I. ASCRC General Education Form

<table>
<thead>
<tr>
<th>Group</th>
<th>Group XI Natural Science</th>
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<tbody>
<tr>
<td>Dept/Program</td>
<td>Applied Arts and Sciences</td>
</tr>
<tr>
<td>Course #</td>
<td>SCN175N</td>
</tr>
<tr>
<td>Course Title</td>
<td>Integrated Physical Science</td>
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<tr>
<td>Prerequisite</td>
<td>Appropriate score on math assessment</td>
</tr>
<tr>
<td>Credits</td>
<td>3</td>
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</table>

II. Endorsement/ Approvals

Complete the form and obtain signatures before submitting to Faculty Senate Office

| Instructor | Ashley Preston |
| Phone / Email | 243-7915 |
| Program Chair | Cathy Corr |
| Dean | Barry Good |

III. Description and purpose of the course:

General Education courses must be introductory and foundational. They must emphasize breadth, context, and connectedness; and relate course content to students’ future lives: See Preamble: http://www.umt.edu/facultysenate/gened/GEPreamble_final.html

SCN175N Integrated Physical Science meets a variety of general education requirements. It is available to students in all majors and is three credits. The course is particularly useful for non-science majors and/or education majors whose knowledge of the practice and principles of science may be limited, and who need to acquire a broad, integrated understanding of the basic concepts of the physical sciences. The course introduces the scientific method as a tool for learning about the natural world, and the student is asked to apply the method to the various problems and observations encountered during the course. Science is presented as a creative, iterative practice that adheres to established rules of investigation and to the demands of reason. Fundamental concepts, principles, theories, and laws are introduced (in qualitative and quantitative forms) with an emphasis on the empirical evidence and reasoning processes that led to their establishment. Students learn to think critically about the meaning and significance of fundamental principles, to connect them to real-world situations, and apply them to everyday life. The course provides students with the skills to continue learning and to investigate the merits of scientific claims encountered in daily experience. The course is designed to promote scientific literacy so that graduates can make informed decisions as professionals, consumers and citizens.

IV. Criteria:

Briefly explain how this course meets the criteria for the group. See: http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm
<table>
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<tr>
<th>Course explores a discipline in the natural sciences and demonstrates how the scientific method is used within the discipline to draw scientific conclusions.</th>
<th>SCN175N introduces the fundamental concepts and principles in physics, chemistry and the earth and environmental sciences. Emphasis is placed on understanding the process of scientific inquiry in general, while the problems and methods (of data collection, analysis, interpretation, and validation) peculiar to each discipline are explored, compared and contrasted. The course focuses on several disciplines in the physical sciences on the premise that since lived experience is not discreet, our understanding of how complex physical, chemical, and environmental systems interact is critical to making informed decisions in our personal lives, the marketplace and the voting booth.</th>
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| Course addresses the concept of analytic uncertainty and the rigorous process required to take an idea to a hypothesis and then to a validated scientific theory. | Because the course emphasizes science as an iterative and ongoing process, one that involves creativity as well as empirical rigor, every effort is made to avoid presenting fundamental principles and laws of each discipline as simply given. Instead, the human story behind some of the major findings in each discipline is presented. In this way, the student begins to appreciate that science is an imperfect process that proceeds with little assurance of success or a prescient understanding of the ultimate implications of new findings.  

This method of presentation further allows the student to see how an observation or simple question might be formulated into a testable hypotheses, how an experiment or series of experiments might be designed to test the hypothesis, how the test results are interpreted (and some of the difficulties in interpreting ambiguous data), and how interpretations, once used to make successful predictions, can lead to the articulation of theories and laws—both of which are provisional and subject to continued testing. |
Lab courses engage students in inquiry-based activities where they formulate a hypothesis, design an experiment to test the hypothesis, and collect, interpret, and present the data to support their conclusions.

