Approved by Undergraduate Council 2/1/2011

Sharon Gill

Digitally signed by Sharon Gill
DN: cn=Sharon Gill, o=Undergraduate Education, ou=Undergraduate Council, email=sgill@uky.edu, c=US
Date: 2011.02.04 08:23:52 -05'00'

General Education Course Submission Form **Date of Submission:** May 14, 2010

1. Check which area(s) this course applies to.

Inquiry – Arts & Creativity		Composition & Communications - II	
Inquiry – Humanities		Quant Reasoning – Math	
Inquiry – Nat/Math/Phys Sci	X	Quant Reasoning – Stat	
Inquiry – Social Sciences		Citizenship – USA	
Composition & Communications - I		Citizenship - Global	

2. Provide Course and Department Information.

Department: Department of Physics and Astronomy

Course Prefix and Number: AST191 Credit hours: 3

Course Title: AST 191 The Solar System

Expected Number of Students per Section: 150 Course Required for Majors in your Program? No

Prerequisite(s) for Course? None

This request is for (check one): A New Course [ ] An Existing Course [X]

Departmental Contact Information

Name: Kwok-Wai Ng Email: kwng@uky.edu

Office Address: CP171 Phone: 257-1782

3. In addition to this form, the following must be submitted for consideration:

- A syllabus that conforms to the Senate Syllabi Guidelines, including listing of the Course Template Student Learning Outcomes.
- A narrative (2-3 pages max) that explains: 1) how the course will address the General Education and Course Template Learning outcomes; and 2) a description of the type(s) of course assignment(s) that could be used for Gen Ed assessment.
- If applicable, a major course change form for revision of an existing course, or a new course form for a new course.

4. Signatures

Department Chair: _____ Date: 6/24/10

Dean: Anna R. K. Bosch _____ Date: _____

College Deans: Submit all approved proposals electronically to:
Sharon Gill Sharon.Gill@uky.edu
Office of Undergraduate Education

Revised May 6, 2010

Explanation:

Two sections of AST191 are offered in each semester. The enrollment of each section is about 150. 3 teaching assistants are required for each section (6 in total) to conduct the GenEd activities outlined in the syllabus and the learning outcome during the class. These TA supports are critical for the success of this GenEd course.

Learning Outcome for AST191

1. Describe methods of inquiry that lead to scientific knowledge and distinguish scientific fact from pseudoscience.

Throughout this course students will be asked to develop on conjecture about the reason for a given physical phenomenon. They will then be given various observables (lines of evidence) and asked to reconcile these observables with their conjecture. If their conjecture is falsified by the observables, then they will be asked to modify their conjecture to allow it to meet the observable criteria. As an example, early in the course students will be asked to conjecture why there are seasons on the Earth. They will then be given various observables, such as the seasons are flipped between the North and South Hemispheres. They will then have to modify their original conjecture to be consistent with this observable. This type of inquiry will be used throughout the course and in the student's final projects.

2. Explain fundamental principles in a branch of science.

In this course we will make use of many scientific principles in order to describe various phenomena. We will make use of Newton's Laws of Motion, Newton's Law of Gravity, Energy Conservation, Geologic principles of superposition, stratigraphy, volcanism, Coriolis Effect, etc. These fundamental principles will be used to describe phenomena on various planets, satellites and minor planets. Students will not only use these principles but will also be required to demonstrate their understanding of the fundamental principle that they are using.

3. Apply fundamental principles to interpret and make predictions in a branch of science.

In this course we will use most of the fundamental principles to describe phenomena seen on the Earth. We will then use these same principles to both predict and describe what is happening on other objects in the Solar System. We will assume that the fundamental principles work throughout the Universe and that variations between the principle and the observable are due to either incorrect conjecture on the nature of the phenomenon or the requirement that more than one principle is need to describe the phenomenon. This application of fundamental principles will be applied throughout the term and will be a required component of the final student projects.

4. Demonstrate an understanding of at least one scientific discovery that changed the way scientists understand the world.

This course will require students to demonstrate an understanding of many different important scientific discoveries. One example will be an understanding of plate tectonics and the ramifications to the production of mountain ranges, composite volcanoes and earthquakes. In this specific example students will demonstrate their understanding of this discovery by searching for evidence of plate tectonics on other objects in the solar system (e.g. mountain ranges, composite volcanoes, etc.)

5. Give examples of how science interacts with society.

This course will provide knowledge of the workings of the Earth and the Earth's history. Furthermore the analysis of other objects in the Solar System allows us to construct some of the history of our planet. For instance the methane atmosphere of Titan provided insights into the early Earth atmosphere, the composition of comets, provide clues into the deposition of water

onto our world, while amino acids in the solar system provide possible sites for the origin of life. The potentially catastrophic result of asteroid collisions warns of potential dangers to our society and the greenhouse effect on Venus warns of the results of a runaway greenhouse effect. All of these examples have direct interaction of our society.

