

SYLLABUS REQUIREMENTS: ELEMENT 4

Instructions: All syllabi for GE courses must include the following two sections:

1. General Education Goals
2. Student Learning Outcomes

General Education Goals: The required GE goals for Element 4 courses are listed below. Instructors may copy/paste these goals directly into syllabi.

Student Learning Outcomes: The *approved, core set* of student learning outcomes is listed below for each course in this GE Element. Instructors may copy/paste these SLOs directly into syllabi. These are the *core set* of SLOs that must appear on every syllabus, for every section of a GE course. Instructors may add to this core set other SLOs that are specific to their sections.

ELEMENT 4: NATURAL SCIENCES

GENERAL EDUCATION GOALS FOR ELEMENT 4 COURSES *(revised GE 2.13.14)*

Students will be able to:

1. Use appropriate methods of critical thinking and quantitative reasoning to examine issues and to identify solutions. (GE Goal two)
2. Analyze the fundamental natural processes of the world and the interactions of humans and their environment. (GE Goal five)
3. Distinguish the methods that underlie the search for knowledge in the arts, humanities, natural sciences, history, and social and behavioral sciences. (GE Goal seven)
4. Integrate knowledge that will deepen their understanding of, and will inform their own choices about, issues of personal and public importance. (GE Goal eight)

COURSE SPECIFIC STUDENT LEARNING OUTCOMES (revised for fall 2010)

All Writing Intensive Courses:

For all writing intensive courses this student learning outcome should be added to the core set of outcomes:

1. Demonstrate a writing process that produces effective documents appropriate to course level. *SLO may be reworded to fit course*

ANT 201: Introduction to Physical Anthropology

By the end of the course, the successful student will correctly:

1. Describe the history and significance of evolutionary and genetic principles.
2. Describe and apply the main methods used in primatology, paleontology, and human osteology.
3. Explain and evaluate how scientists define species, classify organisms, and group major taxa within the order Primates.
4. Describe and compare evidence of how humans adapt biologically to different stresses, including UV radiation, altitude, temperature and disease.
5. Reconstruct the human fossil record, and explain the role of climate change, from the origin of primates through the origins of plant and animal domestication.
6. Analyze how dental and skeletal features in living and extinct primates relate to diet, movement, habitat use, and sociality, including differentiating bipedal adaptations in the cranium, vertebrae, pelvis, leg bones, and foot bones.
7. Apply and integrate fossil and primatological evidence to understand and to evaluate scientific hypotheses about primate, biped, and *Homo sapiens* origin, diversification, and extinction.

AST 135: Introductory Astronomy (passed GE 2.13.14; rev. 3.26.15))

Upon completion of this course students will be able to:

1. Describe the structure and patterns in the solar system.
2. Describe basic astronomical observations and how those observations are made.
3. Recognize basic laws of physics that are crucial to understanding astronomical behavior including Kepler's Laws, Newton's Law of Universal Gravitation, and the nature of light and telescopes.
4. Apply physical laws and astronomical models to specific cases to make informed predictions about the behavior of these astronomical systems.
5. Integrate the physical laws and the astronomical observations to form scientific theories about the nature of the solar system.
6. Demonstrate an understanding of scientific method by applying it to investigate astronomical phenomena in the laboratory and in the observatory.

AST 335: Stars, Galaxies & Cosmology *(passed CAA 1.16.14)*

Upon completion of this course students will be able to:

1. Describe the structure and patterns of the stars, galaxies and the universe as a whole.
2. Describe basic astronomical observations and how those observations are made.
3. Recognize basic laws of physics that are crucial to understanding astronomical behavior including Newton's Law of Universal Gravitation, Einstein's General Relativity, and the nature of light.
4. Apply physical laws and astronomical models to specific cases to make informed predictions about the behavior of these astronomical systems.
5. Demonstrate an understanding of the scientific method.
6. Integrate the physical laws and the astronomical observations to form scientific theories about the nature of stars and galaxies.

