Colorado Teacher-Authored Instructional Unit Sample

Science
High School - Biology

# Unit Title: Population Ecology

Colorado's District Sample Curriculum Project


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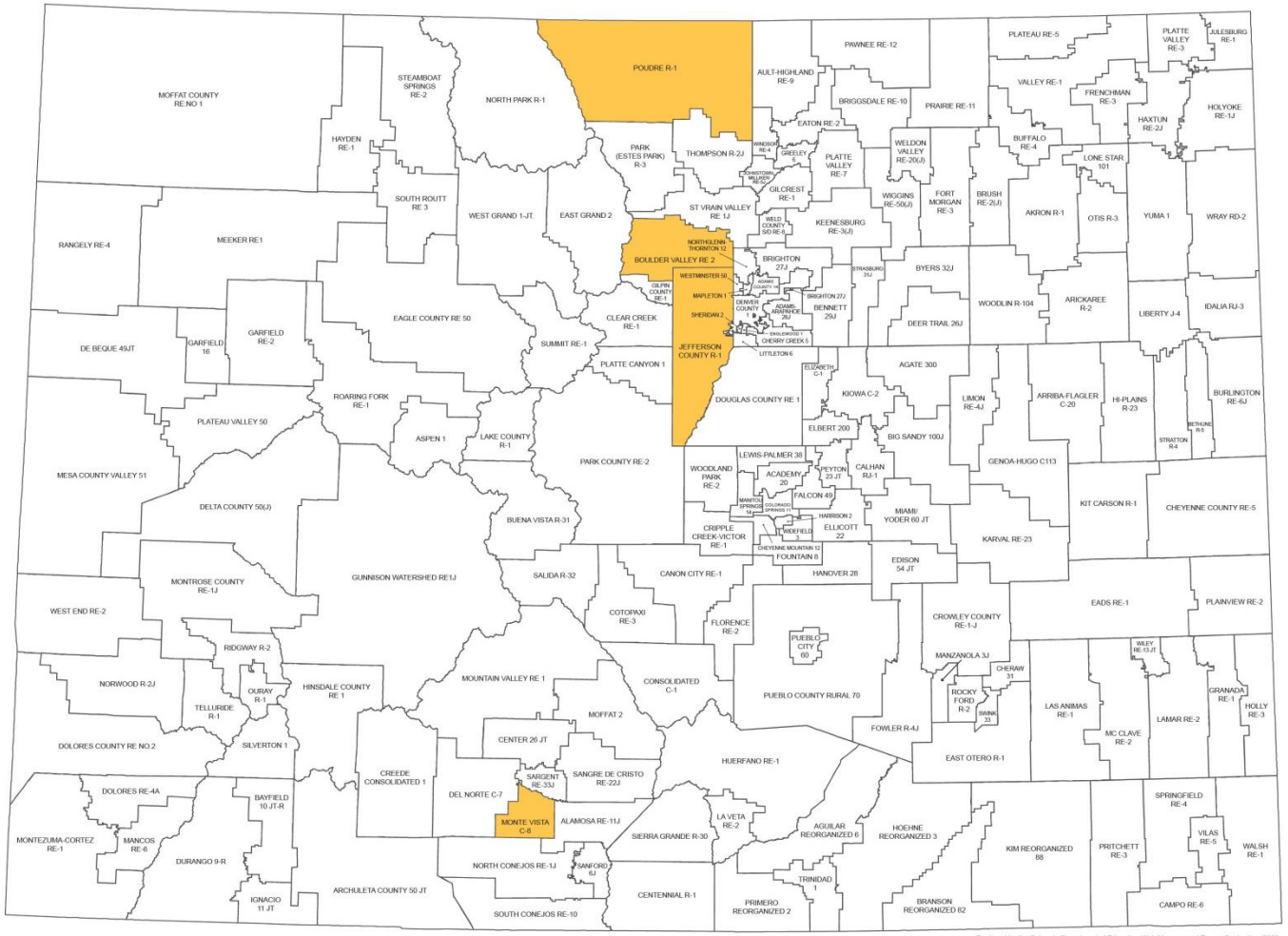


*This unit was authored by a team of Colorado educators. The template provided one example of unit design that enabled teacher-authors to organize possible learning experiences, resources, differentiation, and assessments. The unit is intended to support teachers, schools, and districts as they make their own local decisions around the best instructional plans and practices for all students.*


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**Colorado Teacher-Authored Sample Instructional Unit**

| **Content Area** | Science | **Grade Level** | High School |
|---|---|---|---|
| **Course Name/Course Code** | Biology | | |

| **Standard** | **Grade Level Expectations (GLE)** | **GLE Code** |
|---|---|---|
| 1. Physical Science | 1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations | SC09-GR.HS-S.1-GLE.1 |
| | 2. Matter has definite structure that determines characteristic physical and chemical properties | SC09-GR.HS-S.1-GLE.2 |
| | 3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy | SC09-GR.HS-S.1-GLE.3 |
| | 4. Atoms bond in different ways to form molecules and compounds that have definite properties | SC09-GR.HS-S.1-GLE.4 |
| | 5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined | SC09-GR.HS-S.1-GLE.5 |
| | 6. When energy changes form, it is neither created not destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases | SC09-GR.HS-S.1-GLE.6 |
| 2. Life Science | 1. Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem | SC09-GR.HS-S.2-GLE.1 |
| | 2. The size and persistence of populations depend on their interactions with each other and on the abiotic factors in an ecosystem | SC09-GR.HS-S.2-GLE.2 |
| | 3. Cellular metabolic activities are carried out by biomolecules produced by organisms | SC09-GR.HS-S.2-GLE.3 |
| | 4. The energy for life primarily derives from the interrelated processes of photosynthesis and cellular respiration. Photosynthesis transforms the sun's light energy into the chemical energy of molecular bonds. Cellular respiration allows cells to utilize chemical energy when these bonds are broken. | SC09-GR.HS-S.2-GLE.4 |
| | 5. Cells use the passive and active transport of substances across membranes to maintain relatively stable intracellular environments | SC09-GR.HS-S.2-GLE.5 |
| | 6. Cells, tissues, organs, and organ systems maintain relatively stable internal environments, even in the face of changing external environments | SC09-GR.HS-S.2-GLE.6 |
| | 7. Physical and behavioral characteristics of an organism are influenced to varying degrees by heritable genes, many of which encode instructions for the production of proteins | SC09-GR.HS-S.2-GLE.7 |
| | 8. Multicellularity makes possible a division of labor at the cellular level through the expression of select genes, but not the entire genome | SC09-GR.HS-S.2-GLE.8 |
| | 9. Evolution occurs as the heritable characteristics of populations change across generations and can lead populations to become better adapted to their environment | SC09-GR.HS-S.2-GLE.9 |

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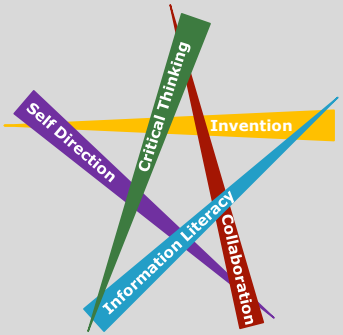
| 3. Earth Systems Science | 1. The history of the universe, solar system and Earth can be inferred from evidence left from past events | SC09-GR.HS-S.3-GLE.1 |
| | 2. As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of ways | SC09-GR.HS-S.3-GLE.2 |
| | 3. The theory of plate tectonics helps to explain geological, physical, and geographical features of Earth | SC09-GR.HS-S.3-GLE.3 |
| | 4. Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere | SC09-GR.HS-S.3-GLE.4 |
| | 5. There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources | SC09-GR.HS-S.3-GLE.5 |
| | 6. The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes | SC09-GR.HS-S.3-GLE.6 |
| | 7. Natural hazards have local, national and global impacts such as volcanoes, earthquakes, tsunamis, hurricanes, and thunderstorms | SC09-GR.HS-S.3-GLE.7 |