6. Conduct a hands-on project using scientific methods to include design, data collection, analysis, summary of the results, conclusions, alternative approaches, and future studies.

In this course, students will be expected to learn a scientific approach to understanding our Solar System. Throughout the course students will be taught to construct sound conjectures, test their conjectures using known observables and fundamental principles of science, and modify their conjectures to become consistent with what is known. The course will also include individual projects where students will conduct research on a topic and use data and principles to reach a scientific conclusion about the topic. Students will be required to write a final paper that includes literature research, student measurements and analysis, results, and conclusions that include a the importance to the global understanding of the object, an indication of uncertainty in the results, and potential improvements to the study.

One example of a student project is using crater density on the surface of Mars to determine the age of geologic features, such as dried river beds. In this example, students use NASA images to measure the crater density of various interesting features on the planet. This measure is then compared to the known age-crater density relation provided by Lunar investigations. The results from this investigation will provide constraints on when liquid water flowed on Mars and provide a time-scale for when Mars began to lose its atmosphere.

7. Recognize when information is needed and demonstrate the ability to find, evaluate and use, effectively, sources of scientific information.

The final project in this course will demonstrate the students ability to find and evaluate other sources of scientific information. The individual projects will not be specifically covered in the lecture portion of the course. Students will need to form a conjecture about what the observations for the project are indicating to them. Although the specific project data will not be available in other published scientific information, students will need to read about similar investigations in order to find the best way to proceed with their investigations, understand the limitations and accuracy of their results, and conjecture about possible differences found between their results and published results.

In the previous example of crater densities on Mars, there published values for when water last flowed across the surface. Students will need to compare their specific results to these published results and reach a conclusion about why differences in the time-scale for water flow may have occurred.

University Senate Syllabi Guidelines

AST191

General Course Information

- ☑ Full and accurate title of the course.
- ☑ Departmental and college prefix.
- ☑ Course prefix, number and section number.
- ☑ Scheduled meeting day(s), time and place.

Instructor Contact Information (if specific details are unknown, "TBA" is acceptable for one or more fields)

- ☑ Instructor name.
- ☑ Contact information for teaching/graduate assistant, etc.
- ☑ Preferred method for reaching instructor.
- Office phone number. MISSING
- ☑ Office address.
- ☑ UK email address.
- ☑ Times of regularly scheduled office hours and if prior appointment is required.

Course Description

- ☑ Reasonably detailed overview of the course.
- ☑ Student learning outcomes.
- ☑ Course goals/objectives.
- ☑ Required materials (textbook, lab materials, etc.).
- ☑ Outline of the content, which must conform to the Bulletin description.
- ☑ Summary description of the components that contribute to the determination of course grade.
- N/A ☐ Tentative course schedule that clarifies topics, specifies assignment due dates, examination date(s).
- ☑ Final examination information: date, time, duration and location.
- ☑ For 100-, 200-, 300-, 400-, 400G- and 500-level courses, numerical grading scale and relationship to letter grades for *undergraduate* students.
- ☐ For 400G-, 500-, 600- and 700-level courses, numerical grading scale and relationship to letter grades for *graduate* students. (Graduate students cannot receive a "D" grade.)
- ☑ Relative value given to each activity in the calculation of course grades (Midterm=30%; Term Project=20%, etc.).
- ☑ Note that undergraduate students will be provided with a Midterm Evaluation (by the midterm date) of course performance based on criteria in syllabus.
- ☑ Policy on academic accommodations due to disability. Standard language is below:

  If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Course Policies

- ☑ Attendance.
- ☑ Excused absences.
- ☑ Make-up opportunities.
- ☑ Verification of absences.
- ☑ Submission of assignments.
- ☑ Academic integrity, cheating & plagiarism.
- ☑ Classroom behavior, decorum and civility.
- N/A ☐ Professional preparations.
- ☑ Group work & student collaboration.

Solar System Astronomy
AST 191_001 – GenEd Course
Fall 2010

Instructor: Ron Wilhelm
Office: Chem-Phys Building Room 275
Contact information: ron.wilhelm@uky.edu

Class: 1:00 - 1:50 PM. MWF in Room 155

Office Hours: M 1:30 - 2:30 PM
T & Th 11:00 - 12:00 AM
WF 10:00 - 11:00 AM
Or drop in when you're around

TA #1
TA #2
TA #3
TA #4
TA #5
TA #6

Textbook: Cosmic Perspective: The Solar System 6/E , *Bennett, Donahue, Schneider, Voit*

The Course:

This astronomy course is likely to be quite different than what you are expecting. In most introductory science courses a professor will spend a great deal of time telling you what scientists do, and what scientists have found. In this class we will spend a great deal of time making you scientists.

