| LSC Use Only Proposal No: | UWUCC Use Only Proposal No: 12-76c. |
|---|---|
| LSC Action-Date: AP-1/31/13 | UWUCC Action-Date: AP-2/19/13 Senate Action Date: App-3/26/13 |

**Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee**

| Contact Person(s) Kenneth S. Coles | Email Address kcoles@iup.edu |
|---|---|
| Proposing Department/Unit Geoscience Dept. | Phone 724-357-5626 |

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

**1. Course Proposals (check all that apply)**

- ☐ New Course
- ☑ Course Revision
- ☐ Course Prefix Change
- ☐ Course Number and/or Title Change
- ☐ Course Deletion
- ☐ Catalog Description Change

*Current* course prefix, number and full title: GEOS 105 Exploring the Universe

*Proposed* course prefix, number and full title, if changing:

**2. Liberal Studies Course Designations, as appropriate**

This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

- ☐ Learning Skills
- ☑ Knowledge Area
- ☐ Global and Multicultural Awareness
- ☐ Writing Across the Curriculum (W Course)

☐ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

- ☐ Global Citizenship
- ☐ Information Literacy
- ☐ Oral Communication
- ☐ Quantitative Reasoning
- ☐ Scientific Literacy
- ☐ Technological Literacy

**3. Other Designations, as appropriate**

- ☐ Honors College Course
- ☐ Other: (e.g. Women's Studies, Pan African)

**4. Program Proposals**

- ☐ Catalog Description Change
- ☐ Program Revision
- ☐ Program Title Change
- ☐ New Track
- ☐ New Degree Program
- ☐ New Minor Program
- ☐ Liberal Studies Requirement Changes
- ☐ Other

*Current* program name:

*Proposed* program name, if changing:

| 5. Approvals | Signature | Date |
|---|---|---|
| Department Curriculum Committee Chair(s) | Kenneth S. Coles | 11/5/2012 |
| Department Chairperson(s) | | 11/5/12 |
| College Curriculum Committee Chair | | 12/4/12 |
| College Dean | | 12/5/12 |
| Director of Liberal Studies (as needed) | | 2/12/13 |
| Director of Honors College (as needed) | | |
| Provost (as needed) | | |
| Additional signature (with title) as appropriate | | |
| UWUCC Co-Chairs | Gail S Sechrist | 2/25/13 |

Received FEB 25 2013 Liberal Studies

Received FEB 12 2013 Liberal Studies

Received DEC 10 2012 Liberal Studies

Part II

**1. Syllabus of Record**
**I. Catalog Description**

GEOS 105 Exploring the Universe 3c-0l-3cr
Prerequisites: No Geoscience Majors/Minors
Examines the evolution and properties of objects in the solar system, galaxy, and universe, how light is used to study distant objects, and the relationship between Earth and space in terms of resources and hazards.

**II. Course Outcomes and Assessment (Expected Undergraduate Student Learning Outcomes)**

By engaging in the activities and exercises of this course, the students will:

**Objective 1:**
Demonstrate how distant objects in the heavens are identified, described, and analyzed using light and other observations.
**Expected Student Learning Outcomes 1 and 2**
Informed and Empowered Learners
**Rationale:**
Light is the primary tool for study of distant planets, asteroids, comets, stars, and galaxies. Course content and assignments are designed to show how understanding of composition, present state, and evolution of these objects are fundamentally linked to the light they give off.

**Objective 2:**
Explain how solar system history, objects, and processes, such as chemical differentiation and asteroid impacts, influence life on Earth.
**Expected Student Learning Outcomes 1 and 2**
Informed and Empowered Learners
**Rationale:**
All life on Earth depends on chemical elements, physical conditions at Earth's surface, and energy input from outside sources. Course assignments and content will engage students in the critical interpretation of planetary evolution and the near-Earth environment, strengthening their ability to explain the results of these processes that are visible on Earth today.