## Colorado 21st Century Skills




**Critical Thinking and Reasoning:** *Thinking Deeply, Thinking Differently*

**Information Literacy:** *Untangling the Web*

**Collaboration:** *Working Together, Learning Together*

**Self-Direction:** *Own Your Learning*

**Invention:** *Creating Solutions*

## Reading & Writing Standards for Literacy in Science and Technical Subjects 6 - 12

**Reading Standards**

- Key Ideas & Details
- Craft And Structure
- Integration of Knowledge and Ideas
- Range of Reading and Levels of Text Complexity

**Writing Standards**

- Text Types & Purposes
- Production and Distribution of Writing
- Research to Construct and Present Knowledge
- Range of Writing

| Unit Titles | Length of Unit/Contact Hours | Unit Number/Sequence |
|---|---|---|
| Population Ecology | 5-6 weeks | 1 |

| **Unit Title** | Population Ecology | | **Length of Unit** | 5-6 weeks |
|---|---|---|---|---|
| **Focusing Lens(es)** | Interdependence | **Standards and Grade Level Expectations Addressed in this Unit** | SC09-GR.HS-S.2-GLE.1<br>SC09-GR.HS-S.2-GLE.2<br>SC09-GR.HS-S.1-GLE.3 | |
| **Inquiry Questions (Engaging-Debatable):** | • How is life dependent on death?<br>• Which has more human impact on the environment, vegetarianism or omnivory?<br>• How are humans positively or negatively impacting the biosphere?<br>• How are natural systems such as wetlands both similar and different than human-managed systems such as waste water treatment plants? (SC09-GR.HS-S.2-GLE.1;RA.2) | | | |
| **Unit Strands** | Life Science | | | |
| **Concepts** | Ecosystem, Interactions, Change, Equilibrium, Energy, Populations, Balance, Sustainability, Biotic, Abiotic, Adaptation, Cycles | | | |

| **Generalizations**<br>**My students will Understand that…** | **Guiding Questions**<br>**Factual** | **Conceptual** |
|---|---|---|
| Populations are interdependent and fluctuate within an ecosystem due to available resources (SC09-GR.HS-S.2-GLE.2-EO.c) | What resources are needed for populations to be successful? (SC09-GR.HS-S.2-GLE.2-EO.c; IQ.2; RA.1)<br>What are the differences between carrying capacity, limiting factors and growth models? (SC09-GR.HS-S.2-GLE.2-EO.c; IQ.2; RA.1) | How do resources impact populations? (SC09-GR.HS-S.2-GLE.2-EO.c; IQ.2; RA.1)<br>How do the different forms of population dynamics differ in ecosystems? (SC09-GR.HS-S.2-GLE.2-EO.c; IQ.2; RA.1) |
| Interdependence between organisms depends on energy and its transformation and conservation for survival. (SC09-GR.HS-S.2-GLE.1-EO.a, f) | Why must an ecosystem have autotrophs? (SC09-GR.HS-S.2-GLE.1-EO.a; IQ.2)<br>Why are there more autotrophs than heterotrophs? (SC09-GR.HS-S.2-GLE.1-EO.a; IQ.2)<br>What energy transformations occur in ecosystems? (SC09-GR.HS-S.2-GLE.1;IQ.3) | How does the introduction of a non-native species influence the balance of an ecosystem? (SC09-GR.HE-S.2-GLE.2;IQ.2)<br>How does the elimination of a keystone species influence the balance of an ecosystem? (SC09-GR.HE-S.2-GLE.2;IQ.1)<br>How does the process of burning carbon-rich fossil fuels compare to the oxidation of carbon biomolecules in cells? (SC09-GR.HS-S.2-GLE.1;RA.2) |
| The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium. (SC09-GR.HS-S.2-GLE.2-EO.c) | How does energy move within an ecosystem? (SC09-GR.HS-S.2-GLE.2-EO.c;IQ.2,3; RA.1) | How do populations achieve balance? (SC09-GR.HS-S.2-GLE.2-EO.c;IQ.2;RA.1) |

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| Sustainable ecosystems adapt to varying levels of biotic and abiotic factors (SC09-GR.HS-S.2-GLE.2-EO.c;RA.2) | What are biotic and abiotic factors?<br>What is a disturbance to an ecosystem? (SC09-GR.HS-S.2-GLE.2-EO.c;IQ.2) | How would an ecosystem respond to an abiotic disturbance?<br>How is the succession of local organisms altered in an area that is disturbed or destroyed? (SC09-GR.HE-S.2-GLE.2;IQ.3))<br>Can an ecosystem be truly sustainable? (SC09-GR.HS-S.2-GLE.2-EO.d)<br>How does a change in abiotic factors influence the stability or progression of an ecosystem? |
| Matter cycling through ecosystems creates opportunities for renewal and survival of populations. (SC09-GR.HS-S.2-GLE.1-EO.f) | What are the four nutrient cycles used within ecosystems?<br>What is the difference between matter and energy? (SC09-GR.HE-S.2-GLE.1-EO.e) | What happens when the cycling of matter in ecosystems is disrupted? (SC09-GR.HS-S.2-GLE.1;IQ.2;RA.1) |

| **Critical Content:**<br>**My students will Know…** | **Key Skills:**<br>**My students will be able to (Do)…** |
|---|---|
| • Biotic and Abiotic factors (SC09-GR.HS-S.2-GLE.2)<br>• Levels of organization of the biosphere (ecosystem, community, population…) SC09-GR.HS-S.2-GLE.2)<br>• Trophic levels of energy flows (energy pyramid, food webs, etc.) (SC09-GR.HS-S.2-GLE.1-EO.a,g)<br>• Disturbances and succession (SC09-GR.HS-S.2-GLE.2-EO.a,b)<br>• Ecosystem interactions (SC09-GR.HS-S.2-GLE.2-EO.d)<br>• Human impact on ecosystems (SC09-GR.HS-S.2-GLE.2-EO.a,c)<br>• Population dynamics (carrying capacity, limiting factors, growth models…) (SC09-GR.HS-S.2-GLE.2)<br>• The difference between matter and energy and how they are cycled or lost through life processes (SC09-GR.HE-S.2-GLE.1-EO.e)<br>• Potential ecological impacts of a plant-based or meat-based diet (SC09-GR.HS-S.2-GLE.2-EO.b)<br>• The law of conservation of matter and energy (SC09-GR.HS-S.2-GLE-1-EO.d) and (SC09-GR.HS-S.1-GLE.3)<br>• The water, carbon, nitrogen and phosphorus cycles (SC09-GR.HS-S.2-GLE.1-EO.f)<br>• Primary and secondary succession. (SC09-GR.HS-S.2-GLE.2-EO.b) | • Explain interactions between biotic and abiotic factors in an ecosystem (SC09-GR.HS-S.2-GLE.2)<br>• Analyze and interpret data about the impact of disturbances in an ecosystem such as removal of keystone species or addition of non-native species, excess nutrients, or drought (SC09-GR.HS-S.2-GLE.2-EO.a, GLE.1-EO.c)<br>• Describe or evaluate communities in terms of primary and secondary succession as they progress over time (SC09-GR.HS-S.2-GLE.2-EO.b)<br>• Examine and evaluate a variety of sources to investigate claims around ecosystem interactions. (SC09-GR.HS-S.2-GLE.2-EO.d)<br>• Model the flow of energy through an ecosystem (SC09-GR.HS-S.2-GLE.1-EO.a)<br>• Evaluate data and predict consequences regarding future human population growth (SC09-GR.HS-S.2-GLE.2-EO.c)<br>• Analyze data regarding population dynamics (SC09-GR.HS-S.2-GLE.2)<br>• Use computer simulations to analyze how energy flows through trophic levels (SC09-GR.HS-S.2-GLE.1-EO.g) |