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<tr>
<th>V. Student Learning Goals: Briefly explain how this course will meet the applicable learning goals. See: <a href="http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm">http://www.umt.edu/facultysenate/ASCRCx/Adocuments/GE_Criteria5-1-08.htm</a></th>
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<tr>
<td>Understand the general principles associated with the disciplines studied;</td>
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<td>SCN175 textbooks and associated materials explain and exhibit graphically the major principles in the disciplines studied. Classroom lecture, discussion, and demonstrations allow the instructor to pose questions and/or hypothetical, historical, or current situations which require students to consider how known general principles might be used to solve a problem or test the validity of a point of view or policy.</td>
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<td>Understand the methodology and activities scientists use to gather, validate, and interpret data related to natural processes;</td>
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<td>The chronology of the development of key ideas and theories in the disciplines illustrates how scientific practice proceeds and scientific knowledge is accumulated and negotiated. In many instances, alternative hypotheses are presented so that students understand that the most successful explanation of the phenomena wasn’t necessarily the only one proposed at the outset. Students are then expected to use these rudimentary historical models of scientific process as a basis for the consideration of the current state of scientific understanding and inquiry.</td>
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<td>A key asset in achieving this learning objective is the peer-reviewed journal article summary assignments. These summaries require the student to read scientific articles and identify the hypothesis, explain the design of the experiment or field study (selection of test subjects, variables, control groups, methods of data collection, margins of error, technologies employed, etc.), summarize the data, explain how the data is interpreted and conclusions drawn. Special attention is given to the researchers’ own articulation of levels of uncertainty and margins of errors.</td>
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<td>SCN175N is a non-lab course.</td>
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| Detect patterns, draw conclusions, develop conjectures and hypotheses, and test them by appropriate means and experiments; | The scientific method and the steps that a researcher goes through in the process of enquiry and validation are illustrated time and again in the way that the textbook presents key concepts in a discipline, the way the material is presented in lectures, and in demonstrations. The intent is to show the student that though enquiry can begin in many ways, the standards for validation once a hypothesis is formulated are rigorous and the methods or steps are clearly established by the scientific community to ensure reproducibility.

Students are expected to demonstrate their understanding of the steps and their functions in the scientific method in the journal article summary exercises. The articles themselves illustrate the process of scientific enquiry and theory-making. By asking students to summarize these findings, and then by using their reports as the basis for discussion, students have the opportunity to engage with the research process and theory-making in the scientific community. In many instances, the studies summarized have inconclusive results or results which contradict other studies. These provide real opportunities for students to examine the patterns and facts in each case and develop hypotheses that might be tested and to accept that scientists often express a level of uncertainty with respect either to the data or its interpretation. This often leads students to follow the developments in the field to see if their conjectures were correct. |
Understand how scientific laws and theories are verified by quantitative measurement, scientific observation, and logical/critical reasoning; and, Students are not asked to accept on faith any law or theory. Rather, the processes by which major theories were developed and verified are presented so that students have a chance to evaluate for themselves the interplay between observation/measurement, reason, and critical analysis. Quantitative data that supports a particular model or law is presented in a fashion that allows students to examine it for ambiguity making it clear that conclusions drawn from this data depend in part on human reason and the rules of logic. Student summaries of science journal articles often report new developments in our understanding of fundamental theories or report surprising results that cannot be explained by current theories. These articles serve as the springboard for discussion that deepens understanding of the principles involved and the logical reasoning which might be followed to bring the ‘old’ views into alignment with the ‘new realities’.
Understand the means by which analytic uncertainty is quantified and expressed in the natural sciences.

The method of presentation as well as the summary assignments are designed to help students to learn to recognize how levels of confidence are reported in scientific findings. Students are encouraged to investigate the level of certainty and precision that attends any particular experimental process and interpretation of the data, and to explore the difficulties of drawing conclusions from ambiguous data. To do this, students must learn to distinguish clearly between data or facts and interpretation of the facts; or between the role of observation and measurement and that of reason.

Discussion of current issues, such as fossil fuel supplies, climate change, or human impacts on natural systems inevitably result in examination of current analytic and empirical models of complex systems. Over the course of the semester developments that support or contradict the dominant explanatory models are in the news. Students with particular points of view are eager to try to use the new data to support their view and to argue that the uncertainty of the model they prefer is less. Contrary points of view using the same or other data are proffered by other students or instructors and generally students realize more research must be done to achieve unequivocal results.