**Objective 3:**
Discriminate between scientific and non-scientific explanations for astronomical phenomena, such as comets, eclipses, the seasons, and magnetic storms on Earth, and justify which conclusions are credible using scientific criteria.
**Expected Student Learning Outcomes 1, 2, and 3**
Informed, Empowered, and Responsible Learners
**Rationale:**
The validity of scientific conclusions depends critically on the kinds of evidence used and how it is evaluated and validated. Assignments and course content will require students, working in groups, to distinguish scientific from pseudoscientific reasoning and to master interpretation of evidence in order to answer questions about the occurrence of, and hazard from, phenomena in near-Earth space.

**Objective 4:**

Connect the history and processes of objects in the galaxy, such as supernovae and stellar evolution, to the chemical elements that exist on Earth today.

**Expected Student Learning Outcomes 1 and 2**

Informed and Empowered Learners

**Rationale:**

Most chemical elements are created either in stars or in supernova explosions. Students will learn what conditions lead to the synthesis of each element and interpret the series of events that brought those elements to our present environment.

## III. Course Outline

| | |
|---|---|
| **Part A:** The sky | 3 hours |
| Describing locations in the sky | |
| Motion and distance | |
| **Part B:** Light | 6 hours |
| Theory of light; what it tells about the source | |
| Telescopes | |
| **Part C:** Earth and its neighborhood | 6 hours |
| Origin of the Solar System | |
| Earth, Moon, and Eclipses | |
| **Exam One** | 1 hour |
| **Part D:** The Solar System | 10 hours |
| Terrestrial Planets | |
| Jovian Planets | |
| Moons, Rings, and small objects | |
| Impact cratering | |
| **Part E:** The Sun and Stars | 3 hours |
| Solar structure and processes | |
| Families of stars | |
| **Exam Two** | 1 hour |
| **Part F:** Processes and Objects in the Galaxy | 6 hours |
| Star birth, life, and death | |
| White dwarfs, neutron stars, and black holes | |
| **Part G:** The Galaxy and Universe | 6 hours |
| The Milky Way and other galaxies | |
| Motion and time in the universe | |
| Cosmology: origin and fate of the universe | |
| **Cumulative final during final exam period** | 2 hours |

## IV. Evaluation Methods

Each component of the course will contribute to final grade according to:

| | |
|---|---|
| In-Class Written Work | 25% |
| Assignments | 10% |
| Exam 1 | 20% |
| Exam 2 | 20% |
| Final Exam | 25% |
| Total | 100% |

**V. Example Grading Scale**
The final grade for this course will be determined using the following schedule:
A=90-100%; B=80-89%, C=70-79%, D=60-69%, F=<60%

**VI. Attendance Policy**
The attendance policy will conform to IUP's undergraduate course attendance policy as outlined in the undergraduate catalog.

**VII. Required textbooks, supplemental books and readings**

Text: Comins, Neil, 2012, Discovering the Essential Universe, 5th Edition: Freeman, 412 pages.

Supplemental Readings: Johnson, G., 2006, Miss Leavitt's stars: The untold story of the woman who discovered how to measure the universe: Norton, 176 p.
Paulos, J. A., 1988, Innumeracy: Mathematical illiteracy and its consequences: Farrar Straus and Giroux, 135 p.

**VIII. Special resource requirements**
There are no special resource requirements for this course.

**IX. Bibliography**
In addition to the required textbooks and supplemental readings from science journals, the following will be used to develop the course curriculum:


Comins, N. F., 2001, Heavenly Errors: Misconceptions about the real nature of the universe: Columbia University Press, 244 p.
de Pater, I, and Lissauer, J. J., 2010, Planetary Sciences, 2nd Edition: Cambridge University Press, 647 p.
Green, P. J., 2003, Peer Instruction for Astronomy: Prentice Hall, 178 p.
Greene, B., 2004, The Fabric of the Cosmos: Space, Time, and the Texture of Reality: Knopf, 569 p.
Hartmann, W. K., 2005, Moons and planets, 5th edition: Thomson Brooks/Cole, 428 p.
Johnson, G., 2006, Miss Leavitt's stars: The untold story of the woman who discovered how to measure the universe: Norton, 176 p.
Langmuir, C. H., and Broecker, W., 2012, How to build a habitable planet, Revised edition: Princeton, 718 p.
Moche, D. L., 2009, Astronomy: A self-teaching guide, 7th edition: John Wiley, 388 p.
Ridpath, I., 2004, Norton's star atlas, 20th edition: Pi Press, 195 p.
Rothery, D. A., McBride, N., and Gilmour, I., 2011, An introduction to the solar system, Revised edition: Cambridge University Press, 412 p.
Slater, T. F., and Adams, J. P., 2003, Learner-centered astronomy teaching: Strategies for Astro 101: Prentice-Hall, 167 p.
Shoemaker, Carolyn S., 1999, Ups and downs in planetary science: Annual Review of Earth and Planetary Sciences, vol. 27, p. 1-17.

## 2. Summary of the proposed revisions.

1. Objectives – course objectives were modified from the 1995 syllabus of record and aligned with the Expected Undergraduate Student Learning Outcomes (EUSLO).

2. Common Learning Objectives for non-laboratory Natural Science course were incorporated into the content of the course. These objectives include: examine a body of knowledge of natural science that will contribute to an understanding of the natural world and an appreciation of the impacts that natural sciences have on the lives of individuals and the world in which they live; understand the differences between science as a knowledge base and science as a process that generates knowledge; develop an inquiring attitude consistent with the tenets of natural science; understand the empirical nature of science; understand the concept of bias and the efforts to which scientists go to avoid it.

3. Revised the content of the course to reflect current teaching and research in astronomy and the creation of a separate course, GEOS 154 Human Exploration of Space, to address the history of space flight.

4. Updated text and non-textbook to more current books and also updated the bibliography.

## 3. Justification/Rationale for the revision.

The course is a currently approved Liberal Studies Non-Laboratory Natural Science course and is being revised to meet the new curriculum criteria for this category.

**Liberal Studies Course Approval General Information**

1. This course has been taught by one instructor each semester it has been offered, generally taught in one section. Occasionally, one instructor may teach two sections, or two sections may be taught by two different instructors. Instructors frequently consult and collaborate on syllabi, textbooks and assignments for this course.

2. Readings taken from Johnson, G., 2006, Miss Leavitt's stars: The untold story of the woman who discovered how to measure the universe: [Norton, 176 p.] will showcase contributions that female scientists have made to astronomy. Scientists highlighted in these readings and in the the course include Caroline Herschel: She and her brother revolutionized the study of astronomy; Annie Jump Cannon: Built a star classification of more than 350,000 stars; Henrietta Leavitt: Discovered a way to measure distances between stars; Cecilia Payne Gaposchkin: The first woman granted a Ph.D. in astronomy at Harvard; Margaret Burbidge: Described the way chemical elements form in stars; Jocelyn Bell Burnell: Discovered quasars; Vera Rubin: Discovered dark matter in galaxies; Carolyn Shoemaker: Discovered more comets than any living person.

3. In addition to the textbook "Discovering the Essential Universe", the class will read portions of Johnson's biography of Henrietta Leavitt, detailing the story behind the discovery of how to measure the distance to stars. This discovery by a woman scientist enabled Edwin Hubble to show that the universe is expanding. Readings from John Allen Paulos's "Innumeracy: Mathematical illiteracy and its consequences" illustrate simple arguments against the validity of astrology and that it is unlikely that aliens are visiting Earth. These readings will be used as a springboard for reflective writing and group discussions on the what is and is not scientific thinking.

4. This course introduces students to the fundamental processes that create the objects we see in the sky, how we gather information without visiting these objects, and how they influence our life on Earth today. This course is intended to give students enough knowledge of astronomy to permit them to make informed and responsible judgments, both on the personal level ("Is the assertion of hazard from a Planet X plausible?" "Is astrology a reasonable basis for making major decisions?) and on a broad national level ("What will a proposed space mission tell us about Mars?"). The strong emphasis on how we learn about the universe and how objects and processes in space influence our life on Earth makes this course very different from our majors courses such as GEOS 341 and 342 that go into more detail and depth about the objects in the solar system and universe and how they evolved.

