final exam will cover material from the text that may or may not be discussed in class.

Reading assignments will be posted online at least a week in advance.

HOMEWORK --- Online homework will be posted on Blackboard or similar LMS periodically throughout the semester. The homework will cover material that has been presented since the previous homework, and it designed to test both your factual knowledge of the subject, as well as your ability to analyze, evaluate, and synthesize that knowledge. It is designed to assist you in reviewing the material after it is covered in class and prepare you for future assessments (exams, quizzes, and the final). The lowest homework grade will be dropped.

Because the homework assignments are online, it is possible for technical errors to occur occasionally. It is your responsibility to make sure your answers have been submitted correctly before the deadline. No extensions will be given. If you miss a homework for any reason, that will be the one which is dropped.

LECTURE TUTORIALS --- During many of the lecture periods, you will be working on activities in the tutorial book in small groups. These will not be collected, but they will greatly assist you in understanding the material. A solid understanding of these activities will be essential to a good grade in the course. These activities are also designed to improve your teamwork skills as you are required to collaborate with others by discussing the problems and sharing ideas. This entails both listening and contributing to the discussion! As such, it requires the abilities to (1) effectively express your ideas, (2) consider other points of view, and (3) come to a conclusion. Ultimately, when you are asked to answer questions, you must do so in your own words. You are responsible for your own understanding of the material.

PARTICIPATION / FEEDBACK --- Your participation credit will be based on responding to either in-class or online surveys which will be given frequently. You will receive full credit for a survey by meaningfully answering at least one of the questions on it. The aim of these surveys is for you to reflect on and critically engage in the subject material, as well as to effectively communicate that engagement to me.

CONCEPT TESTS --- There will be a few 15-question concept tests during the course. Their dates are given on Blackboard. They are intended to serve as monitors of your progress halfway until the next quiz or exam and to assess your critical thinking skills. The lowest concept test score will be dropped. If you miss a concept test for any reason, it will be the one that is dropped. There are no make-ups for the concept tests.

EXAMS --- There will be two 50-question exams during the course. Their dates are given on Blackboard. Like the homework, the exams are designed to test both your factual knowledge of the subject, as well as your ability to analyze, evaluate, and synthesize that knowledge. The first exam will cover all material since the beginning of the class, and the second will focus on material since the first exam. Please understand that, although the second exam is not cumulative, the material it covers will rely on your knowledge of earlier material.

Make sure you are present for the exam. If you know that you will miss an exam, you must notify me at least two weeks in advance so that we can arrange a time for a make-up. All make-up exams will consist entirely of written short-answer and essay questions.

LABORATORY --- The lab component of your grade (25% OF THE TOTAL COURSE GRADE) will be based on the following components:

1. Lab Quizzes - A brief (5--10 question) multiple-choice quiz will be given at the beginning of each lab period. The quiz will cover the pre-lab questions that are contained in each lab. It is essential that you complete the pre-lab questions before coming to class.

2. Post-lab Questions - At the end of every lab, before leaving, you will turn in your answers to the post-lab questions found at the end of every lab. Answers should be written on a separate, full sheet of paper in complete sentences. Make sure you include your name, email address, section, and the title of the lab on each submission. Make sure your handwriting is legible. Credit will not be given for illegible work.

3. Lab Reports – Students will be assigned to groups the first week of class, and it is within your group that lab activities will be completed. Each week you will perform a series of activities with your group members with whom you will discuss the main concepts of the lab, and manipulate and analyze numerical data and/or observable facts in order to arrive at informed conclusions. You are then required to synthesize the information and summarize your findings in a lab report. Each member of your group is required to submit an individual and unique lab report. Copying of information is strictly forbidden and will result in a failing grade. Please refer to the ``Lab Report Guide" posted on Blackboard for instructions regarding your lab reports.

<u>Lab reports are due at the beginning of the next lab period. Late work will not be accepted</u>

NOTE: Astronomy students are expected to attend the SHSU Observatory at least one night during the semester to complete the observatory assignment in the lab manual. Students must keep in mind that, due to the fact that the observatory is outside, its availability is subject to the weather. If the observatory is not available on a given night, students are expected to try again until they are able to attend the observatory. Conflicts in schedule are NOT an excuse for failing to complete this assignment. A schedule of available observatory nights will be posted on Blackboard at the beginning of the semester.

FINAL --- The final examination is cumulative. It will be broken down roughly as follows: 25% will be on material covered before Quiz 1; 25% will be on material covered between Quiz 1 and Quiz 2; 50% will be on material covered after Quiz 2.
end{description

Grades
Your grade in this class will be determined by several methods:
15% Homework (lowest one dropped)
10% Participation / Feedback
10% Concept Tests (lowest one dropped)
20% Quizzes (2)
25% Laboratory
20% Final Exam

Feedback
I am not teaching this class for myself; I am teaching it for you. I will be as transparent as possible regarding the structure of the course, the role of each kind of assignment, and how you will be graded. I would like to know what works and what doesn't. The online surveys should facilitate this, but you should also feel free to talk with me or email me suggestions for improvement.