BIO 100: Introductory Biology *(passed GE 2.13.14)*

At the conclusion of this course, successful students will

1. Demonstrate an understanding of biological terminology and the proper use of the use of the scientific method and instrumentation used in biology. (comprehension; methods)
2. Identify how to study the cellular nature of life, and describe how cells are structured, function and reproduce. (comprehension; methods)
3. Describe the various levels of biological organization and demonstrate the ability to integrate that knowledge within the underlying concepts of genetic drift, natural and artificial selection, and the relationship to evolution. (integration)
4. Explain the need for a system to differentiate and catalogue the vast number of living and extinct organisms. (comprehension)
5. Apply the chromosomal basis of inheritance to problems relating to inheritance, genetic mutation, and molecular manipulation. (application)

BIO 101: Essentials of Biology *(passed GE 2.13.14)*

Students will

1. Synthesize a basic experiment that applies the scientific method to a research question. (GE Goal 2: use , GE Goal 5: analyze, GE Goal 7: distinguish, and GE Goal 8: integrate)
2. Explain biological evolution and the role that environment, mutation, genetic inheritance and genetic expression have in natural populations. (GE Goal 2: use, GE Goal 5: analyze, and GE Goal 7: distinguish)
3. Synthesize a basic experiment that applies the scientific method to a research question. (Use, analyze, distinguish, and integrate)
4. Explain biological evolution and the role that environment, mutation, genetic inheritance and genetic expression have in natural populations. (use, analyze, and distinguish)
5. Evaluate the effects of non-sustainable practices and uncontrolled population growth on the interrelatedness of ecosystems. (use, analyze, and integrate)

BIO 102: Inquiry Biology for Teachers *(passed GE 2.13.14)*

At the conclusion of this course, successful students will

1. Demonstrate the ability to use the instrumentation and methods of scientific inquiry. (Methods; GE Goal two and seven)
2. Analyze the cell as the basic unit of life and of multi-cellular organisms, and explain how cells function, grow and reproduce (Analyze; GE Goal five)
3. Apply the chromosomal basis of inheritance to problems relating to human inheritance, genetic mutation and manipulation. (Application; GE Goal two, five and eight)
4. Draw upon an understanding of material and energy movement in ecosystems to address the ecological ramifications of human use of energy and material resources. (Integration; Application; GE Goal five and eight)
5. Explain how evolution integrates genetics, ecology and population genetics. (Integration; GE Goal five)

BIO 111: Cell and Molecular Biology

By the end of this course students will be able to:

1. Demonstrate an understanding of the scientific methods used to answer biological questions.
2. Use observational and experimental data to make reasonable and valid conclusions.
3. Identify the cell as the basic unit of all multicellular organisms, and explain how the cell functions, grows and reproduces.
4. Comprehend the need for energy in life processes and articulate the biochemical processes (photosynthesis and respiration) which generate energy in the form of ATP.
5. Recognize evolutionary processes and how they are a common thread throughout biology.
6. Determine the roles of DNA and RNA in the flow of information from the genotype to the phenotype.
7. Identify how molecular biology applies to areas that touch our everyday lives, including the foods that we eat to the future of medicine

BIO 112: Ecology and Evolution

By the end of this course students will be able to:

1. Demonstrate an understanding of the scientific methods used to answer biological questions.
2. Use observational and experimental data to make reasonable and valid conclusions.
3. Recognize evolutionary processes and how they are a common thread throughout biology.
4. Demonstrate an understanding of how genetic mechanisms contribute to evolution.
5. Identify how evolutionary processes produce patterns of diversity.
6. Recognize the variation of species interactions and how they influence the functioning of ecological communities.
7. Trace the flow of energy and cycling of materials within ecosystems.
8. Analyze the effects of human activities on biodiversity in natural systems.

CHE 100: Inquiry Chemistry for Teachers

This course is different from others in that it seeks to reconcile the published core content in science education relevant to chemistry, the need to incorporate enhanced technology into the classroom, the contemporary understanding that hands-on, inquiry-based learning and peer-mediated group work are able to communicate the ideas in any discipline far better than standard lecture modes, and the need to overcome basic fears and mistrust with regard to chemistry and science in general.

The principal objective of this course is to teach you, the student, to appreciate the scientific process and its methods of inquiry. In addition, you will gain a solid content-based understanding of chemistry, and its relationship to our needs as a society. At the conclusion of this course, you will have practical experience with how chemistry functions (understanding of scientific methods), a solid grasp of the main language of chemistry, an ability to describe matter and energy and their transformations (explaining the major concepts of the natural sciences), and an ability to use technological tools, especially the Internet and computer interfacing, to learn more about chemistry. You will be in a position to make better lifestyle choices based on an enhanced understanding of how chemistry influences our lives (applying scientific knowledge to address issues). Finally, as teachers-in-training, you will be able to design practical lesson plans which incorporate better and more accessible approaches to teaching chemistry at the K-8 levels (Integration across course).