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| **Critical Language:** includes the Academic and Technical vocabulary, semantics, and discourse which are particular to and necessary for accessing a given discipline.<br>EXAMPLE: A student in Language Arts can demonstrate the ability to apply and comprehend critical language through the following statement: *"Mark Twain exposes the hypocrisy of slavery through the use of satire."* | |
| **A student in _____ can demonstrate the ability to apply and comprehend critical language through the following statement(s):** | Interactions between biotic and abiotic factors create an ecosystem<br>The size of a population is determined by the limiting factors within an environment |
| **Academic Vocabulary:** | analyze, claim, model, evaluate, primary, secondary, dynamics, native, disturbance, interactions |
| **Technical Vocabulary:** | succession, disturbance, trophic levels, ecosystem, community, population, limiting factors, carrying capacity, abiotic, biotic, species, keystone, autotroph, heterotroph, biological magnification |

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| **Unit Description:** | This unit focuses on ecological interactions between populations of organisms and their environment. The unit describes biotic interactions, trophic levels and energy flow, cycles of matter, abiotic and biotic resources, and population and community dynamics. Beginning with ecosystem components, across the unit students will explore ecological concepts such as biotic and abiotic factors, biomes, niche, keystone species, communities, populations, ecosystems, and the biosphere. The unit culminates in a performance assessment that asks students to create a presentation for a local authority (county commissioner, city council, zoning board, etc.) to present an analysis of the impacts of the eradication of a top level consumer. |
| **Considerations:** | **Considerations**:<br>Teachers need to consider that the timing of the unit may not coincide with the original intention of the unit creators due to district high school scheduling differences.<br><br>**Possible misconceptions**:<br>Ecosystems strive to achieve balance. There is no "striving for balance" in ecosystems due to the constant state of change and the lack of directionality.<br>Energy is not conserved in living systems.<br>Matter is not conserved in living systems. |
| **Unit Generalizations** | |
| **Key Generalization:** | Populations are interdependent and fluctuate within an ecosystem due to available resources |
| **Supporting Generalizations:** | Interdependence between organisms depends on energy and its transformation and conservation for survival |
| | The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium |
| | Sustainable ecosystems adapt to varying levels of biotic and abiotic factors |
| | Matter cycling through ecosystems creates opportunities for renewal and survival of populations |

| **Performance Assessment:** *The capstone/summative assessment for this unit.* | |
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| **Claims:**<br>(Key generalization(s) to be mastered and demonstrated through the capstone assessment.) | Populations are interdependent and fluctuate within an ecosystem due to available resources |
| **Stimulus Material:**<br>(Engaging scenario that includes role, audience, goal/outcome and explicitly connects the key generalization) | You have been asked to create a presentation for a local authority (county commissioner, city council, zoning board, etc.) to present an analysis of the impacts of the eradication of a top level consumer (e.g. coyote removal, etc.) on the interdependence of the ecosystem in your local area. You must include an analysis of carrying capacity, interspecies relationships, limiting factors, ecological impact, and a visual representation (data analysis) of the impact. Your report needs to include a minimum of three scientifically credible references. |
| **Product/Evidence:**<br>(Expected product from students) | Students will create a presentation for their local authority (county commissioner, city council, zoning board, etc.) to present an analysis of the impacts of the eradication of a top level consumer (e.g. coyote removal, etc.) on the ecosystem in a local area. Student presentations must include an analysis of carrying capacity, interspecies relationships (symbiosis, predator/prey, mutualism, parasitism, etc.), food webs, limiting factors, bio-magnification, keystone species, intended and unintended impacts on humans, data tables, and graphs. |

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| **Differentiation:**<br>(Multiple modes for student expression) | • The teacher may incorporate accommodations/modifications of IEP such as extended time, oral presentation, use of dictionaries, etc.<br>• The teacher may provide opportunity to produce a report using alternative modes of communication (Power Point, Prezi, oral report, written report, etc.).<br>• The teacher may scaffold report, providing the structure of the report (e.g. data table calculation, graph axes, stems or prompts for rationale).<br>• The teacher may provide defined independent and dependent variables for graphs and have student fill in label blanks on graph, or provide skeleton graph as a prompt.<br>• The teacher may provide word lists/key concepts for vocabulary students are expected to know and understand.<br>• The teacher may allow for one-on-one presentation with the teacher.<br><br>• To extend this work, the student may investigate options using technology to model population interactions. |

## Texts for independent reading or for class read aloud to support the content

| Informational/Non-Fiction | Fiction |
|---|---|
| *Introduction to Population Ecology* – Dick Neal [lexile level 1110]<br>*An Inconvenient Truth* - Al Gore [lexile level 1070] | *Ecotopia* - Bantam Books [lexile level1150-1220]<br>*The Hobbit* - J.K. Tolkien [lexile level 1000] |

## Ongoing Discipline-Specific Learning Experiences

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| 1. | Description: | Think like a scientist: Scientific method and experimentation | Teacher Resources: | http://www.brainpopjr.com/science/scienceskills/scientificmethod/grownups.weml (Near middle of page teacher resources page with activities)<br>http://undsci.berkeley.edu/teaching/misconceptions.php (A list of common misconceptions about the nature of science)<br>http://undsci.berkeley.edu/teaching/ (Tips for introducing and teaching scientific method and experimentation)<br>http://www.livescience.com/6727-invisible-gorilla-test-shows-notice.html (Video in which most people fail to observe large "gorilla" moving across room)<br>http://www.shodor.org/succeed-1.0/forensic/teacher/lessons/observation.html (Lesson plan devoted to developing observation skills)<br>http://blogs.loc.gov/teachers/2011/06/look-again-challenging-students-to-develop-close-observation-skills/ (Library of Congress brief of tools for helping students develop observation skills) |
| | | | Student Resources: | http://www.brainpopjr.com/science/scienceskills/scientificmethod/grownups.weml (At top of page student link for movie and activities about scientific method)<br>http://www.glencoe.com/sites/common_assets/science/virtual_labs/E16/E16.html (Virtual lab to practice use of scientific method and experimentation)<br>http://www.brainpop.com/science/scientificinquiry/scientificmethod/preview.weml (Movie and quiz for scientific method/inquiry) |

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| | | | | http://lifehacker.com/5960811/how-to-develop-sherlock-holmes+like-powers-of-observation-and-deduction (Explanation of tools to increase observation skills with hook related to Sherlock Holmes) |
| | Skills: | Write a testable question to be answered in an experiment<br>Design an experiment that controls for independent and dependent variables<br>Analyze experimental results with respect to their support of the hypothesis<br>Identify possible sources of error<br>Critique research methodology of scientists or other students | Assessment: | Students will be assessed within the learning experiences |
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| 2. | Description: | Work like a scientist: Create and analyze graphs | Teacher Resources: | Power Point presentation (Dealing with identification of dependent and independent variables)<br>http://professionaldevelopment.ibo.org/files/ocd/TaughtPractice%20with%20%20identifying%20variables.pdf (Practice worksheet for identifying dependent and independent variables)<br>http://www.clemson.edu/ces/phoenix/tutorials/graph/index.html (Rules for graphing)<br>http://www.wtamu.edu/academic/anns/mps/math/mathlab/beg_algebra/beg_alg_tut9_bar.htm#line3 (Teaches how and why to use different graphs and also teaches how to read a graph)<br>http://www.teachervision.fen.com/skill-builder/graphs-and-charts/48946.html?page=1&detoured=1 (Provides questions to ask students as they analyze a graph)<br>http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs) |
| | | | Student Resources: | http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs) |
| | Skills: | Label and title axes<br>Identify dependent and independent variables<br>Determine the appropriate type of graph<br>Identify trends in graphs and tables<br>Read different types of graphs<br>Compare two or more sets of data to relate and draw conclusions<br>Synthesize given information in graphic organizer | Assessment: | Students will be assessed within the learning experiences |

