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SCN 195T.01: Introduction to Physical Science

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**THE UNIVERSITY OF MONTANA
COLLEGE OF TECHNOLOGY
COURSE SYLLABUS
APPLIED ARTS AND SCIENCES DEPARTMENT**

SCN 195T Introduction to Physical Science

SEMESTER CREDITS: 4

Professor: Richard Bayless

Office: H&B Building, East Campus, College of Technology

Phone: 243-7824

Email:

Office Hours: 1200 to 1300 MW

Prerequisites or Co-requisites: MAT 005 (Math 100 Suggested)

RELATIONSHIP TO PROGRAMS:

This course provides a broad basic introduction to the current scientific worldview that is the foundation for the lifestyles (including modern evidence-based Medicine) in the developed world. Some programs at the COT require this course. If you have questions about course or **Minimum Grade Requirements check with your advisor.**

COURSE DESCRIPTION: This course is an introduction to Science as a way of knowing and specific areas of science as they relate to living systems, Earth systems, and the wider universe. Topics emphasized include: mechanics, energy and thermodynamics, electricity and magnetism, waves and electromagnetic radiation, the atom, quantum mechanics, basic chemistry, the nucleus, and basic biology.

STUDENT LEARNING OUTCOMES:

Upon completion of this course, the student will:

1. Possess a knowledge base consistent with current scientific worldview in the Physical Sciences.
2. Organize and interpret quantitative data related to natural processes. Students will also be able to identify patterns and formulate and test elementary predictions based on the interpretation of quantitative data.
3. Use creative and critical methods of scientific questioning to evaluate claims encountered in future education or work environments.

(Assessed by testing, student portfolios, and surveys in succeeding courses)

Students With Disabilities will receive appropriate accommodation. Please see me after class or in my office. Please bring a letter from your DSS Coordinator.

STUDENT PERFORMANCE ASSESSMENT METHODS AND GRADING PROCEDURES:

- 1) A student portfolio will be expected to demonstrate increasing ability to read and interpret current research and keep abreast of future developments in science. The Portfolio will provide 10% of the final grade.
- 2) Six Unit Tests will provide 60% of the final grade.
- 3) Verbal Science News Reviews will provide 10% of the final grade.
- 4) A comprehensive Final Exam will account for 20% of the final grade.

GRADING SCALE:

A= 100-90%
B= 89-80%
C= 79-70%
D= 69-60%
F= 59% AND BELOW

SOURCE OF COURSE GRADE:

Six Unit Tests:	60% Test questions will come from text, class, and handouts
Science News:	10%
Portfolio	10%
Final Exam:	20% Final exam is comprehensive
	100%

Instructions for Science News Reviews:

There are four goals in mind for these reviews. First, they are intended to give students an opportunity to follow/develop their personal interest in science while gaining credit. Second, the exercise is intended to develop some familiarity with professional science and *peer reviewed* professional journals. Third, students will have the opportunity to develop experience communicating with classmates and the instructor. Finally, this will allow all members of the class to benefit from the work and interest of other members of the class. Two publications in the COT library may be used for these reviews, Science News and The Journal of the American Medical Association, JAMA. Students are expected to scan Science News weekly and read and take notes on at least one Science News article. *Peer reviewed* journals may also be used as sources for weekly articles. A brief typewritten double spaced summary of articles will be turned in as indicated on the schedule and saved in the student Portfolio. (Note: Science News is also available online at www.sciencenews.org). Several times during the semester students will verbally share the results of their research with the class as a whole, or in small groups as indicated by the instructor.

REQUIRED TEXT: Trefil and Hazen. 2004. The Sciences: An Integrated Approach, fourth edition. John Wiley and Sons, Inc. ISBN 0-471-21963-0

COURSE OUTLINE and ASSIGNMENTS:

Unit I Text: Introduction, Chapter 1-3

Handouts: Galileo in Historical Context; Scientific Notation Review; Dimensional Analysis; The Metric System.