Attendance Policy
Although there is no penalty for missing class, you will get much more out of the course (and a higher grade) if you regularly attend. I do not require attendance except for the concept tests, quizzes, and the final exam.

Class Schedule
Please see Blackboard for a provisional timeline of the specific topics we will cover.

Students with Disabilities
SHSU adheres to all applicable federal, state, and local laws, regulations, and guidelines with respect to providing reasonable accommodations for students with disabilities. The complete university policy is available online at http://www.shsu.edu/~vaf_www/aps/documents/811006.pdf.

If you have a disability that may affect adversely your work in this class, then you should register with the SHSU Counseling Center http://www.shsu.edu/~counsel/sswd.html and talk with me about how I can best help you. All disclosures of disabilities will be kept strictly confidential.

Excused Absences
The Texas Education Code requires that an institution of higher education excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose. You will remain responsible for all work. The full policy is at http://www.shsu.edu/~vaf_www/aps/documents/861001.pdf.

Classroom Rules of Conduct

Students are expected to assist in maintaining a classroom environment that is conducive to learning. Students are to treat faculty and students with respect. Students are to silence all cell phones while in the classroom. Under no circumstances are cell phones or any electronic devices to be used or seen during times of examination.

Academic Honesty

You are here to learn, not to copy. Sometimes the material will be difficult, and you are encouraged to talk it over with your classmates and contact me for help. However, all work that is turned in for a grade must be your own. This applies to homework, participation surveys, concept tests, quizzes, lab reports, and the final. Students are expected to maintain complete honesty and integrity in all academic experiences both in and out of the classroom.

If you feel inclined to cheat or take other shortcuts because the material is overwhelming, please come talk to me. We will work something out, and your integrity and honesty will be appreciated.

Please take a moment to review the university's policy on academic honesty. It can be found at http://www.shsu.edu/~vaf_www/aps/documents/810213.pdf.

Visitors in the Classroom

Only registered students may attend class. Exceptions can be made on a case-by-case basis by the professor. Unannounced visitors to class must present a current, official SHSU identification card to be permitted in the classroom. They must not present a disruption to the class by their attendance. If the visitor is not a registered student, it is at the instructor's discretion whether or not the visitor will be allowed to remain in the classroom.

ADDENDUM TO PHYS 1311/1111 PROPOSAL

In the field of Astronomy Education Research, there has emerged a suite of research-based learning and assessment tools, as described in the NASA Center for Astronomy Education website: http://astronomy101.jpl.nasa.gov/. These tools include 1) personal response questions/think-pair-share/peer instruction questions, 2) Lecture Tutorials in Introductory Astonomy (3rd Edition, by Prather, Slater, Adams, Brissenden; there is also a suite of unpublished ranking tasks within the CAE website, and several "home-grown" activities developed and tested by SHSU faculty), 3) Astronomy Ranking Tasks (originally developed by Kevin Lee at the University of Nebraska at Lincoln).

Examples of each of these tools are attached.

While it is impossible to gauge the precise personality of everyone who will ultimately teach PHYS 1311/1111 and PHYS 1312/1112, it is expected that each faculty member will incorporate *some subset* of these tools as he/she sees most fit. For instance, not all tenured and tenure track faculty incorporate personal response questions in direct assessments, but those that don't incorporate other, research-supported assessment tools that gauge the same learning outcomes.

Thus within the body of the learning outcome assessment descriptions above, you will frequently find language such as "the class will employ research-supported instructional tools, such as personal response questions, Lecture Tutorials, Ranking Tasks, and/or other instructor-developed activities." *All assessments used will be valid research-supported instruments developed with Bloom's Taxonomy of Educational Objectives in mind.* However, it is impossible to state categorically that every section every semester taught by every instructor for the next decade will use Lecture Tutorials or that they will all use Ranking Tasks. They will use the subset of this suite of research-based tools that best mesh with their personalities. This uncertainty reduces our list to an "and/or" list, rather than an "and" list, but each of these tools has been shown by astronomy education researchers to result in learning gains by students.

The only assessment for each student learning outcome that *must* be common across every section is that of embedded exam questions.

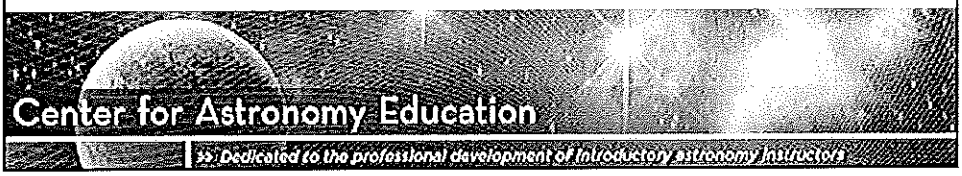
A Short note about Instructional Strategies

Think-Pair-Share:
A questioning in the classroom technique that makes use of a combination of conceptually challenging multiple choice questions, along with systematic classroom feedback designed to increase student-to-student discourse and provide data on students' learning for both you and them.