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| 3. | Description: | Work like a scientist: Application of math | Teacher Resources: | http://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/solving_for_variable/v/rearrange-formulas-to-isolate-specific-variables (Video tutorials on rearranging equations to solve for specific variables)<br>http://serc.carleton.edu/mathyouneed/equations/ManEqInstructor.html (Instructions for guiding students through manipulating equations) |
| | | | Student Resources: | http://www.math.com/school/subject2/lessons/S2U1L2GL.html (Walks students through order of operations problems step-by-step checking for understanding along the way)<br>http://www.algebrahelp.com/worksheets/view/simplifying/oops.quiz (Online order of operations worksheet with a worked out example and step-by-step instructions available for each problem)<br>http://www.coolmath.com/prealgebra/05-order-of-operations/01-order-of-operations-why-01.htm (Slide show overview order of operations including worked out examples and practice problems) |
| | Skills: | Use formulas<br>Use the metric system<br>Use math tools<br>Use proportional thinking, ratios | Assessment: | Students will be assessed within the learning experiences |
| 4. | Description: | Thinking like a scientist: Read critically and extract main ideas | Teacher Resources: | http://www.phschool.com/eteach/language_arts/2002_12/essay.html (Strategies to help develop reading comprehension skills)<br>http://www.readingrockets.org/article/3479/ (7 tips with resources to help students' reading comprehension) |
| | | | Student Resources: | http://www.brainpop.com/english/studyandreadingskills/readingskills/ (Reading comprehension movie and quiz)<br>http://www.brainpop.com/english/writing/mainidea/ (Main idea movie and quiz)<br>http://www.brainpop.com/math/dataanalysis/graphs/preview.weml (Analyzing graphs movie and quiz) |
| | Skills: | Comprehend and utilize academic vocabulary<br>Identify key points and themes<br>Identify faults in research methods, logic, and statistical findings<br>Scrutinize credibility of sources (peer, research, internet, etc.) and resources | Assessment: | The student will read existing text (journal article, newspaper, website, etc.) and/or analyze work of others to identify faults, logic, and statistical findings.<br>The student will utilize academic language through observations of engagement with scientific discourse.<br>The student will critique/analyze scientific procedure so that the students can identify faults. |

## Prior Knowledge and Experiences

Students must have a basic understanding of natural selection and genetic adaptation, matter (atoms and basic chemistry), photosynthesis and respiration, cycles of energy and matter, biotic and abiotic factors, law of conservation of mass and energy, populations, and requirements of all living things for life.

Vertical Articulation: Students have last seen these concepts within this unit in $8^{th}$, $6^{th}$, $4^{th}$, $2^{nd}$, and PK.

## Learning Experiences # 1 – 3
## Instructional Timeframe: Weeks 1-3

**Learning Experience # 1**

The teacher may provide opportunities to examine and analyze various ecosystem components so students may identify and evaluate ecological concepts such as biotic and abiotic factors, biomes, niche, keystone species, communities, populations, ecosystems, and the biosphere.

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| **Teacher Notes:** | Teachers can arrange habitat observations in person, with pictures or video, set up labs where students must identify/categorize examples of each component, and describe the role of each, etc. |
| **Generalization Connection(s):** | Populations are interdependent and fluctuate within an ecosystem due to available resources |
| **Teacher Resources:** | https://www.google.com/search?q=components+of+an+ecosystem&tbm=isch&tbo=u&source=univ&sa=X&ei=jkH9UuqAPYjuqQGWjIDYDw&sqi=2&ved=0CCQQsAQ&biw=1680&bih=930 (Images for components of an ecosystem)<br>http://www.slideshare.net/guest830b45f/two-major-components-of-ecosystem (Slide share for components of an ecosystem)<br>http://www.landscope.org/colorado/plants-animals/animals/ (Keystone species in Colorado) |
| **Student Resources:** | http://education-portal.com/academy/lesson/the-environment-levels-of-ecology-and-ecosystems.html#lesson (Videos and quizzes around levels of ecology and ecosystems)<br>http://education-portal.com/academy/lesson/biomes-tundra-taiga-temperate-grassland-and-coastlines.html#lesson (Videos and quizzes around biomes)<br>http://www.youtube.com/watch?v=hgXHvxon3_g (Video animation using salmon as environmental keystone species)<br>http://www.mhhe.com/biosci/pae/environmentalscience/enger8e/interexplor/chap05.htm (Interactive exploration of keystone species)<br>http://www.youtube.com/watch?v=NHetWkxhpAg (Video on biotic and abiotic) |
| **Assessment:** | Students will examine real-world habitats and identify and evaluate various components of ecosystems (Venn diagrams, expository writing, t-charts, Power Points, etc.)<br><br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting) |

| **Differentiation:** (Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
|---|---|---|
| | The teacher may reduce the number of habitats that a student has to examine<br>http://www.eduplace.com/graphicorganizer/ (Printable templates of graphic organizers)<br>http://www.eduplace.com/graphicorganizer/pdf/sequence.pdf (Printable template for documenting cause-effect relationships)<br>http://education-portal.com/academy/lesson/the-environment-levels-of-ecology-and-ecosystems.html#lesson (Videos and quizzes around levels of ecology and ecosystems) | The student may demonstrate understanding of ecological concepts and the components of ecosystems using templates and/or graphic organizers |
| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow students to independently research and identify the major components of an ecosystem | The student may create a make-believe ecosystem and describe fictional organisms and/or habitats that serve each particular function within that ecosystem |
| **Critical Content:** | • Biotic and abiotic factors are distinguishable and critical for the survival of organisms<br>• Ecosystems within the biosphere are complex, dynamic, and include many components | |
| **Key Skills:** | • Explain interactions between biotic and abiotic factors in an ecosystem<br>• Evaluate the differing scales of living organisms<br>• Interpret the "roles" that organisms may occupy (producer vs. consumer, etc.) | |
| **Critical Language:** | Species, community, population, ecosystem, biosphere, habitat, niche, keystone species, biome, dynamic, interpret, evaluate, explain, research, create, examine | |

| **Learning Experience # 2** | |
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| The teacher may provide opportunities to examine food webs and analyze the relationships between organisms within the food web so that students may identify and evaluate the interconnected nature of all organisms and the various trophic levels within an ecosystem. | |
| **Teacher Notes:** | Teachers' use of online simulations or cut-outs of organisms to demonstrate trophic relationships or examine and evaluate data on predator-prey interactions. |
| **Generalization Connection(s):** | Populations are interdependent and fluctuate within an ecosystem due to available resources<br>Sustainable ecosystems adapt to varying levels of biotic and abiotic factors |

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| **Teacher Resources:** | http://www.gould.edu.au/foodwebs/kids_web.htm (Gould league Food web creators)<br>https://www.google.com/search?q=Trophic+level&sa=X&stick=H4sIAAAAAAAAAGOovnz8BQMDAx8HsxKXfq6-QVJSRUZhlWLY6sc-_LtNw_Tvu_SJTH2onP_DBwBjqGn_KwAAAA&tbm=isch&tbo=u&source=univ&ei=HkH9UpWPMOrAyAGjtoGwBw&ved=0CDAQsAQ&biw=1680&bih=930 (Images for trophic levels)<br>http://www.globalchange.umich.edu/globalchange1/current/lectures/kling/energyflow/highertrophic/trophic2.html (Lesson for trophic levels and energy transfer) | |
| **Student Resources:** | http://education-portal.com/academy/lesson/food-chains-trophic-levels-and-energy-flow-in-an-ecosystem.html#lesson (Videos and quizzes around food webs)<br>http://education-portal.com/academy/lesson/ecosystems-habitats-and-ecological-niches.html#lesson (Videos and quizzes around habitats, niches, and ecosystems)<br>http://www.gould.edu.au/foodwebs/kids_web.htm (Gould league Food web creators)<br>http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/food-webs.htm (Food web study jams, animations) | |
| **Assessment:** | Students will construct and describe a complex food web that involves aquatic and terrestrial organisms, and identifies the trophic level of each (Power Point presentation, poster, graphic organizer, etc.).<br><br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting)<br>http://www.postermywall.com/index.php/p/classroom-posters (Free classroom poster creator) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | http://education-portal.com/academy/lesson/food-chains-trophic-levels-and-energy-flow-in-an-ecosystem.html#lesson (Videos and quizzes around food webs)<br>http://education-portal.com/academy/lesson/ecosystems-habitats-and-ecological-niches.html#lesson (Videos and quizzes around habitats, niches, and ecosystems)<br>http://www.brainpop.com/science/ecologyandbehavior/foodchains/ (Cartoon description of food chain/food web interactions) | The student may watch the presentation and give an example orally of each trophic level observed in the movie, and what organism would be affected directly (could be one-on-one or in a small group setting) |
| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow students to independently research food webs of marine and coastal environments and identify linkages between aquatic and terrestrial habitats (for example, in the Pacific Northwest)<br>http://www.gould.edu.au/foodwebs/kids_web.htm (Gould league Food web creators) | The student may design a hypothetical experiment that tests the consequences of the removal of an aquatic keystone species (i.e., salmon) and create hypotheses on the fate of terrestrial plants and animals in coastal areas |