We will begin the term investigating some physics concepts, and then properties of Earth, the solar system and the individual planets. Throughout the term you will be given assignments that will require you to make conjectures, analyze data, make plots, determine results and draw conclusions from these results. These bench mark lessons are designed to help you understand how to approach an astronomical problem using sound scientific techniques.

In the final month of the term you will be asked to work on a group project which involves real data analysis. We will make use the large amount of data available on-line from missions to the planets, moons, asteroids and comets. The project will require your group to make a sound conjecture about some physical process and explore that conjecture using measurements of data in order to determine a result. This project will also include literature research on the topic and comparisons between your conclusions and published results. In short, you will be asked to become a scientist for your project.

Expected Learning Outcome (What you should know by the end of the course)

1. Describe methods of inquiry that lead to scientific knowledge and distinguish scientific fact from pseudoscience.

Throughout this course students will be asked to develop on conjecture about the reason for a given physical phenomenon. They will then be given various observables (lines of evidence) and asked to reconcile these observables with their conjecture. If their conjecture is falsified by the observables, then they will be asked to modify their conjecture to allow it to meet the observable criteria. As an example, early in the course students will be asked to conjecture why there are seasons on the Earth. They will then be given various observables, such as the seasons are flipped between the North and South Hemispheres. They will then have to modify their original conjecture to be consistent with this observable. This type of inquiry will be used throughout the course and in the student's final projects.

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provide clues into the deposition of water onto our world, while amino acids in the solar system provide possible sites for the origin of life. The potentially catastrophic result of asteroid collisions warns of potential dangers to our society and the greenhouse effect on Venus warns of the results of a runaway greenhouse effect. All of these examples have direct interaction of our society.

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In the previous example of crater densities on Mars, there published values for when water last flowed across the surface. Students will need to compare their specific results to these published results and reach a conclusion about why differences in the time-scale for water flow may have occurred.

Methods of Assessing the Expected Learning Outcomes

We will have weekly quizzes which will assess your level of understanding of basic concepts, facts, discussed topics and reading material. Exam 1 will test the ability to interpret data, uncertainties, critical analysis of results, understanding of basic physical

principles and basic properties of areas covered and developed in class. Exam 2 will cover everything learned in the course, from astronomical facts and theories, to the demonstration of critical thinking in novel situations and the ability to back up this reasoning with sound scientific arguments. Graded discussion board entries on Blackboard will be used to assess gains in understanding over the extent of the course and to assess understanding of individual topics covered in our daily discussions. Periodic progress reports submitted to BlackBoard will be used to assess the development and evolution of each research topic and assess the critical analysis and formation of concept bridges. These reports will also be reviewed by peers in your class who will also be graded on input to the projects. Final research defense, in the form of a written paper and presentation will assess the ability to interpret data, draw meaningful conclusion, and present results in a coherent and concise manner.

Grading

Blackboard discussions

Throughout the term you will be asked to give input on discussion topics on BlackBoard. Some of these topics will involve homework like problems and "what if" type questions. You will be expected to not only participate in the discussion but to offer meaningful responses. This means that full credit will not be given for input such as "I agree with everything that has been said." If you do agree, that statement should be followed with the reasons why you agree.

In the last month of the course you will be asked to provide input on your research topic, discussing what you are currently doing and why. Participation will be graded for the input that you give on your own topic, and also discussions that you have about other groups' research topics. This involvement will be crucial to the success of everyone's research project and is therefore an important part of your homework grade.

Quizzes

We will have a quiz each Friday, consisting of one or two essay questions which will test your overall understanding of the material covered in class. We will have about 12 quizzes in this class. Of these 12 only the 8 highest grades will count toward your final grade.

If you must miss a quiz, a makeup quiz will only be given for well documented reasons. If you do not have documented reasons for missing a quiz, that quiz can become one of your dropped grades.

Participation

This is a very crucial component of this course. Roughly 33% of our lectures will have investigative lessons that you will complete during the lecture period. These lessons are crucial for the scientific development needed to complete the final project in the course. If you miss class on a day of an investigative lesson you can only make it up for a grade if you have a documented, excused absence. As seen below, Participation is 20% of your final grade. These investigative lessons will constitute 15% of that grade.

The other 5% of your participation grade will be based on answering clicker questions during lecture and 5% for attending one Observatory Lab. The Observatory Lab will be conducted at the MacAdam Observatory on top of the parking garage across the street from the Chem-Phys Building.

Exams
We will have two exams during the term. These exams will cover aspects of factual material about the solar system, test understanding of fundamental physical concepts and present critical thinking problems which will be draw on the scientific skills developed over the extent of the course.

