Term Information

Effective Term	Autumn 2014

General Information

Course Bulletin Listing/Subject Area	Astronomy
Fiscal Unit/Academic Org	Astronomy - D0614
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1101
Course Title	From Planets to the Cosmos
Transcript Abbreviation	Planets to Cosmos
Course Description	Overview of the Copernican revolution, the discovery of the nature of our solar system, light, gravity, and planets around other stars; the nature and evolution of stars and origin of the chemical elements; the history of galaxies and the expanding universe. Weekly laboratory. Not recommended for students who plan to major in astronomy or physics.
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Sometimes
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Sometimes
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Math 1050 (075) or an ACT math subscore of 22 or higher that is less than two years old; or 102; or Math Placement R or higher; or permission of instructor.
Exclusions	Not open to students with credit for Astron 1140, 1144, 1611H (H161), 1162H (H162), 2161H, 2162H, 2291 (291), or 2292 (292).

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	40.0201
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Requirement/Elective Designation

General Education course:
Physical Science

Course Details

Course goals or learning objectives/outcomes

- Quantitative Reasoning: Students will understand how quantitative measurements and predictions are used to test scientific ideas and to draw new conclusions.
- Scientific Process: Students will understand the scientific method, interplay between theory and empirical evidence, notions of incremental science and scientific revolutions, and the simultaneous existence of established knowledge and open questions
- Physical Laws: Students will understand that the universe is governed by a set of physical laws and principles that determine the appearance, behavior, and evolution of astrophysical systems.
- Evolution: Students will understand how we infer the evolution of astrophysical systems and the universe from observations at the present day.
- Relevance: Students will identify ways in which science in general and astrophysics in particular are relevant to global issues, US politics, advances in technology, and understanding humanity’s place in the universe.

Content Topic List

- The Long Copernican Revolution. "We are not the center of the Universe." Solar system, heliocentric model, orbits. Gravity and the Newtonian revolution. Extrasolar planets: detection (emphasis on transit method), atmospheres, habitability.
- Stars. "We are star stuff." Distances and masses of stars. Nuclear fusion and the origin of the elements, nucleosynthesis, stellar lifetimes. Supernovae, white dwarfs, neutron stars, black holes.
- Galaxies. "Space is big, time is long." Dark matter, evolution and growth of structure. Evidence for the Big Bang.

Attachments

- syllabus_rev1.pdf

  (Syllabus. Owner: Peterson,Bradley Michael)
- GErationale.pdf

  (Other Supporting Documentation. Owner: Peterson,Bradley Michael)
- GEassessment.pdf

  (GEC Course Assessment Plan. Owner: Peterson,Bradley Michael)

Comments

- The syllabus will need to include the general elective learning goals that this course will attain. See: http://asccas.osu.edu/files/ASC_CurrAssess_Operations_Manual.pdf for details. Since this course is also new, a document that outlines how the GE goals will be met will also be required. *(by Hadad,Christopher Martin on 09/17/2013 05:26 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Peterson,Bradley Michael	09/17/2013 02:36 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	09/17/2013 02:38 PM	Unit Approval
Revision Requested	Hadad,Christopher Martin	09/17/2013 05:26 PM	College Approval
Submitted	Peterson,Bradley Michael	10/02/2013 12:29 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	10/02/2013 12:31 PM	Unit Approval
Revision Requested	Hadad,Christopher Martin	10/02/2013 01:07 PM	College Approval
Submitted	Peterson,Bradley Michael	10/02/2013 04:28 PM	Submitted for Approval
Approved	Peterson,Bradley Michael	10/02/2013 04:29 PM	Unit Approval
Approved	Hadad,Christopher Martin	10/02/2013 04:32 PM	College Approval
Pending Approval	Nolen,Dawn Jenkins,Mary Ellen Bigler Hogle,Danielle Nicole Hanlin,Deborah Kay Vankeerbergen,Bernadette Chantal	10/02/2013 04:32 PM	ASCCAO Approval

Sample Syllabus
Astronomy 1101: From Planets to the Cosmos
Professor Name

Lectures: Days and times.
Weekly Laboratory: Day and time.

Professor:
Office: 4019 McPherson Lab (292-7971)
Office Hours: Monday 1:30-2:30pm, or by appointment
E-Mail: name.#@osu.edu

TA:
Office:
Office Hours:
E-Mail: name.#@osu.edu

Textbook: *Astronomy Today*, 7th Edition, by Chaisson & McMillan

Course Web Page: http://www.astronomy.ohio-state.edu/~professorname

Course Goals & Learning Objectives:
Astronomy 1101 is an overview of astronomy from our solar system to the universe as a whole. It is a General Education (GE) Physical Science course in the Natural Science category.