| | |
|---|---|
| **Critical Content:** | • Food webs are complex and include every organism within the ecosystem<br>• Organisms interact with each another in a variety of ways, and are dependent upon one another<br>• Removal of organisms from a food web can cause a dramatic impact on the other populations within the web<br>• Organisms occupy a trophic level, and contribute to the directional flow of energy within a food web |
| **Key Skills:** | • Identify a keystone species within a food web and predict the consequences of its removal<br>• Model the relationships of between organisms in an ecosystem |
| **Critical Language:** | Food web, food chain, producer, primary consumer, secondary consumer, decomposer, autotroph, heterotroph, symbiosis, parasitism, commensalism, mutualism, identify, model, design, research, construct, describe |

| **Learning Experience # 3** | | |
|---|---|---|
| The teacher may provide opportunities to examine interactions between species competing for limited resources (e.g., food, water, shelter) and the population trends that ensue so that students can evaluate the impacts on competing organisms, as well as other organisms within the local food web. | | |
| **Teacher Notes:** | Students can investigate population trends between endemic and non-native species and make inferences about the impacts on the local communities. | |
| **Generalization Connection(s):** | Sustainable ecosystems adapt to varying levels of biotic and abiotic factors | |
| **Teacher Resources:** | http://education-portal.com/academy/lesson/interspecific-competition-competitive-exclusion-niche-differentiation.html#lesson (Videos and quizzes around competition)<br>http://education-portal.com/academy/lesson/interspecies-competition-and-predator-prey-interactions.html#lesson (Videos and quizzes around predator/prey relationships)<br>http://education-portal.com/academy/lesson/symbiotic-relationships-mutualism-commensalism-amensalism.html#lesson (Videos and quizzes around symbiosis) | |
| **Student Resources:** | http://education-portal.com/academy/lesson/interspecific-competition-competitive-exclusion-niche-differentiation.html#lesson (Videos and quizzes around competition)<br>http://education-portal.com/academy/lesson/interspecies-competition-and-predator-prey-interactions.html#lesson (Videos and quizzes around predator/prey relationships)<br>http://education-portal.com/academy/lesson/symbiotic-relationships-mutualism-commensalism-amensalism.html#lesson (Videos and quizzes around symbiosis) | |
| **Assessment:** | Students will model population trends between competitive species and make predictions about the short and long term impacts on the local ecosystem. (Data tables and graphs, descriptive narratives, Power Point presentation, online simulations, etc.) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow the student to use technology to assist with the modeling of population trends<br>http://education-portal.com/academy/lesson/interspecific-competition-competitive-exclusion-niche-differentiation.html#lesson (Videos and quizzes around competition) | N/A |

| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
|---|---|---|
| | The teacher may have students introduce a "weed" into the ecosystem model and then determine the impacts between competitive species | The student may create a public service announcement around the impact of "weed" introduction on an ecosystem in relation to competitive species |
| **Critical Content:** | • Resources are limited for organisms, which leads to competition between species<br>• Introduced species can outcompete and replace endemic species<br>• Aggressive non-native species can have serious impacts on local food webs | |
| **Key Skills:** | • Analyze and interpret data on competitive interactions between organisms<br>• Describe and predict the consequences of the introduction of invasive, non-native species upon local food webs | |
| **Critical Language:** | N/A | |

## Learning Experiences # 4 – 7
## Instructional Timeframe: Weeks 3-5

| **Learning Experience # 4** | |
|---|---|
| The teacher may provide opportunities to investigate energy as a resource (photosynthesis as a mechanism by which energy enters the biosphere as chemical energy) so that students may evaluate the importance of producers as the foundation of the energy flow pyramid, and the loss of usable energy as it is transformed into mechanical energy and heat at each trophic level. | |
| **Teacher Notes:** | The teacher may set up an investigation where students calculate the amount of energy produced by a particular producer and estimate the amount that producer needed to sustain a particular number of consumers. |
| **Generalization Connection(s):** | Interdependence between organisms depends on energy and its transformation and conservation for survival<br>The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium |
| **Teacher Resources:** | https://www.google.com/search?q=photosynthesis+and+cellular+respiration&tbm=isch&tbo=u&source=univ&sa=X&ei=XKEDU7PWAYq62gW63IHoCw&ved=0CCQQsAQ&biw=1680&bih=930 (Photosynthesis and cellular respiration images)<br>http://www.youtube.com/watch?v=0IJMRsTcwcg (You tube of photosynthesis and cellular respiration)<br>http://www.buzzle.com/articles/photosynthesis-and-cellular-respiration.html (Photosynthesis and cellular respiration resources)<br>http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=10&ved=0CFAQFjAJ&url=http%3A%2F%2Fksuweb.kennesaw.edu%2F~vking2%2FPhotosynthesisandCellularRespirationpost.ppt&ei=XKEDU7PWAYq62gW63IHoCw&usg=AFQjCNHv3z6QOAS8EGBsKe6FXKEYvPp4pA (Power Point around photosynthesis and cellular respiration)<br>http://science.howstuffworks.com/life/27995-assignment-discovery-energy-flow-video.htm (How Stuff Works video on energy flow) |
| **Student Resources:** | http://education-portal.com/academy/lesson/food-chains-trophic-levels-and-energy-flow-in-an-ecosystem.html#lesson (Videos and quizzes around trophic levels)<br>http://science.howstuffworks.com/life/27995-assignment-discovery-energy-flow-video.htm (How Stuff Works video on energy flow) |

| | | |
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| **Assessment:** | Students will describe the mechanism by which energy enters the biosphere, calculate the amount of usable energy that is lost between trophic levels, and make specific predictions on the number of organisms that can be supported by other organisms within a particular trophic level (data tables and graphs, online simulation, class demonstration, graphic organizer, Power Point presentation, poster, etc.)<br><br>http://www.postermywall.com/index.php/p/classroom-posters (Free classroom poster creator) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may provide the calculations of energy lost and allow students to make predictions within trophic levels<br>The teacher may provide pictures of the usable amount of energy<br>http://www.youtube.com/watch?v=8NEbWt0KYGw&list=PL7D80F425D11AE231 (You tube video on population ecology) | The student may report their predictions one-on-one with the teacher verbally<br>The student may point to pictures for the correct amount of energy lost at different trophic levels |
| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow students to research areas of the world that gets may hours of sunlight and compare with an area that gets little sunlight | The student may create a travel brochure for the two areas of the world with varying degrees of sunlight and report out on their usable energy |
| **Critical Content:** | • Energy enters the biosphere primarily by the process of photosynthesis<br>• Energy moves between trophic levels by consumption of the organism (producers are consumed by primary consumers, etc.)<br>• Energy is lost (as a useable form to life) at each trophic level as it is converted into mechanical energy and heat | |
| **Key Skills:** | • Calculate and display data on energy transformation between trophic levels of organisms<br>• Make predictions on the numbers of organisms that can be supported by lower trophic levels | |
| **Critical Language:** | Trophic level, energy flow, photosynthesis, calorie, transformation, organism, mechanical energy, chemical energy, heat, energy pyramid, producer, primary consumer, secondary consumer, decomposer, calculate, predict, display, evaluate, describe | |