Demonstrations/ Activities: Pendulum and Energy Transformation

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Describe the social milieu confronting early scientists.
- 2) Express numbers in scientific notation and carry out multiplication and division of numbers in scientific notation.
- 3) Demonstrate knowledge of the metric system and be able to convert from metric to american units.
- 4) Explain the peer review process.
- 5) Identify publications as peer reviewed or popular press.
- 6) Identify several ways science impacts them personally.
- 7) Identify the components of the scientific method and the relationships between components.
- 8) Compare and contrast Science and Pseudoscience.
- 9) Begin to place scientific discoveries in historical context.
- 10) Describe scientific contributions and begin to place in historical context, individuals such as: Tycho Brahe, Kepler, Galileo Galilei, Newton, Franklin, Hutton, Watt, Galvani, Darwin, Maxwell, Bohr, Curie, Wegener.
- 11) Describe Newtons Laws of Motion.
- 12) Describe and give examples of inverse square laws.
- 13) Define and give examples of inertia, momentum, and angular momentum.
- 14) Compare and contrast work, energy, and power.
- 15) Describe the laws of thermodynamics.

Unit II Text: Chapter 4-6

Handouts: None

Demonstrations/ Activities: Rocks and Minerals; Magnets; Electric Motors; Slinky Waves.

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Distinguish between a rock and a mineral.
- 2) Identify magnetite.

- 3) Identify the parts of a basic electric motor.
- 4) Identify wavelength, reflection, positive and negative interference.

- 5) Define and isolated system and give examples.
- 6) Define entropy and give examples.

- 7) Discuss the relationships between magnetism and electricity.
- 8) Define and describe the following: electrons; current; electric fields, magnetic fields, batteries, series circuits, parallel circuits, electromagnets.

- 9) Describe electromagnetic radiation.
- 10) Describe the electromagnetic spectrum and all of its components.

Unit III Text: Chapters 8-10

Handouts: Heat, Temperature, and Phase;

Demonstrations/ Activities: Spectrometer and Matter Identification; Minerals and Crystals.

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Identify matter using a spectrometer.
- 2) Describe how the internal arrangement of atoms determines the shape of a crystal.

- 3) Discuss the development of atomic theory.
- 4) Describe and draw a “Bohr Model” of the first five elements.

- 5) Name the first fifteen elements in order.
- 6) Define Quanta.

- 7) Describe the Heisenberg Uncertainty Principle.
- 8) Describe the “Wave-Particle Duality”.

- 9) Describe ionic, metallic, covalent bonds and Vander Waals Forces.
- 10) Describe at least 4 states of matter.

- 11) Sketch and label the parts of a two-dimensional graph relating temperature, heat and phase.

Unit IV Text: Chapters 11-12

Handouts: More Quantifiable Properties of Matter,

Demonstrations/ Activities: Hubble Deep Field

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Describe and/or give examples of the following: Density; Pascals (Hydraulic) Principle; Archimedes’ Principle; barometric pressure; Bernoulli Effect.
- 2) Describe the Ideal Gas Law and discuss the effect of changing variables.
- 3) Describe the Hubble Deep Field and how it has changed our perception of the universe.
- 4) Define and give examples of compression, tension and shear forces.
- 5) Describe and give examples of conductors, insulators, semiconductors, and superconductors.

- 6) Define the term Isotope and give examples.
- 7) Discuss the relationship between atomic number, atomic mass and isotopes.
- 8) Describe Alpha, Beta and Gamma Radiation including their source.
- 9) Describe x-ray radiation and its source.
- 10) Describe the basic components of a nuclear electric power plant.

- 11) Describe methods of dealing with nuclear waste.

Unit V Text: Chapters 17 (through page 423)-20 plus Sunrise Video

Handouts: The Reason for the Seasons

Demonstrations/ Activities: Sunrise Video; Globe/Seasons; “After the Warming Part I”(?) Video.

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Diagram Earth/ Sun relationships on about 21 March, 21 June, 21 September and 21 December.
- 2) Describe why we have seasons.
- 3) Describe several factors that influence Earth’s climate.
- 4) Describe several ways climate influences people.
- 5) Describe Continental Drift as proposed by Alfred Wegener in 1912.

- 6) Identify at least 3 discoveries that lead to the development of Plate Tectonic Theory.
- 7) Describe current Plate Tectonic Theory.
- 8) Use the development of Continental Drift into Plate Tectonics as a model for the way science works.
- 9) Describe the hydrologic cycle.
- 10) Define the Coriolis Effect.

- 11) Describe and sketch the Global Atmospheric Circulation Model.
- 12) Describe the Rock Cycle.
- 13) Describe the “Law of Unintended Consequences”.
- 14) Define Ecology and Ecosystem.
- 15) Sketch the human population growth curve from the year zero to present.