CHE 101: Chemistry in Everyday Life

Upon completion of the course work all students will be able to:

1. Classify matter and define phases of matter. (Understanding of the methods of scientific inquiry)
2. Set up and perform conversion calculations using dimensional analysis. (Applying scientific principles to make reasonable and valid conclusions)
3. List the fundamental units of measurement used in the SI system. (Understanding of the methods of scientific inquiry)
4. Use significant figures to represent the uncertainty in an experimental measurement. (Understanding of the methods of scientific inquiry)
5. Describe atomic structure and predict the electronic configurations of elemental species. (Explaining the major concepts of the natural sciences)
6. Identify isotopes and explain the use of natural radioisotopes in nuclear medicine. (Explaining the major concepts of the natural sciences)
7. Recognize periodic trends and use atomic structure to rationalize periodicity the arrangement of the elements in the periodic table. (Understanding of the methods of scientific inquiry)
8. Distinguish between ionic and covalent chemical compounds. (Explaining the major concepts of the natural sciences)
9. Interrelate the names and formulas of chemical compounds. (Explaining the major concepts of the natural sciences)
10. Interrelate the concepts of bond polarity and molecular geometry to predict molecular polarity. (Integration across the course)
11. Set up and carry out calculations for mass balance problems involving the stoichiometry of reactants and products for aqueous solution and gas phase reactions. (Applying scientific principles to make reasonable and valid conclusions)
12. Describe the state of a gas using pressure, volume, amount, and temperature. (Explaining the major concepts of the natural sciences)
13. Predict and describe the intermolecular forces that exist in bulk matter. (Explaining the major concepts of the natural sciences and Applying scientific principles to make reasonable and valid conclusions)
14. Correlate intermolecular forces with the physical properties of pure substances and two component mixtures. (Applying scientific principles to make reasonable and valid conclusions)
15. Summarize the colligative properties of solutions. (Explaining the major concepts of the natural sciences)
16. Constitute differences that distinguish heat and temperature. (Explaining the major concepts of the natural sciences)

17. Predict the direction of spontaneity change. (Applying scientific principles to make reasonable and valid conclusions)
18. Express the relationship between reaction rate and temperature. (Explaining the major concepts of the natural sciences)
19. Describe the behavior of systems in chemical equilibrium and predict the result(s) of stresses applied to the system. (Applying scientific principles to make reasonable and valid conclusions)
20. Define acids and bases according to Arrhenius and Brønsted/Lowery acid-base theory. (Explaining the major concepts of the natural sciences)
21. Differentiate acids from bases and their unique roles in chemical reactions. (Explaining the major concepts of the natural sciences)

CHE 105: Chemistry for the Health Sciences

At the completion of this course students should be able to critically analyze problems of a chemical nature as well as proficiently do all of the following:

1. Perform conversion calculations using dimensional analysis.
2. Make measurements with graduated devices and accurately report those measurements.
3. Classify matter on the basis of atomic structure.
4. Write formulas and name organic and inorganic chemical compounds.
5. Perform calculations involving the stoichiometry of reactants and products for aqueous solution and gas phase reactions.
6. Explain periodicity and rationalize the arrangement of the elements in the periodic chart.
7. Represent bond polarity as dipole moments.
8. Distinguish between ionic and covalent chemical compounds.
9. Represent the molecular geometry of small molecules predicted by the VSEPR Theory.
10. Explain how molecular forces give rise to biological systems.
11. Describe biological chemical systems and forces, which drive biological reactions.
12. Explain genetic / metabolic bases for disease and health and biochemical links between physiology and nutrition.
13. Synthesize positive lifestyle decisions through an enhanced understanding of biochemistry and nutrition.
14. Understand the impact of chemistry on our society.