| **Learning Experience # 5** | |
|---|---|
| The teacher may present the concepts of the carbon, nitrogen, water and phosphate cycles so that students will be able to describe or illustrate the process of each cycle (e.g., the role of nitrogen fixation in the nitrogen cycle). | |
| **Generalization Connection(s):** | Matter cycling through ecosystems creates opportunities for renewal and survival of populations |
| **Teacher Resources:** | http://www.windows2universe.org/earth/climate/carbon_cycle.html (Carbon cycle online game)<br>http://www.windows2universe.org/teacher_resources/nitrogen_main.html (Nitrogen Cycle online game)<br>http://www.windows2universe.org/earth/Life/biogeochem.html (Biogeochemical cycles with links to other resources)<br>http://www.ucar.edu/educ_outreach/visit/caee/images/FINAL_All_carbon_Game.pdf (Carbon cycle classroom activity – Passport activity) |

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| | http://gk12.asu.edu/node/45 (Carbon adventures: A game to teach the carbon cycle)<br>http://www.melodyshaw.com/files/activity4.pdf (Carbon Cycle Board Game)<br>http://www.biology.ualberta.ca/facilities/multimedia/uploads/alberta/CarbonCycle.html (Carbon Cycle Animation)<br>http://www.youtube.com/watch?v=hehXEYkDq_Y (Bill Nye water cycle)<br>http://www.youtube.com/watch?v=i3NeMVBcXXU (Water Cycle Rap)<br>http://studyjams.scholastic.com/studyjams/jams/science/ecosystems/water-cycle.htm (Good water cycle video)<br>http://studyjams.scholastic.com/studyjams/index.htm (Scholastic Site with Science& Math Videos & Activities) | |
| **Student Resources:** | http://education-portal.com/academy/lesson/biogeochemical-cycling-and-the-phosphorus-cycle.html#lesson (Videos and quizzes around biogeochemical cycles)<br>http://education-portal.com/academy/lesson/the-nitrogen-cycle-acid-rain-and-fossil-fuels.html#lesson (Videos and quizzes around the nitrogen cycle)<br>http://education-portal.com/academy/lesson/the-carbon-cycle-greenhouse-gases-and-global-warming.html#lesson (Videos and quizzes around carbon cycle) | |
| **Assessment:** | Students will be able to create visual representations and/or write narratives describing the carbon, nitrogen, water, and phosphate cycles or create a chart or graph to illustrate where greater or lesser amounts of matter are stored (e.g., Carbon in glucose in producers, etc.)<br><br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may provide partially completed cycles (graphic organizer)<br>http://education-portal.com/academy/lesson/biogeochemical-cycling-and-the-phosphorus-cycle.html#lesson (Videos and quizzes around biogeochemical cycles)<br>http://education-portal.com/academy/lesson/the-nitrogen-cycle-acid-rain-and-fossil-fuels.html#lesson (Videos and quizzes around the nitrogen cycle)<br>http://education-portal.com/academy/lesson/the-carbon-cycle-greenhouse-gases-and-global-warming.html#lesson (Videos and quizzes around carbon cycle) | The student may fill in missing information on the partially completed cycle |
| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow students to analyze a real world ecosystem, identify & explain where those geochemical cycles are in operation within that ecosystem | The student may present their findings to their peers using any of the following: report, poster, brochure, Prezi, Power Point, etc. |

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| **Critical Content:** | • What are the carbon, nitrogen, water, and phosphate cycles?<br>• Why are the carbon, nitrogen, water, and phosphate cycles important for living organisms?<br>• Photosynthesis<br>• Cellular Respiration |
| **Key Skills:** | • Follow a crucial molecule throughout its cycle & predict the consequence of a missing component of the cycle |
| **Critical Language:** | Carbon cycle, nitrogen cycle, water cycle, phosphate cycle, photosynthesis, cellular respiration, nitrogen fixation, producer, consumer, autotroph, heterotroph, decomposer, describe, illustrate, create, predict |

| **Learning Experience # 6** | | |
|---|---|---|
| Teachers may discuss/present the interaction of biogeochemical cycles and the concepts of dynamic and static equilibrium so that students can understand how biogeochemical cycles are dependent on many factors. | | |
| **Teacher Notes:** | The circle of life in recycling matter, deforestation and the effects that deforestation has on the carbon cycle through photosynthesis and cellular respiration. | |
| **Generalization Connection(s):** | Interdependence between organisms depends on energy and its transformation and conservation for survival<br>Matter cycling through ecosystems creates opportunities for renewal and survival of populations | |
| **Teacher Resources:** | http://prezi.com/80amqsq1wzpk/community-ecology-and-ecosystems-period-2/ (Prezi on Ecological communities)<br>http://www.youtube.com/watch?v=09_sWPxQymA (You tube on Biogeochemical cycles)<br>http://www.youtube.com/watch?v=rpohHGb1YUE (Video of a lecture on biogeochemical cycles)<br>http://www.youtube.com/watch?v=hllU9NEcJyg (NASA time lapse of deforestation) | |
| **Student Resources:** | http://prezi.com/80amqsq1wzpk/community-ecology-and-ecosystems-period-2/ (Prezi on Ecological communities)<br>http://www.youtube.com/watch?v=09_sWPxQymA (You tube on Biogeochemical cycles)<br>http://www.youtube.com/watch?v=U3SZKJVKRxQ (Video cartoon on the Carbon Cycle)<br>http://www.youtube.com/watch?v=wlD_ImYQAgQ (Video on dynamic equilibrium)<br>http://www.youtube.com/watch?v=dxM9lsbUbpw (Video on static equilibrium)<br>http://www.youtube.com/watch?v=yvdfqrnvu6Q (Video on deforestation) | |
| **Assessment:** | Students will analyze data around the factors that impact biogeochemical cycles and report on those impacts (e.g.,oral report, written report, diagrams, etc.).<br><br>http://nces.ed.gov/nceskids/createagraph/default.aspx (Online way to create different types of graphs) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may provide partially completed cycles (graphic organizer) | The student may fill in missing information on the partially completed cycle & add information about the impact of changes in those cycles on their diagram |

| Extensions for depth and complexity: | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
|---|---|---|
| | The teacher may allow students to analyze an ecosystem that has had significant changes & apply knowledge of geochemical cycles to determine the effect of those changes on $CO_2$ levels, Nitrogen levels, water levels, etc. (Ex. Forest fires destroying thousands of acres, volcanic eruption causing prolonged periods of darkness, over fertilization in farming communities or urban areas with lawns such as golf courses). | The student may present their findings to their peers using any of the following: report, poster, brochure, Prezi, Power Point, etc. |
| **Critical Content:** | • What is the interaction of biogeochemical cycles (with one another?, human interaction?,)<br>• What is equilibrium? (Static & Dynamic)<br>• How do human &/or natural changes (i.e. natural disasters) affect biogeochemical cycles? | |
| **Key Skills:** | • Analyze data for $CO_2$ levels & how that relates to increased or decreased levels of photosynthesis through deforestation | |
| **Critical Language:** | Carbon cycle, nitrogen cycle, water cycle, phosphate cycle, photosynthesis, cellular respiration, nitrogen fixation, producer, consumer, autotroph, heterotroph, decomposer, static equilibrium, dynamic equilibrium, biogeochemical cycles, explain, analyze | |