VII. Syllabus: Paste syllabus below or attach and send digital copy with form. The syllabus should clearly describe how the above criteria are satisfied. For assistance on syllabus preparation see: [http://teaching.berkeley.edu/bgd/syllabus.html](http://teaching.berkeley.edu/bgd/syllabus.html)

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<tr>
<th>INTEGRATED PHYSICAL SCIENCES SCN175N COURSE SYLLABUS</th>
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<tr>
<td><strong>Course Title:</strong> SCN 175N Integrated Physical Sciences</td>
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<td><strong>Semester Credits:</strong> 3</td>
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<tr>
<td><strong>Professor:</strong> Ashley Preston/Richard Bayless</td>
</tr>
<tr>
<td><strong>Office:</strong> H&amp;B Building, College of Technology</td>
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<tr>
<td><strong>Phone:</strong> 243-7915</td>
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<tr>
<td><strong>Email:</strong> <a href="mailto:ashley.preston@umontana.edu">ashley.preston@umontana.edu</a></td>
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<td><strong>Office Hours:</strong> By Appointment</td>
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**Course Description**
SCN175N Integrated Physical Sciences 3 cr. Offered every term. Prereq. Appropriate score on math assessment. An introduction to the basic principles of physics, chemistry,
Course Overview
The course offers an introduction to the scientific method as a tool for understanding natural phenomena. The course begins with an examination of the scientific method, introducing the student to methods of observation, data collection, experimentation, validation, interpretation, and theory building. Science is presented as an ongoing process, one that aims to construct a seamless web of knowledge about the workings of the world and the universe as a whole. SCN175N takes an integrated approach to the presentation of basic concepts and principles in physics, chemistry, environmental and Earth sciences. Topics include: mechanics; energy and thermodynamics; electricity and magnetism; waves and electromagnetic radiation; basic chemistry, the atom and nucleus; fundamentals of chemical reactions and bonds; states of matter and attributes of materials; and, the cycling of energy and matter through ecosystems, and atmospheric, hydrologic, and geologic cycles. In each instance, connections between scientific disciplines are emphasized so as to present a broad, integrated picture of science and natural phenomena.

Required Text

Student Learning Outcomes
Upon completion of this course, the student will be able to:
1. Understand and critically evaluate the merit of basic scientific claims and/or findings encountered in education, the workplace, the marketplace, or the media.
2. Identify and differentiate between observations, hypotheses, theories, and laws (e.g., to understand the scientific method and its relationship to creativity, logic, and intuition).
3. Gather information, interpret observations, and quantify data on natural phenomena.
4. Recognize patterns in natural processes and structures; develop tests for elementary predictions based on pattern recognition; draw conclusions and construct hypotheses and/or theories.
5. Understand the meaning and significance of the basic principles and concepts of the major scientific disciplines.
6. Make connections between the different sciences to construct an integrated web of knowledge about the natural world.
7. Conduct independent research when faced with a problem or question.
8. Apply scientific methods and principles to real-world situations; assess the social, economic, political, environmental, and ethical impacts of scientific findings or research agendas.

Students with disabilities
Students with disabilities will receive reasonable accommodations in this online course. To request course modifications, please contact me as soon as possible. I will work with you and Disability Services in the accommodation process. For more information, visit the Disability Services website at http://www.umt.edu/dss/ or call 406.243.2243 (Voice/Text).

Assessment Methods and Grading Scale
1) The peer-reviewed journal article summaries are expected to demonstrate an increasing ability to read, interpret, and critically evaluate current scientific research (see below).
2) Five Unit Tests.
3) Discussion Board submissions and responses of summaries (see below); participation; and attendance (NA for online course).
4) A comprehensive Final Exam.

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<tr>
<th>Component</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>Five Unit Tests</td>
<td>50%</td>
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<tr>
<td>Participation/homework</td>
<td>20%</td>
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<tr>
<td>Summaries (5)</td>
<td>15%</td>
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<tr>
<td>Cumulative Final Exam</td>
<td>15%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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**Grading Scale**
A= 100-90%
B= 89-80%
C= 79-70%
D= 69-60%
F= 59% and below

**Attendance policy**
**Attendance is required.** Class participation is expected and will impact grades. All readings and work should be completed prior to attending class. The online section does not meet face to face, thus attendance and participation are measured by the level of participation (frequency and quality of contributions) in the Discussion Board, timely submission of ALL work, and adherence to testing schedule. The online section is not a correspondence course that you can do at your leisure and on your own schedule.

**Instructions for Summaries and Oral Presentations:**

There are five objectives for these portfolios and presentations.
1. To give the student an opportunity to follow/develop a personal interest in science.
2. To familiarize the student with the language and methods of science through reading peer reviewed journals.
3. To develop the ability to summarize major scientific findings and communicate these insights to others.
4. Enable others to share and benefit from the work and interests of each individual class member.
5. To demonstrate that principles learned in the book apply to real life discoveries, inventions, and research projects.

