Washtenaw Community College Comprehensive Report

SCI 101 The Nature of Science
Effective Term: Spring/Summer 2018

Course Cover

Division: Math, Science and Engineering Tech
Department: Physical Sciences
Discipline: Sciences
Course Number: 101
Org Number: 12340
Full Course Title: The Nature of Science
Transcript Title: The Nature of Science
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Course description
Outcomes/Assessment
Objectives/Evaluation
Rationale: Three-year review based on assessment.
Proposed Start Semester: Spring/Summer 2018
Course Description: In this course, students will learn the importance of the natural and physical sciences to everyday life. The emphasis is on science as a way to evaluate the validity of scientific information in the media and on the Internet. The goal is for students to apply the basic laws, concepts, and themes that underlie our natural world in order to place important public issues such as the environment, energy and medical advances in a scientific risk assessment and risk management context.

Course Credit Hours

Variable hours: No
Credits: 3
Lecture Hours: Instructor: 45 **Student:** 45
Lab: Instructor: 0 **Student:** 0
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 45 **Student:** 45
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

No Level Required

Requisites

General Education

General Education Area 4 - Natural Science
Assoc in Applied Sci - Area 4

Request Course Transfer

Proposed For:

Central Michigan University
Eastern Michigan University
Jackson Community College
Michigan State University
University of Michigan
Western Michigan University

Student Learning Outcomes

1. Recognize the steps involved in the scientific method.
   Assessment 1
   Assessment Tool: Common Test Questions
   Assessment Date: Winter 2019
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: The common test questions will be scored against an answer key.
   Standard of success to be used for this assessment: 70% of students will score 70% or higher on the common test questions.
   Who will score and analyze the data: Common test questions will be graded by each instructor and the data will be analyzed by the full-time faculty.

2. Recognize the general concepts of physics, chemistry, biology, astronomy and earth science.
   Assessment 1
   Assessment Tool: Common Test Questions
   Assessment Date: Winter 2019
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: The common test questions will be scored against an answer key.
   Standard of success to be used for this assessment: 70% of students will score 70% or higher on the common test questions.
   Who will score and analyze the data: The common test questions will be scored by each instructor and the data will be analyzed by the full-time faculty.

3. Differentiate and apply the concepts of toxicology, risk assessment and risk management in relation to scientific issues.
   Assessment 1
   Assessment Tool: Common Test Questions
   Assessment Date: Winter 2019
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: The common test questions will be scored against an answer key.
   Standard of success to be used for this assessment: 70% of students will score 70% or higher on the common test questions.
   Who will score and analyze the data: The common test questions will be scored by each instructor and the data will be analyzed by the full-time faculty.

Course Objectives

1. **Science Skills and Processes and the Scientific Method; History and Development of Science**
   Distinguish observations from inferences. Given a set of samples, create a dichotymous key based on

similarities and differences in observable characteristics. Identify different science processes. Describe the function and importance of standards in measurement. Define calibration curve and detection limits. Define science as a "way of knowing." Compare inductive and deductive reasoning. Distinguish between basic and applied science. Describe the function and importance of controls in scientific experiments. Given an example, recognize applications of the steps of the scientific method: hypothesis; experimental design; data; results; conclusion; controls; peer review. Based on the reasoning employed, evaluate the probability and/or validity of a conclusion. List the factors that contribute to "junk science." Distinguish "good" from "junk" science.