| **Learning Experience # 7** | |
|---|---|
| Teachers may provide information on carrying capacity and competition for resources so that students can discuss the big idea of carrying capacity and how that is affected by biotic and abiotic limiting factors and competition. | |
| **Generalization Connection(s):** | The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium<br>Sustainable ecosystems adapt to varying levels of biotic and abiotic factors<br>Populations are interdependent and fluctuate within an ecosystem due to available resources |
| **Teacher Resources:** | http://www.peregrinefund.org/docs/pdf/vmic/education/carrying-capacity-activity.pdf (Carrying Capacity Activity)<br>http://www.gov.mb.ca/conservation/sustain/carcap.pdf (Carrying Capacity Activity)<br>http://www.projectwild.org/documents/ohdeer.pdf (Carrying Capacity Activity - Project Wild)<br>http://teachers.sduhsd.k12.ca.us/lolson/Biology/Labs/Human%20Population%20and%20Carrying%20Capacity%20WebQuest.pdf (WebQuest for Human Population/Carrying Capacity)<br>http://www.phschool.com/atschool/phbio/active_art/predator_prey_simulation/index.html (Great Carrying Capacity Simulation) |
| **Student Resources:** | http://education-portal.com/academy/lesson/populations-growth-density-and-carrying-capacity.html#lesson (Videos and quizzes around carrying capacity)<br>http://www.peregrinefund.org/docs/pdf/vmic/education/carrying-capacity-activity.pdf (Carrying Capacity Activity)<br>http://www.gov.mb.ca/conservation/sustain/carcap.pdf (Carrying Capacity Activity)<br>http://www.projectwild.org/documents/ohdeer.pdf (Carrying Capacity Activity - Project Wild)<br>http://teachers.sduhsd.k12.ca.us/lolson/Biology/Labs/Human%20Population%20and%20Carrying%20Capacity%20WebQuest.pdf (WebQuest for Human Population/Carrying Capacity)<br>http://www.phschool.com/atschool/phbio/active_art/predator_prey_simulation/index.html (Great Carrying Capacity Simulation) |

<table>
<tr><td>Assessment:</td><td colspan="2">Students will model carrying capacity to demonstrate their understanding of the factors that determine it (e.g., computer simulation, analyzing lab data, etc.).</td></tr>
<tr><td rowspan="2">Differentiation:<br>(Multiple means for students to access content and multiple modes for student to express understanding.)</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may use of a storyboard template<br>The teacher may use a graphic organizer, paragraph narrative, analyzing data through graphs, charts, etc.<br>http://education-portal.com/academy/lesson/populations-growth-density-and-carrying-capacity.html#lesson (Videos and quizzes around carrying capacity)</td><td>The student may create a storyboard for carrying capacity that include limiting factors<br>The student may demonstrate carrying capacity and limiting factors using a graphic organizer that includes graphs</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>http://education-portal.com/academy/lesson/populations-density-survivorship-and-life-histories.html#lesson (Video and quiz around survivorship and population density)<br>The teacher may allow students to take the role of a wildlife biologist and track surviving species over time<br>The teacher may provide data for a given ecosystem so that students can determine the possible consequences of certain changes on that ecosystem</td><td>The student may report out on which species survived the longest in a certain ecosystem and postulate why the survival rate is high</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• What is carrying capacity?<br>• What are limiting factors?<br>• What is competition & how is that related to limiting factors & carrying capacity?<br>• What is a keystone species & how does the removal of that species affect carrying capacity for other species?</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• SWBAT identify, compare, & assess the importance of various abiotic & biotic factors in an ecosystem. As well as discuss the impact on that ecosystem if a those factors are changed.<br>• Be able to predict the fate of a population when resources are altered or manipulated<br>• Calculate/estimate the carrying capacity based on trophic level energy availability<br>• Analyze data for limiting factors, carrying capacity, & competition for an ecosystem (ex. Kaibab Deer Lab)<br>• Analyze how changing one part of a system affects another part of a system<br>• Using computer simulations to model competition, limiting factors, & carrying capacity</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Limiting factors, carrying capacity, competition, keystone species, energy pyramid (trophic levels), food webs, carnivore, herbivore, omnivore, producer, consumer (1st, 2nd, 3rd level, etc.), abiotic & biotic factors, immigration, emigration, barriers, fatality, natality, isolation, population density, discuss, create, model, predict, compare, analyze, calculate, estimate, simulate</td></tr>
</table>

## Learning Experiences # 8 – 11
## Instructional Timeframe: Weeks 5-6

| Learning Experience # 8 | | |
|---|---|---|
| The teacher may provide opportunities to examine succession so that students may identify and predict changes in populations of organisms over time. | | |
| **Generalization Connection(s):** | The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium<br>Sustainable ecosystems adapt to varying levels of biotic and abiotic factors | |
| **Teacher Resources:** | http://www.mrphome.net/mrp/succession.swf (Ecological succession simulation)<br>http://www.biologycorner.com/worksheets/examining_stages_succession.html#.UmrJzHvnZdg (Website to evaluate stages of succession)<br>http://www.pbs.org/americanfieldguide/teachers/forests/forests_unit.html (Science lab investigating primary and secondary succession.<br>http://tiee.ecoed.net/vol/v3/experiments/floristic/faculty.html (The use of gaming to teach succession) | |
| **Student Resources:** | http://education-portal.com/academy/lesson/ecological-succession-from-pioneer-to-climax-communities.html#lesson (Videos for students to interact with ideas around succession)<br>http://www.youtube.com/watch?v=V49IovRSJDs (You tube video of ecological succession)<br>http://www.mrphome.net/mrp/succession.swf (Ecological succession simulation)<br>http://science.howstuffworks.com/life/29496-assignment-discovery-succession-in-the-environment-video.htm (Assignment discovery-Environmental succession)<br>http://www.youtube.com/watch?v=E0qdWoLdk1c (Ecological succession simulation) | |
| **Assessment:** | Students will examine and analyze successional change within a habitat and predict the community of organisms and their relative amounts after a disturbance and during various time intervals in the future (e.g., data tables and graphs, Power Point presentation, online simulations, computer constructed models, etc.). | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may allow students to represent succession through models<br>http://www.biologycorner.com/worksheets/dragonfly/4-1_4-2_climate_ecosystems.html (Worksheet for students to use to build vocabulary around succession)<br>https://www.google.com/search?q=ecological+succession&espv=210&es_sm=93&tbm=isch&source=lnms&sa=X&ei=kxQFU7GjKcWTyQHM1IGgAQ&sqi=2&ved=0CAcQ_AUoAQ&biw=1092&bih=533&dpr=1.25 (Images of ecological succession) | The student may create a 3-D model for successional change |

| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
|---|---|---|
| | The teacher may allow students to investigate ecological succession after a catastrophic event (i.e., forest fire, flood, etc.) | The student may create a video to represent successional change within an environment |
| **Critical Content:** | • There are two categories of succession – primary and secondary<br>• Succession can increase biodiversity on the short term<br>• Natural processes create situations where succession can occur<br>• Change is a natural part of any habitat | |
| **Key Skills:** | • Analyze and interpret data about the impact of disturbances on various habitats and the organisms that live there<br>• Describe and evaluate communities in terms of primary and secondary succession as they progress over time | |
| **Critical Language:** | Succession, habitat, species, organism, change, disturbance, population, community, identify, predict, analyze, describe, evaluate, interpret, create | |