The expected learning outcomes for GE courses in the Natural Science category are as follows:

1. Students understand the basic facts, principles, theories and methods of modern science.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
3. Students describe the inter-dependence of scientific and technological developments.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

Astronomy 1101 will meet these expected outcomes by through coverage of three overarching and interconnected themes: (1) the Copernican revolution, the discovery of the nature of our solar system and planetary systems around other stars, the physics of light and gravity; (2) the nature and evolution of stars and black holes and the origin of the elements we find in nature; (3) the history of galaxies and the universe, evidence for the Big Bang, and the structure of the universe on its largest scales.

We will attempt to convey a number of the facts that astronomers and astrophysicists have learned about these topics, to describe the outstanding scientific problems that are the focus of current research, to illustrate ways in which physical principles are used to understand the universe, and to show how scientific theories are developed and tested against observations.

Among the questions that you should be able to answer by the end of the course are the following: What is the architecture of our solar system, and how do we find other planetary systems? What is a star? What is a galaxy? What is the evidence for dark matter? What is the Big Bang theory? What empirical evidence supports and/or challenges our explanations for the physical nature of stars, galaxies, and the cosmos?

Weekly Laboratory & Homework:
There will be a weekly laboratory. Attendance is required. The primary goals will be to reinforce the concepts covered in lecture. The lab will typically start with 0.5–1 hour in the Ohio State University Planetarium or an introduction by the instructor to the topic and the analysis that will be carried out. Then, the class will be divided into smaller groups of 3–5 students who carry out the work of the lab, answer questions presented by the TA or professor, and turn in a common laboratory write-up. This weekly write-up will be due at the end of the lab session.

There will be weekly Homework Assignments, each consisting of a set of multiple-choice and short answer questions. The questions are open-book, open-notes, and open-discussion. They will typically be handed out at the end of the laboratory session and due a few days later.

Collectively, the laboratory write-ups and accompanying homework assignments will count for 40% of your grade. No late homework will be accepted, except for legitimate, documented emergencies.

In-Class Quizzes:
There will be two in-class quizzes, held at normal class time. There will be no lecture on quiz days, and the quiz will start promptly at class time. Each quiz will cover the material in the lectures and laboratory sessions since the previous quiz. All quizzes are closed-book, closed-notes multiple-choice tests. They will consist of approximately 40 questions. Collectively, the quizzes will account for 30% of your final grade.

Makeup quizzes are only offered by advance arrangement with the professor. Exceptions are for legitimate, documentable emergencies. If you will be away on an official University-sponsored activity (e.g., sports teams, band, etc.), please bring the professor a letter from your coach, director, etc. in advance of the quiz. Quizzes must be made up by the Wednesday after the quiz you missed, otherwise that quiz becomes the one that we will drop in computing your final grade.

Final Exam:

Attendance at the Final Exam is mandatory. The final will be comprehensive, covering all lectures and laboratories, and has the same multiple-choice/short answer format as the in-class quizzes, only about two times longer. It is worth 30% of your grade.

No makeup final will be offered. Students who miss the final exam will be given an incomplete (I) with an alternative grade equal to getting a zero on the final, and have to make it up early the following Semester, as per University policy, to avoid the alternative grade. In keeping with official University policy, early finals will not be available for those persons who wish to depart early for break. Please plan ahead and make your travel plans accordingly.

Grading Policy:

- The weekly laboratory writeups and homework assignments collectively account for 40% of your final grade.
- Together, the two in-class quizzes will account for 30% of your final grade.
- The final exam accounts for 30% of your final grade, and must be taken by all students.
- Attendance at lectures is strongly encouraged and will have a large impact on your performance on tests and thus on your grade. Attendance at the weekly laboratory session is required.
- Participation is strongly encouraged. The professor will often ask if there are any questions or comments on the topics covered, or on sample Quiz and Homework questions we discuss in class.
- Participation counts towards your final grade, and will be used to bump it up (e.g., from a B+ to an A-) in the event that your calculated final grade is within approximately 1% of the higher score.

Lectures, Notes, & Readings:
The lectures and laboratory meetings are your primary resource for this course. The textbook is used as a secondary reference from which related readings will be suggested.

In between these two resources in importance are the lecture notes available on the web. These notes are meant to be useful aids for studying and following along during lectures; they are no substitute for attendance. Most students find that the best strategy is to print out the notes, bring them to class, and then add their own notes in the margins. Remember, these are only outlines of what is covered each day in class, not comprehensive transcripts of the lectures.

Textbook:
Because introductory astronomy textbooks designed for non-majors are rarely organized exactly the same as our courses, we will not strictly follow the order of topics in the book. You can expect to jump around as the course progresses. As such, instead of specific reading assignments, each section of the course has related reading suggestions from the text. Not all topics in this course are covered by the book, and similarly not all topics covered in the book will be discussed in class. You are only responsible for the contents of the lectures.