Many publications in the COT/UM library may be used for these reviews. The minimum requirement is that the publication be peer reviewed. Examples of publications that may be used to complete this assignment include: Science News, The Journal of the American Medical Association (JAMA), Scientific American, Lancet, PLoS (online, link can be found on Blackboard), Nature, Science, etc. (Note: Science News is also available online at www.sciencenews.org as are many of the other journals listed. For a complete listing, access the UM Mansfield Library or see the Librarian.).

Five times over the course of the semester, students are expected to scan a peer reviewed scientific journal of interest. Read and take notes on at least one article. Write a brief, typewritten, double-spaced summary of the article. Be sure to provide a citation for the article, as well as to attach a copy of the source article to the summary (sample citations and summaries can be found in the Assignments folder of the Course Supplement). Two times during the semester students will verbally share the results of their research with the class as a whole. These presentations will form the basis of discussion. Students are also expected to read classmates’ summaries and respond on the Discussion Board.
Academic Misconduct Policy
In an effort to ensure that students are informed about the consequences of academic misconduct, the Academic Officers of The University of Montana have determined that the following statement must be present on every course syllabus. You will be held to these standards in this course.

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.

All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/SA/VPSA/index.cfm?page=1321.

Drop/Add Policy
http://www.umt.edu/catalog/policy_procedure.htm

Email policy at UM
According to the new University email policy effective on 1 July 2007, an “employee must use only UMM assigned student email accounts for all email exchanges with students, since such communication typically involves private student information.” This means that you must send any correspondence through your GrizMail account. For more information on setting up and using your GrizMail account, please go to http://www.umt.edu/it/email/studentemail.htm.

Topical Outline

Physics
- Introduction to science and the scientific method;
- motion, Newton, energy and momentum, gravity,
- heat, EM, waves, the atom, the nucleus

Chemistry
- materials, bonds, reactions, organic chemistry

Enviro Science
- ecosystem processes and ecology, evolution

Earth Science
- plate tectonics, earth systems

Unit Learning Objectives

Physics
Unit I: Chapters 1-5
Topics: Introduction to science and the scientific method; motion, Newton, energy and momentum, gravity
Handouts/Worksheets: Review: Scientific Notation Review and Dimensional Analysis.
Demonstrations/Activities: Pendulum Demo and Energy Transformation
Learning Objectives:
1) Identify ways science and scientific findings impact daily life.
2) Describe how the social context and level of technology affect the progress of science.
3) Describe the scientific method, explain the relationship between components; understand the processes of knowledge-making in science.
4) Compare and contrast science and pseudoscience.
5) Understand the power and limits of the scientific method and the areas of inquiry to which it can be successfully applied.
6) Define and differentiate between speed, velocity, and acceleration.
7) Understand the basic principles of motion.
8) Describe, apply, and interpret the significance of Newton’s Laws of Motion.
9) State and understand the meaning of the law of universal gravitation, and the force of gravity.
10) Define and give examples of inertia, momentum, and angular momentum.
11) Compare and contrast force, work, energy, and power.
12) State and understand the meaning of the first law of thermodynamics.
13) Understand energy and energy flows and conversions.

Unit II: Chapter 6-8
Topics: heat, electricity and magnetism, waves
Handouts/Worksheets: None
Demonstrations/Activities: Magnets/Electromagnets; Electric Motors; Slinky Waves; Reflection.
Learning Objectives:
1) Distinguish between heat and temperature.
2) Demonstrate an understanding of specific heat capacity and its relationship to heat transfer and/or insulation.
3) Define and calculate efficiency in terms of energy transfers.
4) Define entropy; state and understand the significance of the second law of thermodynamics; compare and contrast it with the first law.
5) Identify the connection between energy, heat, order, and time.
6) Define and understand the principles of electricity.
7) Differentiate between static electricity and an electrical current.
8) Identify and explain the basic components and workings of an electric circuit in terms of power source, pathway, and load.
9) Understand the meaning of amps, volts, ohms, and watts.
10) Define and understand magnetism and explain the basic principles of magnetic force.
11) Discuss the relationship between electricity and magnetism.
12) Identify Maxwell’s four formulations and explain their significance for our use and understanding of the electromagnetic force.
13) Identify the parts of a basic electromagnet, electric motor, and dynamo. Explain how each technology applies the principles of electromagnetism.
14) Define and discuss the properties of waves, the different types, and how they relate to energy and material transfer.
15) Explain and give examples of the Doppler effect (light and sound).
16) Define and give examples of reflection, absorption, and scattering.
17) Describe EM radiation and give examples of the electromagnetic spectrum.
18) Identify and explain the basic EM principles applied in technologies such as MRIs, X-rays, sonar/radar, microwaves, and radios.