- 16) Describe 3 options for human population growth.
- 17) Discuss the implications of human population growth.
- 18) Describe 3 human activities that are changing global energy or mass balances.
- 19) Define exotic species and give at least 3 examples.
- 20) Describe Linnaean Classification.

- 21) Describe how Penicillin was discovered and how it works.
- 22) List the fundamental characteristics that all living organisms have in common.
- 23) Describe the form and some survival strategies of the following: fungi; simple plants; vascular plants; invertebrates; vertebrates.

Unit VI Text: Chapter 22 pgs. 541-547 and 561-562, Chapters 24 and 25

Handouts: Origin of Life: “A Rocky Start”

Demonstrations/ Activities: “The Evolutionary Arms Race” Video

Specific Learning Objectives

Upon completion of this unit students will be able to:

- 1) Describe the physical and chemical environment near “Black Smokers” on the sea floor and how those environments may have provided the conditions necessary for the development of life.
- 2) Describe how predators and prey might evolve simultaneously to accentuate characteristics in each other.
- 3) List 3 major components of cell theory.
- 4) Describe cell membranes and their function.
- 5) Describe in general terms how primitive cells and more-specialized cells differ in the way they extract energy from molecules.

- 6) Define genetic engineering and discuss at least 3 examples of widely used products.
- 7) Describe the process of genetic fingerprinting.
- 8) Describe cloning.
- 9) Describe stem cells and their potential uses.
- 10) Describe gene therapy.

- 11) Discuss ethical issues related to genetic engineering and related technology.
- 12) Describe some fundamental differences between cancer cells and normal cells.
- 13) Describe at least 2 ways DNA can be damaged and the frequency of DNA damage and the basics of natural DNA repair in cells.
- 14) Define and describe HIV and AIDS.
- 15) Explain how computer assisted drug design differs from previous methods of developing new drug treatments.

- 16) Explain how antibiotic resistance evolves.
- 17) Describe how evolution can be considered both a fact and a theory.
- 18) Describe at least 3 lines of evidence used to support evolution.
- 19) Compare and contrast artificial selection and natural selection.
- 20) Define mass extinction and discuss at least one example.

ATTENDANCE POLICY:

All students are expected to come to every class and come on time. Students should be prepared by having completed all assigned work on the Tentative Schedule below and any work assigned in class. Class participation is expected and will impact grades.

Tentative Schedule Fall 04*
SCN 195T: 13:10 to 15:00 MW

DATE	ASSIGNMENT	Other
30 Aug. 01 Sept.	Introduction, Chapter 1 Chapter 2	Galileo Handout Scientific Notation Review Dimensional Analysis Handout
06 Sept. 08 Sept.	NO SCHOOL Chapter 3	
13 Sept 15 Sept.	Science News; Finish Chapters; Review for Test I Test I (over Ch.1, 2, 3 and Handouts) Chapter 4	Pendulum Demo Heat and Temperature Handout
20 Sept. 22 Sept.	Chapter 4 and 5 Chapter 6	Mineral/Electric/Magnetic Demo's Slinky, Reflection Demo's
27 Sept. 29 Sept.	Science News, Finish Chapters, Review for Test II Test II and Chapter 8	Spectrometer Demo
04 Oct. 06 Oct	Chapter 8 and Chapter 9 Chapter 10 and Review for Test III	Minerals/ Crystal Demo
11 Oct. 13 Oct.	Test III and Science News Chapter 11	Our Material World Handout
18 Oct. 20 Oct.	Chapter 12 Material World Discussion	Hubble Deep Field Discussion
25 Oct. 27 Oct.	Science News, Finish Chapters, Review for Test IV Test IV and Chapter 17 through pg. 423.	
01 Nov. 03 Nov.	Science News and finish Chapter 17 through pg. 423 Chapter 18 and 19	After The Warming Part I Video????
08 Nov. 10 Nov.	Chapter 19 and Science News Chapter 20	After The Warming Part II Video???? Sunrise Video
15 Nov. 17 Nov.	Test V and Science News Chapter 22, Pg. 541-547 and 561-562	
22 Nov. 24 Nov.	Science News, Chapter 24 NO SCHOOL	Black Smokers Handout
29 Nov. 01 Dec.	Chapter 25 Science News, Finish Chapters, Review for Test VI	Evolutionary Arms Race Video
06 Dec 08 Dec	Test VI Science News, Review for Final	
16 Dec	Final Exam Thursday 13:10-15:10	

* All scheduled events are subject to change with as much notice as possible.