Academic Misconduct:
It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Students with Disabilities:

Students with disabilities that have been certified by the Office for Disability Services (ODS) will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/. We will rely on ODS to verify the need for accommodation and to help develop the appropriate strategies. Students with disabilities who have not previously contacted ODS are encouraged to do so, by visiting the ODS website and requesting an appointment. Please take care of this well in advance of the quizzes, as processing the paperwork takes time.

GENERAL EDUCATION RATIONALE FOR ASTRON 1101 "FROM PLANETS TO THE COSMOS"

Astronomy 1101 is an overview of astronomy from our solar system to the universe as a whole. It is a General Education (GE) Physical Science course in the Natural Science category, with an integral laboratory component. It is intended for both BS and BA students.

The expected learning outcomes for GE courses in the Natural Science category are as follows:

1. Students understand the basic facts, principles, theories and methods of modern science.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
3. Students describe the inter-dependence of scientific and technological developments.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

(a) How do the course objectives address the expected learning outcomes?

Astronomy 1101 will meet these expected outcomes by through coverage of three overarching and interconnected themes: (1) the Copernican revolution, the discovery of the nature of our solar system and planetary systems around other stars, the physics of light and gravity; (2) the nature and evolution of stars and black holes and the origin of the elements we find in nature; (3) the history of galaxies and the universe, evidence for the Big Bang, and the structure of the universe on its largest scales. Students will learn basic observational facts (motions of bodies in the Solar System and proof of the Earth's motion; nature and composition of stars; fossil evidence of the Big Bang, including elemental abundances and cosmic background radiation), the methodology used in astronomy (measurement of positions and brightness of celestial sources and principles of spectroscopy), and the theories derived from the observations (the Copernican Solar System, universal gravitation, stellar evolution, and the Big Bang). It is worth emphasizing that this course was designed in collaboration with UCAT personnel following the "Understanding by Design" framework, beginning with the high-level goals that are listed in the Course Request and proceeding to more specific objectives that then guide the ordering and design of individual laboratories and other assignments. The high-level goals, though constructed specifically for this course, map well to the four expected learning outcomes for GE courses in the Natural Science category. While the content and context of the course is defined by the astronomical themes above, the laboratories and associated assignments are intended specifically to achieve the learning objectives described in the Course Request and to assess the degree to which students are attaining the desired learning outcomes.

(b) How do the readings assigned address the expected learning outcomes?

Readings are selected to reinforce lessons learned in lecture and laboratory.

(c) How do the topics address the expected learning outcomes?

The three themes that will be covered form the underpinnings of modern astronomy and astrophysics. The first topic, "The Long Copernican Revolution" is the on-going development of humanity's place in the universe. Copernicus first elucidated our modern view of the Earth in the Solar System. In the last 100 years, we have come to understand that we are on the outskirts of an undistinguished galaxy that is in turn on the outskirts of a large, but typical, supercluster comprised of thousands of galaxies. The second topic, the evolution of stars, leads to an understanding of the origin of elements heavier than helium, i.e., the elements that are common on Earth, yet cosmically relatively rare. The third topic, history of the universe, affords an explanation for the origin of the universe that is consistent with a wide variety of basic data and amenable to rigorous tests. In each instance, understanding how we came to this realization requires understanding of the methodology, observations, and underlying physics.

(d) How do the written assignments address the learning outcomes?

Written assignments that accompany the laboratory sessions are designed to reinforce how the basic data are assembled coherently, lead to hypotheses that are then amenable to tests.

(e) How do the prerequisites provide an appropriate level of preparation for the proposed course?

The laboratories will be designed so that only very basic geometry, algebra, and trigonometry will be required to execute and understand the assignments.

(f) What type(s) of experience will students have in the laboratory component of the course?

The individual laboratory exercises will vary, both week-to-week, depending on content, and through the course as students develop skills and knowledge that they can build on. Here we sketch examples of two laboratory experiences, one for the first week of the course and largely qualitative, and one for late in the course and more quantitative.

1. Astronomical objects and the Sun-Earth-Moon system

In the planetarium, students observe images of a wide range of astronomical objects, from the solar system to interstellar nebulae and galaxies. They write their observations about these images. They are also shown images of lunar phases and a lunar eclipse.

In the classroom portion of the laboratory, students first discuss their observations on individual images in small groups (3-4 students), then reach consensus on their 2-4 most significant observations about each image and what these observations may reveal about the objects themselves. These group results are then input for a general class (20-30 students) discussion.