2. Identify contributions of Pythagoras, Aristotle, Aristarchus, Ptolemy, Arabs, Aquinas, Copernicus, Brahe, Kepler, Galileo and Newton to the development of science and a "world view." Differentiate the Aristotelian world view from the modern.
3. **General Principles from Physics: Laws of Motion; Energy & Thermodynamics; Electricity & Magnetism; Electromagnetic Radiation** Describe the concept of force. Given a situation, identify the laws of motion that are acting. Explain how the Laws of Motion give predictability to the universe. Interpret mathematical expressions of the Laws of Motion and Gravity to identify dependent and independent variables and predict the effect of changes. Define the concepts of work, power, energy and heat. Classify types of energy. Describe 3 types of heat transfer processes. Contrast temperature and heat including how each is measured. Describe how a temperature scale is developed. Apply the First and Second Laws of Thermodynamics to analysis of given systems. Describe the concept of charge and state Coulomb's Law. Compare and contrast electric and magnetic force and the properties associated with them such as induction.
4. **Electricity and Magnetism** Describe the interrelatedness of electricity and magnetism and their application to electric motors and generators. Identify characteristics of longitudinal and transverse waves. Describe the characteristics and origin of the electromagnetic spectrum. Classify types of interactions of electromagnetic waves with matter.
5. **General Principles from Chemistry: Atomic Structure; Periodic Table; Chemical Bonding; Structure and Properties; Types of Reactions, Acids, Bases and pH; Safe Handling, Use and Disposal of Materials** Identify the atom as the fundamental unit of matter. Describe the current model of the atom. Classify chemical substances as elements, compounds and mixtures. Classify elements as metals, non-metals and semimetals and describe the properties associated with each. Observe the periodic table, locate types of elements and recognize the periodicity of properties. Contrast ionic and covalent bonding and the properties that result from each. Observe models of ionic compounds and metals and make inferences about properties. Build models of covalent molecules following chemical bonding rules and determine molecular shares and infer polarity. Describe the structure, unusual properties of water and their effects in the natural world.
6. **Chemical Reactions, Acids and Bases, Chemical Safety, and Nuclear Chemistry** Observe different types of chemical reactions. Compare the properties of acids and bases. Describe the concept of pH and given appropriate materials determine the pH of a sample. Classify common hazards as corrosive, flammable and poison and rank order of associated risks. Describe routes of exposure and cautions to be taken including; protective equipment; special behavior; spill management and what to do in case of accidental exposure. Read product labels to determine the safe handling, use and disposal of materials. Recognize that nuclear energy depends on the conversion of mass into energy. Describe the nature of radioactivity and the 3 types of radiation. Compare the processes of radioactive decay, nuclear fission and nuclear fusion. Describe the concept and applications of half-life. Recognize the different effects of exposure to ionizing and non-ionizing radiation.
7. **Application of Science Principles and Processes to Astronomy: Origin of the Universe and Life Cycle of Stars; Structure, Motions and Phenomena of the Solar System** Describe the current theory of the origin of the universe, called the Big Bang. Account for the seasons using the concepts of planetary motion and the tilt of the earth's axis. Observe characteristics of the planets in the solar system. Compare astronomy, astrology and cosmology. Describe the general life cycle of stars including forces and factors involved. Recognize that all stars have a common birth. Describe the various fates of stars: red giant, white dwarf, neutron star, supernova and black hole. Recognize that the sun and other stars use nuclear fusion to convert mass into energy and that when a star's nuclear fuel is depleted, it must burn out. Describe a supernova and the events leading to the formation of chemical elements.
8. **Application of Science Principles and Processes to Earth Science: Plate Tectonics Model and**

Cycles in Nature Compare the old and new views of the Earth and the evidence to support each. Account for the Earth's features including mountain formation, volcanoes and earthquakes using the theory of plate tectonics. Recognize the ongoing cycles of formation and destruction of the surface of the Earth. Differentiate earth processes that are cyclic and non-cyclic. Recognize the importance of the Earth's cycles: rock, water, carbon, carbon dioxide/oxygen, nitrogen. Apply the concepts of observation and classification to the identification of selected rock samples.