***Old Syllabus of Record***

## GS 105 Exploring the Universe

**I. Catalog Description**

GS 105 Exploring the Universe — 3 credits, 3 lecture hours

Prerequisites: No Geoscience Majors/Minors — (3c-0l-3sh)

Examines the history of time, the reasons for the seasons, the characteristics of the planets, moons, stars and galaxies; and the history and future of space exploration.

**II. Course Objectives**

1. Students will be able to explain the relationships between time keeping and the celestial sky.
2. Students will be able to compare and contrast the characteristics and motions of the planets and their moons.
3. Students will be able to distinguish between characteristics and types of stars to predict the future changes for these stars.
4. Students will analyze the past accomplishments and applications of the space program to determine their usefulness to humans.

**III. Course Outline**

A. History of Astronomy (5 hours)
- 1. Does anybody really know what time it is?
  - Time-keeping methods, old and new
  - Development of the calendar
- 2. Ancient astronomy in many cultures
  - Western developments in astronomy
  - Non-western developments in astronomy

B. What's your Zodiac sign? (3 hours)
- 1. Movement in the heavens
  - Rotation, revolution and precession
- 2. Seasons and signs
  - Turn, turn, turn.... for every time there is a season
  - Astrology: its ancient origins and cultural significance

C. How powerful is that scope? (3 hours)
- 1. Looking at the heavens
  - The nature of light
  - What's the Doppler effect?
- 2. Telescopes -- keep watching those skies!
  - Visual astronomy
  - Other kinds of telescopes

D. Our nearest neighbor (4 hours)
- 1. How we see the Moon
  - Lunar phases
  - Eclipses, solar and lunar
- 2. Moon-Earth interactions

The turning of the tides
The geology of the Moon and its origins

E. The space program --what do you get for your bucks? (2 hours)
1. Unmanned satellites
The history of satellites
The Earth-observing system
2. Manned space-flight
A glorious history
An uncertain future

F. Where are the Martians? (9 hours)
1. The nine planets and their moons
My Very Educated Mother
Just Showed Us Nine Planets
2. The rest of the solar system
Meteors, comets and asteroids

G. The Sun is green (3 hours)
1. How the sun works
Fusion reactions
Sunspots, coronas, flares and solar winds
2. Sun-Earth interactions
Solar energy
Magnetic storms and northern lights

H. Betelgeuse and her sisters (8 hours)
1. How many types of stars are there?
Stellar characteristics
Variations on a theme
Oh, Be a Fine Girl/Guy, Kiss Me!
2. Star cycles
Novas. supernovas and neutron stars

I. Where's the black hole? (3 hours)
1. You are here...the fun stuff is over there
The Milky Way
Other galaxies
2. The Big Bang
Bubbles in space-time
Expanding, contracting, static ... or all of the above?

J. E.T., phone home (2 hours)
1. UFO's and aliens
What's real, what's not
The statistical chances
2. Life in the Universe

**IV. Evaluation Methods**

The final grade for this course will be determined as follows:

85% Tests. Four tests, consisting of multiple choice, true-false and matching questions. 100 points each. Tests will be computer-graded and adjusted to a mean of 75% so that 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D; below 60%=F. The same scale will be used for the final point score.

15% Non-text book review. A four to five page book review of the non-text reading is due the last day of class. Worth 75 points.

**V. Required textbooks, supplemental books and readings**

Textbook: Chaisson, E.E., 1995, ASTRONOMY: A BEGINNER'S GUIDE TO THE UNIVERSE. Englewood Cliffs NJ: Prentice Hall, 451 p.

Non-text: Raup, D. 1986, THE NEMESIS AFFAIR.

**VI. Special resource requirements**: None.

**VII. Bibliography**

Abell, G.O., Morrison, D. and Wolff, S.C., 1993, EXPLORATION OF THE UNIVERSE (6th Ed.). Philadelphia: Saunders College Publishing, 681 p.