CHE 111: General Chemistry I

Upon completion of CHE 111, General Chemistry I, the student will be able to:

1. Classify matter and define phases of matter. (Understanding of the methods of scientific inquiry)
2. Set up and perform conversion calculations using dimensional analysis. (Applying scientific principles to make reasonable and valid conclusions)
3. List the fundamental units of measurement used in the SI system. (Understanding of the methods of scientific inquiry)
4. Use significant figures to represent the uncertainty in an experimental measurement. (Understanding of the methods of scientific inquiry)
5. Interrelate the names and formulas of chemical compounds. (Explaining the major concepts of the natural sciences)
6. Set up and carry out calculations for mass balance problems involving the stoichiometry of reactants and products for aqueous solution and gas phase reactions. (Applying scientific principles to make reasonable and valid conclusions)
7. Define acids and bases according to Arrhenius and Brønsted/Lowery acid-base theory. (Explaining the major concepts of the natural sciences)
8. Describe atomic structure and predict the electronic configurations of elemental species. (Explaining the major concepts of the natural sciences and Applying scientific principles to make reasonable and valid conclusions)
9. Recognize periodic trends and use atomic structure to rationalize periodicity the arrangement of the elements in the periodic table. (Integration across course)
10. Distinguish between ionic and covalent chemical compounds. (Explaining the major concepts of the natural sciences)
11. Represent the molecular geometry of small molecules predicted by the VSEPR Theory. (Integration across course)
12. Combine the concepts of bond polarity and molecular geometry to predict molecular polarity. (Integration across course)
13. Describe the state of a gas using pressure, volume, amount, and temperature. (Explaining the major concepts of the natural sciences)
14. Predict and describe the intermolecular forces that exist in bulk matter. (Explaining the major concepts of the natural sciences and Applying scientific principles to make reasonable and valid conclusions)
15. Correlate intermolecular forces with the physical properties of pure substances and two component mixtures. (Applying scientific principles to make reasonable and valid conclusions)

FMT 140: Introduction to Fermentation

Upon completion of FMT 140, Fermentation Chemistry, the student will be able to:

1. Recognize the fundamentals of chemical bonding and the structure of biological molecules well enough to interpret the chemical reactions that occur during fermentation processes
2. Describe the types of micro-organisms involved in fermentation, learning the environmental conditions each requires to survive along with the chemical transformations they cause.
3. Understand the fermentation processes involved in the production of a wide variety of fermented food, beverage, and chemical products.
4. Recognize the fundamental measurement methodologies to test fermented products
5. Use observational and experimental data to make reasonable and valid conclusions

GEO 110: Environmental Geography *(passed GE 12.11.14)*

This course aims to provide students with an understanding of the basic principles of environmental geography, while examining the complexity of human-environment interactions.

Through this course, students will:

1. Recognize the fundamental spatial distribution of natural and human phenomena affecting environmental systems across the surface of the globe. (Spatial phenomena)
2. Recognize the systemic nature of environmental issues and identify the principles of ecosystem structure and function at varying geographic and temporal scales. (Systems)
3. Develop the ability to apply the basic principles of environmental geography theory to better evaluate current environmental issues. (Theory)
4. Demonstrate skills in geoscientific data collection and analysis and appropriate laboratory protocols. (Techniques)
5. Integrate scientific principles and knowledge about the intricate linkages between physical systems and human activities supplied throughout the course to address environmental issues. (Human-Env Interaction)
- 6.** Employ effective oral and written communication skills through in-class discussion, presentations, and group work.

GEO 210: Introduction to Physical Geography

Students successfully completing this course will be able to:

1. Comprehend the natural processes instrumental in their formation of various landforms, occurrence of meteorological events, climate types, and/or biomes.
2. Explain how to select and use appropriate geographic skills and techniques to solve real-world problems.
3. Apply earth science principles to explain spatial patterns in earth's physical environment and relationships between the atmosphere, biosphere, hydrosphere, and lithosphere.
4. Integrate scientific principles and knowledge about the intricate linkages between physical systems and human activities supplied throughout the course to address environmental issues.

GLY 102: Earth Science for Teachers

At the conclusion of this course, students will be able to:

1. Use scientific methods to learn about the natural world through evaluation of natural phenomena and processes
2. Comprehend earth science core content as defined by the Kentucky Board of Standards and the National Academy of Sciences
3. Apply knowledge about the processes of plate tectonics and earth systems cycles occurring in deep times to explain the behavior of earth materials and the topography of earth's surface
4. Apply earth science core content to issues of importance to Kentucky and its citizens (e.g., water quality, natural disasters, mining for coal and other natural resources)
5. Integrate earth science concepts in the Kentucky Core Content for Assessment and Program of Studies with complementary CCA core content from mathematics, social studies, and language arts.