Crouch, C. H. & Mazur, E. 2001, "Peer Instruction: Ten Years of Experience and Results," *American Journal of Physics*, 69(9), 970, 2001

Development and Application of a Situated Apprenticeship Approach to Professional Development of Astronomy Instructors, Prather, E. E., and Brissenden, G. The Astronomy Education Review, 7(2), 2008

Clickers as Data Gathering Tools and Students' Attitudes, Motivations, and Beliefs on Their Use in this Application, Prather, E. E., Brissenden, G., The Astronomy Education Review, 8 (1), 2009 .



You look to the west at 10am and see the moon on the horizon. What is the phase of the moon that will be high in the sky in three weeks?

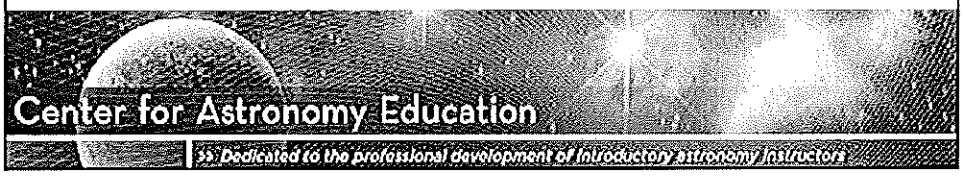
A. Waning Gibbous

B. Waxing crescent

C. New

D.Waxing Gibbous

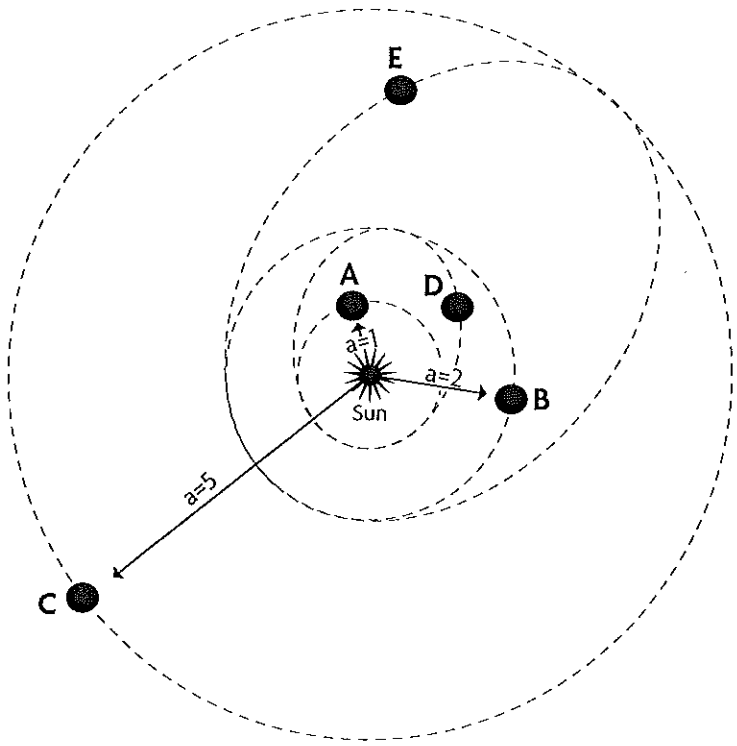
E. Waning Crescent



Astronomy Ranking Task:
Kepler's Laws - Orbital Motion

Exercise #3

Description: The figure below shows a star and five orbiting planets (A – E). Note that planets A, B and C are in perfectly circular orbits. In contrast, planets D and E have more elliptical orbits. Note that the closest and farthest distances for the elliptical orbits of planets D and E happen to match the orbital distances of planets A, B, and C as shown in the figure.



Ranking Instructions: Rank the orbital period (from longest to shortest) of the planets.

Ranking Order: Longest 1 ___ 2 ____ 3 ____ 4 ____ 5 ____ Shortest

Or, the orbital periods of the planets would all be the same. _____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

_____

_____

_____

_____

INTRODUCTION

Prerequisite Knowledge

- A basic familiarity how Kepler's Second Law describes the motion of an orbiting object in terms of equal areas in equal times
- A fundamental understanding of how the motion of an orbiting object changes as it orbits a central star based on Kepler's Second Law

Goals

- Be able to reason about and describe the entire motion of a planet's orbit based on the area swept out by the planets and the time it takes for that motion to occur.
- Practice estimation and analytical reasoning skills.