Chaisson, E.E. and McMillan, S., 1993, ASTRONOMY TODAY. Englewood Cliffs NJ: Prentice Hall, 658 p.

Ebbighausen, E.G. and Zimmerman, R.L., 1992, ASTRONOMY (6th Ed.). Columbus: Merrill Publishing, 196 p.

Engelbrektson, S., 1994, ASTRONOMY THROUGH SPACE AND TIME. Dubuque: Wm. C Brown, 448 p.

Pasachoff, J.M., 1992, JOURNEY THROUGH THE UNIVERSE. Philadelphia: Saunders College Publishing, 389 p.

Protheroe, W.M., Capriotti, E.R. and Newsom, G.H., 1989, EXPLORING THE UNIVERSE (4th Ed.) Columbus: Merrill Publishing, 665 p.

Skinner, B.J. and Porter, S.C., 1995, THE BLUE PLANET: AN INTRODUCTION TO EARTH SYSTEMS SCIENCE. New York: John Wiley & Sons, 493 p.

Zeilik, M., 1994, ASTRONOMY - THE EVOLVING UNIVERSE (7th Ed.). New York: John Wiley & Sons, 525 p.

## Example Assignment and Rubric

### Ranking task grading rubric

This is an in-class exercise.

Exercise 1:

Correct ranking is that all positions of Moon have same amount of their surface illuminated.

Exercise 2:

Correct ranking is that position A appears most illuminated from Earth, down to position D appears least illuminated. (A, F, B and E, C, D)

Both exercises: Explanation

Target: Highlights the distinction in the wording of the two questions and why it leads to different answers: What we see illuminated from Earth generally differs from the amount of the Moon actually illuminated by the Sun. OR From Earth we can only see one-half of the Moon and its position relative to the Sun tells us how much of it will appear illuminated. Answer may also highlight why Moon is Full at A: it does not lie in plane of Earth and Sun in most month (is not in plane of paper).

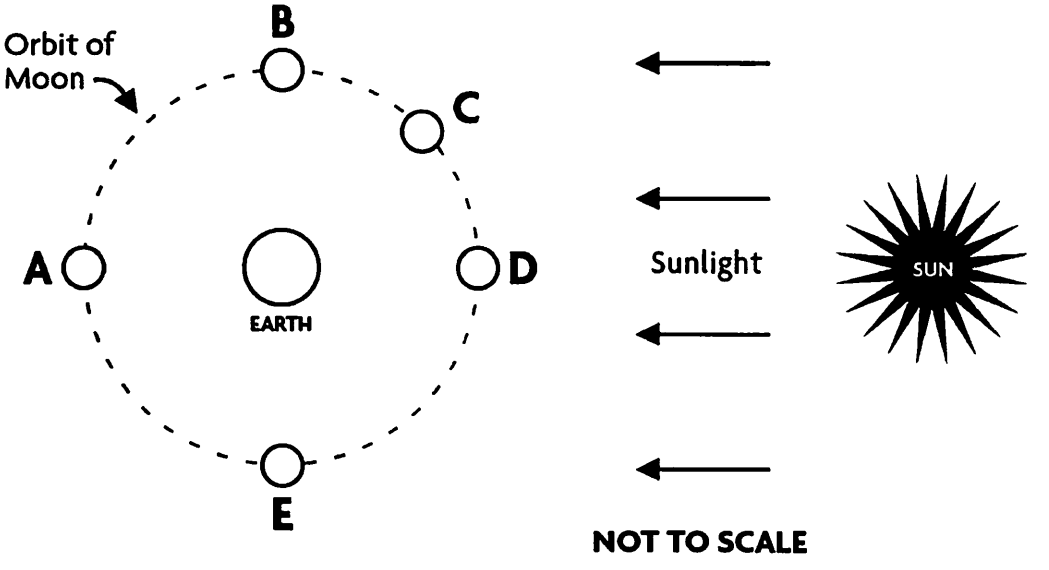
Satisfactory: Gives correct ranking, but explanation does not highlight distinction between the questions or simply states "that is how it looks" or simply lists the names of the phases of the Moon in order.