Returning to small groups, students draw diagrams showing the Earth, Moon, and Sun locations that correspond to different lunar phases. They hypothesize what is going on during a lunar eclipse and what the Earth-Moon-Sun configuration is during an eclipse.

Each student turns in a written report (guided by a question sheet) covering both the qualitative observations and the lunar phase/eclipse diagrams at the end of the laboratory.

2. Hubble's Law and the Expansion of the Universe

In the planetarium, building on material from lecture, students are shown examples of Cepheid variable stars and Type Ia supernovae in galaxies and reminded how they can be identified and used as indicators of distance. They are also shown examples of galaxy spectra and reminded how these are used to infer velocities. Numerical simulations of large scale structure are shown to illustrate how galaxies acquire peculiar velocities and how these complicate the determination of the expansion rate of the universe.

In the classroom, working in groups of 3-4, students plot (on paper) the distance and velocity data from Hubble’s 1929 paper announcing the expansion of the universe. They estimate the slope of the velocity-distance relation and the uncertainty in the slope. They repeat this exercise using modern data on local galaxies.

Using a large elastic band or stretchable tubing, marked with clothespins, students investigate and measure the proportional relation between distance and velocity in an expanding 1-dimensional system. Using their measurements, they relate the expansion law (distance-velocity relation) to the duration of the expansion.

Returning to their earlier plots, the student groups infer the age of the universe from Hubble’s 1929 data and from modern data. They discuss sources of uncertainty. Groups then share their results and discuss their implications and uncertainties.

Each student turns in a written report, guided by a question sheet, at the end of the laboratory.

GENERAL EDUCATION ASSESSMENT FOR
ASTRON 1101 "FROM PLANETS TO THE COSMOS"

Astronomy 1101 is an overview of astronomy from our solar system to the universe as a whole. It is a General Education (GE) Physical Science course in the Natural Science category. It is intended for both BS and BA students. An integral laboratory component distinguishes Astronomy 1101 from other GE courses in astronomy; this is the first time that Astronomy has offered a GE course with a laboratory component and consequently the principal focus of assessment will be on the effectiveness of the laboratory component.

We will employ rubrics to assessing student understanding of laboratory exercises as articulated in their lab reports. In our accompanying GE rationale document, we gave two examples of laboratory exercises that we might use, (1) the Sun-Earth-Moon system and the nature of eclipses and (2) the Hubble diagram and the expansion of the universe. In the Table below we give sample rubrics that we might use to evaluate these two labs. We will carefully evaluate student lab reports to assess student understanding of the material.

We will also use pre- and post-assessment short quizzes to determine how student understanding has changed as a consequence of the laboratory exercise.

Another direct method of assessment that we will employ is embedded testing. The final examination will include multiple-choice questions that address specific concepts that were emphasized in certain of the laboratory exercises. As a control, we will ask the same multiple-choice questions in other GE courses that cover similar material (Astron 1140 "Planets and the Solar System" and Astron 1143 "Cosmology: History of the Universe", and Astron 1144 "Stars, Galaxies, and the Universe"), but which do not have a laboratory component, to determine whether or not the laboratory exercises are effectively improving student's understanding.

As an indirect method of assessment, we will employ exit surveys that will include the specific course objectives and the GE learning objectives and students will be asked whether they strongly agree, agree, disagree, strongly disagree, or neither agree nor disagree that the specific laboratory exercises met these goals. Narrative responses also will be sought.

Feedback from all sources will be examined to determine which individual laboratory exercises were effective or ineffective and whether or not some of the exercises were too complicated/difficult or trivial/too easy. Laboratory exercises that are deemed to be ineffective will be either redesigned or replaced.

Feedback from all these sources will also be used to evaluate the topical content of the course to determine whether or not the areas of selected emphasis are achieving the goals outlined in our GE rationale documents.

Student performance evaluation will be carried out as described in the sample syllabus, with components of the grade including examination and laboratory performance and participation.

Table: Sample Rubrics for Assessing Laboratory Exercises

Evaluation Laboratory Exercise	Does Not Yet Meet Expectations	Minimally Meets Expectations	Fully Meets Expectations	Exceeds Expectations
Eclipses	Can explain eclipse phenomenon, but not eclipse conditions	Correctly explains solar/lunar eclipses and conditions where they occur	Can articulate why there are “eclipses seasons” rather than eclipses every month	Understands precession and why interval between eclipses seasons is less than half a year
Hubble Law	Understands correlation between distance and recession velocity, but cannot explain clearly underlying assumptions and the correlation between luminosity and redshift	Can correctly explain variables used in the Hubble diagram, underlying assumptions, and their implications	Can correctly explain implications of the Hubble diagram for the age of the universe	Can correctly explain implications of dark matter and dark energy for the future of expansion of the universe