Unit III: Chapters 9-10
Topics: the atom, the nucleus
Handouts: None
Demonstrations/Activities: Minerals; Spectrometer
Learning Objectives:
1) Define the atom, explain its structure and the relationship of its parts; discuss the merits of different models.
2) Discuss the development of atomic theory and the evidence to support it.
3) Identify the organizational rationale behind the periodic table of elements.
4) Differentiate between elements, atoms, molecules.
5) Identify matter using a spectrometer and understand the basic principles of spectroscopy.
6) State the basic thesis of Quantum theory, discuss the evidence to support this thesis (double-slit experiment), and discuss the implications for human knowledge.
7) Identify the terms and assess the implications of Einstein’s equation: E=mc².
8) Discuss the organization of the atomic nucleus; differentiate between protons and neutrons.
9) Discuss and define isotopes and ions.
10) Define radioactive decay and indicate the difference between alpha, beta, and gamma decay.
11) Define and discuss the concept of half-life.
12) Define and differentiate between nuclear fission and fusion.
13) Describe the basic workings of a nuclear power plant.
14) Evaluate benefits and risks of nuclear power as an energy source; compare with other energy sources.

**Chemistry**
**Unit IV: Chapters 11-14**
**Topics:** materials, bonds, reactions, organic chemistry (intro)
**Handouts:** Graph of Human Concerns
**Demonstrations/Activities:**
**Learning Objectives:**
1) Explain how an element’s chemical activities are related to its structure and properties.
2) Describe ionic, metallic, covalent bonds, and van der Waals forces.
3) Identify at least 4 states of matter.
4) Discuss the relationship between chemical reactions and energy transfers.
5) Identify the different hydrocarbons in terms of their chemistry and energy signatures.
6) List the features that determine the properties of a material.
7) Define the three different kinds of strength associated with a material.
8) Discuss the characteristics that determine whether a material is a conductor, insulator, semiconductor, or superconductor.
9) Discuss the concepts of “conduction electrons” and “holes” relative to semiconductors.
10) Describe how semiconductors work.
11) Explain “doping” and its relationship to conductivity.
12) Describe how diodes and transistors can be used to control the flow of electrons (energy) in a circuit.

**Environmental Science**
**Unit V: Chapters 17, 21**
**Topics:** ecosystems and environment; [evolution]
**Handouts:** The Reason for the Seasons; Human Population Activity
**Learning Objectives:**
1) Understand the ecosystem concept; identify types of ecosystems.
2) Identify ecosystems in terms of key components, energy flows, and material cycling.
3) Explain the food web in terms of energy and material flows (trophic levels).
4) Understand the basic principles of species interaction and the concept of a niche.
5) Discuss the environmental and social implications of human population growth and consumption patterns.
6) Describe how human activities can change global energy or mass balances.
7) State the “Law of Unintended Consequences,” explain its meaning and significance for human enterprise, find examples.
8) List the fundamental characteristics shared by all living things.
9) Identify and differentiate between different strategies that life forms use to appropriate matter and energy.
10) State the basic thesis of theory of evolution and identify the evidence for the theory

**Earth Science**

**Unit VI**: Chapters 22, 24, 25

**Topics**: Plate tectonics, earth systems, earth’s surface

**Learning Objectives**:
1) Diagram Earth/Sun relationships on about 21 March, 21 June, 21 September and 21 December.
2) Identify factors that influence Earth’s climate at biological and geological time frames.
3) Describe ways that climate influences human systems; identify evidence for and assess implications of global climate change.
4) Explain continental drift and relate it to plate tectonic theory.
5) Identify at least 3 discoveries that led to the development of plate tectonic theory.
6) Identify the forces that are responsible for mountains, earthquakes, volcanoes and geothermal vents.
7) Describe the hydrologic, rock, and atmospheric cycles and explain their interdependence.

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<th>WEEK</th>
<th>Introductory Module</th>
<th>Physics Module</th>
<th>Chemistry Module</th>
<th>Environmental Science Module</th>
<th>Earth Science Module</th>
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<td>Final Exam</td>
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*Please note: As an instructor of a general education course, you will be expected to provide sample assessment items and corresponding responses to the Assessment Advisory Committee.*