Unsatisfactory: Attempts to justify an incorrect answer or asserts that the Moon is eclipsed every month (orbit lies in plane of diagram).

# Astronomy Ranking Task:
# Phases of the Moon

**Exercise #1**

**Description:** The figure below shows a "top view" of the Sun, Earth, and five different positions (A - E) of the Moon during one orbit of Earth. Note that the distances shown for the Sun to Earth and for Earth to the Moon are not drawn to scale.




**Ranking Instructions:** Rank (from greatest to least) the amount of the Moon's entire surface that is illuminated by sunlight for the five positions (A-E) shown.

**Ranking Order:** Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ Least

Or, the amount of the entire surface of the Moon illuminated by sunlight is the same at all the positions. ____ (indicate with check mark).

**Carefully explain** your reasoning for ranking this way:

_____

_____

_____

_____

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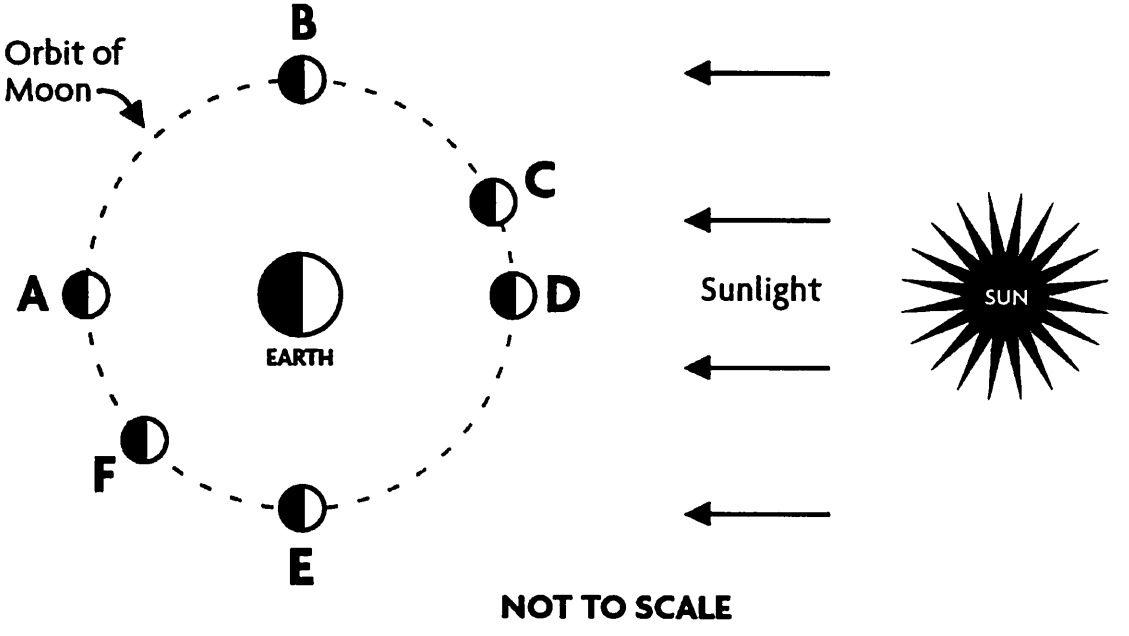
# Astronomy Ranking Task:
# Phases of the Moon

**Exercise #2**

**Description:** The figure below shows a "top view" of the Sun, Earth and six different positions (A - F) of the Moon during one orbit of Earth. Note that the distances shown for the Sun to Earth and for Earth to the Moon are not drawn to scale.




**Ranking Instructions:** Rank (from greatest to least) the amount of the Moon's illuminated surface that is visible from Earth at each of the six positions (A – F) shown.

**Ranking Order:** Greatest 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ Least

Or, the amount of the Moon's illuminated surface visible from Earth is the same in all positions. _____ (indicate with check mark).

**Carefully explain** your reasoning for ranking this way:

_____
_____
_____
_____

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