Final Project Report
Instead of a final exam for the course, each group will be required to submit a scholarly paper on their project. The paper will include an introduction with background information on the project and a sound scientific conjecture on what you expected to find and why you are doing this project. It will also include a section on the data collected and analyzed, including all assumptions that went into the processing of the data. There will be a result section that discusses the final results and uncertainty in those results. Finally, a conclusion that ties back into your original conjecture of what you expected to find, discussion of what other research has found, further conjectures on what this information tells you about global aspects of the given object and a discussion of how your project could be improved and/or modified.
Because your final paper will be a group project, contributions from the various group members will be explicitly discussed on the final page of the report. Furthermore, group member participation will be judged from the contributions that each member gives on the BlackBoard discussion page. If one group member is found to not be contributing to the final project, that group member will lose individual points on the Final Project.

BlackBoard Discussion:	15%
Weekly Quizzes:	10%
Participation	25%
Exams (15% each)	30%
Final Research Project	20%

The grade scale for this course will be:
90-100 (A)
80-89 (B)
70-79 (C)
60-69 (D)
below this, an F.

A Midterm Evaluation will be provided by the midterm date so students can judge their course performance.

Final Exam.
Your final exam will be your project paper. We will spend the final week of class going

over group projects and critiquing projects. The final written paper will be due at the start of our final exam period. This is on Friday, Dec 17 at 1:00 PM.

If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Course Policies

Attendance -- There is no set policy for student attendance in this course. However, we will be doing some type of interactive lessons or participation questions each and every class period. A non-documented absence for a given class period will result in a zero for that particular activity.

Excused Absences -- An excused absence must be documented. These include illness or travel for a university function. But in all cases, the absence must be documented. If a student knows in advance that they will be missing class on a given day they are expected to notify the instructor or TA in advance of the absence.

Make-up Opportunities/Verification – For a documented absence, students will be given the opportunity to make up the missed material. The instructor or TA must be notified on the day the student returns to class and a makeup will be arranged. No makeup will be given if the student does not contact the instructor or TA upon returning from an absence.

Submission of assignments -- Course discussion questions and final project discussions will be submitted on the Blackboard discussion site. These student contributions must be submitted during the allotted time for the discussion. Any submission after the discussion topic is closed will not receive a grade for the contribution.

Academic integrity, cheating & plagiarism – Cheating or plagiarism will be dealt with on an individual basis. For questionable integrity, a student will be warned about the problem and if the problem continues they will receive a zero for the given activity. Cheating or plagiarizing on an exam, quiz or final project will be dealt with according to the severity of the offense. The student may be given a zero on the particular assignment or for a more outrageous offense the student will receive a failing grade for the course and/ or reported to the university for further action.

Classroom behavior, decorum and civility – Throughout the term it is expected that students will act in a civil and respectful manner toward each other and toward the teaching assistance helping with this course.

Group work & student collaboration – In this course you will be working together in

groups for the interactive lessons and the final project. It is expected that everyone in the group will contribute equally in these activities. For the final project, any group member that is found not to be contributing to the project will receive a substantially reduced grade relative to the other members in the group. Students should make use of the in class activities to try to find other students which are compatible for doing the final project. If there are problems within a given group, the concerned group members should contact their TA and report the problem as soon as possible. This way we can deal with the problem and try to correct it. Reporting a problem with a group member after the final project is completed will be far less likely to warrant any response and may be detrimental to your own grade.

Tentative Course Outline:

Week of class	Topics	Text Readings
Aug 25	**Critical thinking, Scaling of Universe**	**Chapter 1,2**
Aug 30	**The night sky, physical data interpretation critical thinking techniques and science background**	**Chp 3, 18**
Sep 6	**The Earth (basics)**	**Chap 9**
Sep 13	**Comparing the Earth and Moon**	**Chap 9 & 7**
Sep 20	**Surface age of Earth, Moon and meteors**	**Chp 7 & 4**
Sep 27	**Cratering on Moon and Mercury**	**Chap 8**
Oct 4	**Interpreting Mars**	**Chp 11**
Oct 11	**More Mars** **EXAM #1 (October 11)**	**Chp 11 & 12**
Oct 18	**Interpreting Venus**	**Chap 10**
Oct 25	**Moons of Jupiter and Saturn**	**Chp 15**
Nov 1	**Atmospheres, Earth, Venus, Mars, Jupiter**	**Previous Chps & 13**
Nov 8	**Compositions of Gas Giants**	**Chp 13,14**
Nov 15	**Kuiper belt, Oort cloud, comets**	**Chp 14, 6**
Nov 22	**Origin of solar system**	**Chp 17**

Nov 29	**Finish up topics** **EXAM #2 (November 29)**
Dec 6	**In class discussions of final projects**
Dec 17	**Final Project papers to be turned in at 1:00 PM on Friday, Dec 17.**