GLY 104: The World Ocean (passed GE 12.12.13)

1. Students will demonstrate understanding of how geologists collect data about the natural world and how geologic data are analyzed and interpreted.
2. Students will be able to apply scientific principles of geologic processes in the context of geologic time in order to make reasonable and valid conclusions about their effects on oceanic and Earth systems, and their inhabitants.
3. Students will comprehend plate tectonics and be able to explain and infer geologic processes and characteristics of plate tectonic settings in order to infer and predict processes, events, and consequences to the Earth and its life.
4. Students will be able to integrate information presented throughout the course to explain and infer the behavior of interconnected Earth systems in order to understand and appreciate their effects on climate, organisms, and its life on Earth, including humans.

GLY 107: Gold and Diamonds

Students will be able to:

1. Understand the environmental and economic impact of the extraction of gold, diamonds, and other natural resources.
2. Explain how geologists use knowledge of geologic processes to locate deposits of valuable earth materials.
3. Analyze known geologic occurrences of gold, diamonds, and other natural resources in order to design an exploration model for these resources.
4. Integrate course material to evaluate the influence of gold and diamonds (especially with respect to their geologic occurrences) in history and current events (including foreign and domestic policies), and be able to hypothesize similar roles for other natural resources in the future.

GLY 108: Plate Tectonics: The Active Earth

In this course, students will be able to:

1. Understand and utilize the concept of geologic time to describe the dynamic nature of the Earth.
2. Understand how geologists learn about the natural world through scientific study and evaluation of natural phenomena and processes.
3. Apply the fundamental concept of plate tectonics to explain geologic patterns in Earth materials and processes that we see on the Earth's surface.
4. Integrate course knowledge to demonstrate the importance of natural hazards associated with geological processes in everyday life.

GLY 109: Great Moments in Earth History

At the conclusion of this course, students will be able to:

1. Comprehend the concept of geologic time: an ancient Earth.
2. Understand the scientific methods used to construct the geologic time scale.
3. Apply knowledge of rates of geologic processes in the context of geologic time to understand and appreciate their effects on Earth systems and inhabitants of the Earth.
4. Apply information about geologic processes and characteristics of plate tectonic settings to infer and predict processes, events, and consequences to the Earth and its life over the course of geologic time.
5. Integrate course knowledge to explain and infer the behavior of interconnected Earth systems to understand and appreciate their effects on the Earth and its life over the course of geologic time.

PHY 101: Conceptual Physics (Rev. GE 3.26.15)

Upon completion of this course students will be able to:

1. Demonstrate an understanding of scientific reasoning and the scientific method.
2. Demonstrate a conceptual understanding of the topics of introductory physics.
3. Apply scientific method in laboratory exercises to generate good data
4. Analyze the results of experiments
5. Integrate understanding of observable quantities with the physical laws that govern their behavior.

PHY 102: Inquiry Physics for Teachers

Upon completion of this course students will be able to:

1. Demonstrate an understanding of scientific reasoning and the scientific method.
2. Demonstrate a conceptual understanding of the topics of introductory physics.
3. Apply scientific method in laboratory exercises to generate good data
4. Analyze the results of experiments
5. Integrate understanding of observable quantities with the physical laws that govern their behavior.

PHY 131: College Physics I (Rev. GE 3.26.15)

Upon completion of this course students will be able to:

1. Demonstrate understanding of the process of science and apply scientific method in their laboratory exercises.
2. Demonstrate understanding of physical laws by applying them qualitatively to specific cases.
3. Apply general physical laws to specific problems to generate quantitative solutions.
4. Exhibit quality laboratory technique to generate good data
5. Analyze the results of experiments
6. Integrate understanding of observable quantities with the physical laws that govern their behavior.

PHY 201: University Physics I (Rev. GE 3.26.15)

Upon completion of this course students will be able to:

1. Demonstrate understanding of the process of science and apply scientific method in their laboratory exercises.
2. Demonstrate understanding of physical laws by applying them qualitatively to specific cases.
3. Apply general physical laws to specific problems to generate quantitative solutions.
4. Exhibit quality laboratory technique to generate good data
5. Analyze the results of experiments
6. Integrate understanding of observable quantities with the physical laws that govern their behavior.