Pre-activity Question

1. Kepler's second law says "a line joining a planet and the Sun sweeps out equal areas in equal amounts of time." Which of the following statements means nearly the same thing?
   a. Planets move farther in each unit of time when they are closer to the Sun.
   b. Planets move equal distances throughout their orbit of the Sun.
   c. Planets move the same speed at all points during their orbit of the Sun.
   d. Planets move slowest when they are moving away from the Sun.
   e. Planets move fastest when they are moving toward the Sun.

TUTORIAL GUIDE

1) **[Yes]** Since the planet is in a perfectly circular orbit, and the distance between the lettered positions looks the same, the area swept out by the planet between each of the lettered positions would be the same. So, since the time intervals between each of the letters positions is also the same—one month—it obeys Kepler's second law: equal areas swept out in equal amount of time.

2) **[Staying the same]** Since the planet is moving the same distance in the same time it must be traveling at the same speed the entire time.

4) **[possible correct answers C-H or D-I] There are many choices that could be offered which should be considered correct provided they identify a distance traveled which is greater than the distance between locations A and B.**

   Students may struggle with deciding which letters to choose since there are several options. In addition, some students struggle with understanding what is meant by "swept-out-area." If students are stuck here, it can be helpful to ask them if they

were going to carpet (or paint) a new area with the same size as the triangle they made between Positions A and B, which two of the points between C and I would use the same amount of carpet.

5) **[Equal to]** The lettered positions identified in answer 4 were chosen because the area swept out between them would be about the same as the area swept out between A and B. And since we are told that the planet obeys Kepler's second law—equal areas in equal times—the time interval must be equal.

6) **[Question 4]**

7) **[Question 4]** Since the planet traveled a greater distance for the motion identified in Question 4 than it did in Question 3, and both motions took place in the same amount of time, the planet had to be moving faster during the interval identified in Question 4.

   Some students struggle with making the connection that if the planet travels a greater distance in the same amount of time it must be traveling with a greater speed.

8) **[No]**

9) **[Fastest: G; Slowest: A]** Since the time intervals between the lettered positions is the same, and the distance traveled in that time interval is greatest at Position G and smallest at Position A, it must be moving fastest at Position G and slowest at Position A.

10) **[Increasing]** Since the time intervals between each of the lettered positions is the same, and the distance between Positions D and E is greater than the distance between Positions D and C, the speed of the planet must be increasing.

11) The closer a planet is to its companion star the faster it moves, and the further away it is the slower it moves.

12) **[A]** Orbit A is a circle, and Earth's eccentricity is nearly zero, and since orbits with an eccentricity of zero are "perfectly circular," Orbit A must be the one that most closely matches Earth's orbits. Orbits B and C are not circles.

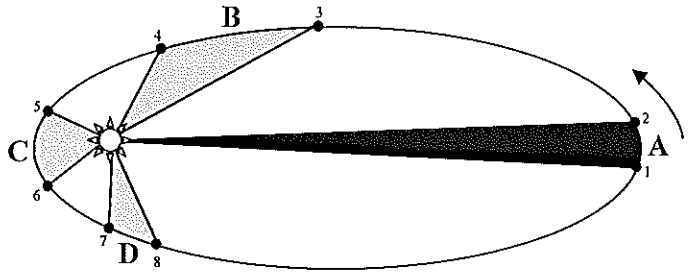
    Many students have the misconception that Earth's orbit is highly elliptical.

13) **[Largest: Pluto; Smallest: Venus]**

14) Earth's orbital speed wouldn't change very much throughout the year because its orbit is nearly a perfect circle, so it wouldn't change its distance from the Sun very much. And, since we found it Question 11 that the closer a planet is to its star it moves faster, and the further away it is it moves slower, Earth would have to change its distance from the Sun to change its speed.

ADDITIONAL QUESTIONS

The planet in the orbit shown in the drawing at right obeys Kepler's Laws. Use this drawing to answer the next four questions.



1. According to Kepler's Second Law, during which one of the portion of the planets orbit "B", "C", or "D", would the planet take the same amount of time as it took for the portion of the orbit identified with letter "A"? If you think all the portions of the orbit take the same amount of time, answer "E". **[B is the correct answer]**

2. During which part of the planet's orbit (A, B, C, or D) would the planet move with the greatest speed? **[C is the correct answer]**

3. During how many portions of the planet's orbit (A, B, C and D) would the planet be speeding up the entire time?

   a. **Only during one of the portions shown.**
   b. During two of the portions shown.
   c. During three of the portions shown.
   d. During four of the portions shown.
   e. None of the above.

4. During which of the portions of the planet's orbit would the planet experience an increase in speed for at least a moment?
   a. Only during one of the portions shown.
   b. During two of the portions shown.
   c. **During three of the portions shown.**
   d. During four of the portions shown.
   e. None of the above.