9. **Application of Science Principles and Processes to Life Sciences: Biological Molecules and Polymers; Classification of Living Things, Basic Biological Principles; Bioenergetics** Recognize that living systems follow the same laws of nature as non-living systems. Compare the characteristics of living things with non-living things. List the similarities possessed by all living things. Describe the basic life functions and biological work. Trace the flow of energy from the sun through the biological niches: producers, consumers and decomposers. Describe the organization of living things from cells through organisms and give examples of each level. Recognize the current classification of living things into 6 kingdoms and the classification of humans. Describe structure and function of cells and cellular organelles: cell membrane, ribosome, endoplasmic reticular network, nucleus, mitochondrion, Golgi apparatus and vacuoles.
10. **Biological Molecules and Their Functions** Identify the work done by systems of the human body. Give examples of causes and effects of diseases that result from genetics, life style choices and components of the environment. Recognize that living organisms are composed of the same elements found in nonliving materials. Make models and describe structural features of biological molecules: carbohydrates, lipids (fats); and proteins. Give examples of biological molecules and describe their functions and the relationship of structure to function. Give health implications of dietary constituents including saturated and unsaturated fat, cholesterol and sugars. Compare function and impact of low density lipoprotein ("bad cholesterol") with high density lipoprotein ("good cholesterol"). Apply principles of good nutrition to the analysis of a food label. Recognize the complexity of proteins and cell membranes. Demonstrate the importance of structure and shape to the function of biological molecules, particularly proteins and enzymes.
11. **Basic Concepts of Genetics** Review the work of Mendel in formulating the principles of classical genetics. Apply the terminology and concepts of classical genetics: homozygous, heterozygous, genotype, phenotype, dominant and recessive. Construct Punnett squares and predict the results of given genetic crosses. Describe the modern model of transmission and expression of traits including the structure and function of DNA and its role in providing the genetic code and directing proteins synthesis. List examples of current advances in molecular biology. Discuss ethical issues arising from current advances in molecular biology. Define evolution as a process of change that has occurred over and give examples of changes that have occurred. Differentiate between chemical and biological evolution. Recognize that the conditions and materials on the primitive earth might have given rise to biological molecules. Recognize the Miller-Urey experience provided evidence for chemical evolution.
12. **Basic Concepts of Biological Evolution** Recognize that there are gaps in our own understanding of the particulars of the origins of life. Recognize the contribution of Darwin to the concept of biological evolution. Describe the factors at work in biological evolution: variation in populations and natural selection. Give examples of "survival of the fittest" through natural selection. List evidence for biological evolution: one chemical vocabulary, one cellular vocabulary, comparative embryology, vestigial structures, fossil records and extinctions, results of DNA sequencing, protein similarities, DNA mutations.
13. **Toxicology, Risk Assessment, and Risk Management** Differentiate among toxicology, risk assessment and risk management. Given a situation, list risks and benefits, evaluate probability, severity and scope of risk and determine a desirability quotient for the activity. Recognize both the value and limitation of evidence from laboratory studies and epidemiology. Given a situation, develop a risk assessment using the model: source, transport and fate, exposure, dose and effect. Define the term LD-50 as used in toxicology and infer the desirability of high and low numbers. Given a situation, recognize or devise possible control methodologies to intervene between the source and the receptor by modifying the material or process to prevent, contain or mitigate.
14. Given a situation, devise possible strategies to manage the risk using Miller's Strategies: moral persuasion, tort law, ban, prohibition, licenses and permits, payments and incentives, selling pollution rights, pollution charges. Evaluate the effects of the proposed strategies and choose one or two to

implement.

New Resources for Course

Course Textbooks/Resources

Textbooks

Hazen, R. M. and Trefil, J. . *Science Matters, Achieving Scientific Literacy* , 2nd ed. New York: Anchor Books, 2009

Manuals

Periodicals

Software

Equipment/Facilities

Level III classroom

Reviewer	Action	Date
Faculty Preparer:		
Kathleen Butcher	*Faculty Preparer*	*Oct 20, 2016*
Department Chair/Area Director:		
Kathleen Butcher	*Recommend Approval*	*Oct 20, 2016*
Dean:		
Kristin Good	*Recommend Approval*	*Oct 25, 2016*
Curriculum Committee Chair:		
David Wooten	*Recommend Approval*	*Jan 27, 2018*
Assessment Committee Chair:		
Michelle Garey	*Recommend Approval*	*Jan 29, 2018*
Vice President for Instruction:		
Kimberly Hurns	*Approve*	*Jan 30, 2018*