| **Learning Experience # 9** | |
|---|---|
| The teacher may provide students with information on human impacts on ecosystems and natural resources such as air, water, forestry, agricultural (soil), so that students will be able to compare and contrast these impacts as long term or short term and local or global in relation to **cycles**. | |
| **Teacher Notes:** | The teacher may provide students with background materials around deforestation and have them determine the impacts on cycles. |
| **Generalization Connection(s):** | Populations are interdependent and fluctuate within an ecosystem due to available resources<br>The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium |
| **Teacher Resources:** | http://www.accessexcellence.org/AE/ATG/data/released/0515-TrumanHoltzclaw/index.php (Lab on duckweed population)<br>http://www.serc.si.edu/labs/co2/co2_overview.aspx (Researching the Effects of Rising Atmospheric CO2 on Plant Communities)<br>http://www.projectnoah.org/education (Project Noah and Project Blitz, citizen science for wildlife population)<br>http://www.aphis.usda.gov/wildlife_damage/nwrc/research/invasive_wildlife/index.shtml (NWS information on wildlife population)<br>Sinclair, A.R., Fryxell, J.M., and Caughley, G. (2006). *Wildlife Ecology, Conservation, and Management 2nd Edition.* Wiley-Blackwell: New York.<br>https://www.populationeducation.org/sites/default/files/the_pop_ecology_files_0.pdf (Worksheet with population data for graphs)<br>http://www.saps.org.uk/secondary/teaching-resources/258-ecology-practical-1-measuring-abundance-and-random-sampling (Student simulation for practicing random sampling)<br>http://www.biologycorner.com/worksheets/ecosystem.html#.UmmALpHDn7I (Construction an ecosystem) |
| **Student Resources:** | http://www.biologycorner.com/flash/mark_recap.swf (Trap and release)<br>http://www.dummies.com/how-to/content/biology-basics-population-ecology.html (Population ecology for dummies) |
| **Assessment:** | Students will choose a major industry or human activity and communicate the types of impacts this activity has on local environmental cycles and global ecosystems. (Presentation, oral report, extended essay, on-line poster, news broadcast, video, |

<table>
<tr><td></td><td colspan="2">etc.)<br>http://www.postermywall.com/index.php/p/classroom-posters (Free classroom poster creator)</td></tr>
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<tr><td>The teacher may use audio visual presentations of content<br>The teacher may use differentiated group work<br>The teacher may determine variables and procedures for the experiments<br>The teacher may provide examples of students prior high quality work<br>The teacher may use writing frames and scaffolds for lab report<br>The teacher may provide graph paper with predetermined scales and labels<br>The teacher may allow students to use photographs and make qualitative analysis if math skills are prohibitive</td><td>The student may create posters or other visual presentations rather than a written product</td></tr>
<tr><td rowspan="2">Extensions for depth and complexity:</td><td>Access (Resources and/or Process)</td><td>Expression (Products and/or Performance)</td></tr>
<tr><td>The teacher may challenge students to design their own experiment, choose variables, create their own procedures for measuring population size, and evaluate the accuracy of several methods for estimating population</td><td>The student may present a lab report with background research and create follow-up questions for future investigation</td></tr>
<tr><td>Critical Content:</td><td colspan="2">• Sustainable/non sustainable use of resources<br>• Long term or short-term impacts<br>• Local environmental impacts versus global impacts to major biogeochemical cycles<br>• Understand a growth rate<br>• Limiting factors prevent a population from growing too large<br>• Carrying capacity is the size of the population that an ecosystem can support<br>• Change to a system (perturbation)<br>• Population measurement techniques/scientific method</td></tr>
<tr><td>Key Skills:</td><td colspan="2">• Categorize<br>• Make connections<br>• Compare and contrast<br>• Evaluate and project impacts<br>• Measure and estimate population size</td></tr>
<tr><td>Critical Language:</td><td colspan="2">Sustainable, sustainable yield, pollution, habitat, land use, carbon foot print, remediation, pollution controls, water quality, growth rate, limiting factor, carrying capacity, exponential growth, birth rate, death rate, extinction event, speciation, compare, contrast, measure, evaluate, categorize, connect, design, present</td></tr>
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| Learning Experience # 10 | | |
|---|---|---|
| The teacher may provide students with information on human impacts on ecosystems and natural resources such as air, water, forestry, agricultural (soil), so that students will be able to compare and contrast these impacts as long term or short term and local or global in relation to **habitats**. | | |
| **Teacher Notes:** | The teacher may provide students with background materials around deforestation and have them determine the impacts on habitats. | |
| **Generalization Connection(s):** | Matter cycling through ecosystems creates opportunities for renewal and survival of populations<br>Populations are interdependent and fluctuate within an ecosystem due to available resources | |
| **Teacher Resources:** | https://www.google.com/search?q=components+of+an+ecosystem&tbm=isch&tbo=u&source=univ&sa=X&ei=jkH9UuqAPYjuqQGWjIDYDw&sqi=2&ved=0CCQQsAQ&biw=1680&bih=930 (Images for components of an ecosystem)<br>http://www.slideshare.net/guest830b45f/two-major-components-of-ecosystem (Slide share for components of an ecosystem)<br>http://www.ucar.edu/learn/1_4_2_20t.htm (Human Activity & Climate Change)<br>http://education.nationalgeographic.com/education/encyclopedia/climate-change/?ar_a=1 (National Geographic - Climate Change Resources) | |
| **Student Resources:** | https://www.google.com/search?q=components+of+an+ecosystem&tbm=isch&tbo=u&source=univ&sa=X&ei=jkH9UuqAPYjuqQGWjIDYDw&sqi=2&ved=0CCQQsAQ&biw=1680&bih=930 (Images for components of an ecosystem)<br>http://www.slideshare.net/guest830b45f/two-major-components-of-ecosystem (Slide share for components of an ecosystem)<br>http://education-portal.com/academy/lesson/fossil-fuels-greenhouse-gases-and-global-warming.html#lesson (Videos and quizzes around climate change) | |
| **Assessment:** | Students will critically analyze and discuss differing opinions on human impacts on ecosystems and natural resources, how they may impact habitats, and report their findings. (e.g., compare and contrast graphic organizer, poster, brochure, debate, etc.)<br><br>http://www.postermywall.com/index.php/p/classroom-posters (Free classroom poster creator)<br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting) | |
| **Differentiation:**<br>(Multiple means for students to access content and multiple modes for student to express understanding.) | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
| | The teacher may provide students with specific scenarios or opinions<br>http://castle.eiu.edu/eiu1111/Critical%20Thinking%20case%20analysis.doc (Critical analysis worksheet)<br>http://education-portal.com/academy/lesson/fossil-fuels-greenhouse-gases-and-global-warming.html#lesson (Videos and quizzes around climate change)<br>The teacher may provide a partially filled in graphic organizer<br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting) | The student may create an artistic representation of human impacts on ecosystems (e.g., diorama, picture, model, etc.) |

| **Extensions for depth and complexity:** | **Access** (Resources and/or Process) | **Expression** (Products and/or Performance) |
|---|---|---|
| | The teacher may assign students the concept of climate change and students will have to discuss possible human impacts on ecosystems and resources | The student may create a public service announcement around climate change and human impacts |
| **Critical Content:** | • Ecosystems within the biosphere are complex, dynamic, and include many components<br>• What is climate change?<br>• What are possible causes of climate changes?<br>• How does human activity impact climate?<br>• Consumption of fossil fuels & the impact of that consumption of climate | |
| **Key Skills:** | • Critically analyzing climate change data for validity & reliability | |
| **Critical Language:** | Climate, climate change, time scales, fossil fuels, discuss, analyze | |

| **Learning Experience # 11** |
|---|
| The teacher may provide students with information on human impacts on ecosystems and natural resources such as air, water, forestry, agricultural (soil), so that students will be able to compare and contrast these impacts as long term or short term and local or global in relation to **food webs**. |

| | |
|---|---|
| **Teacher Notes:** | The teacher may provide students with background materials around deforestation and have them determine the impacts on food webs. |
| **Generalization Connection(s):** | Populations are interdependent and fluctuate within an ecosystem due to available resources<br>The struggle for energy and resources by populations within an ecosystem strives toward balance/equilibrium |
| **Teacher Resources:** | http://www.gould.edu.au/foodwebs/kids_web.htm (Gould league Food web creators)<br>https://www.google.com/search?q=Trophic+level&sa=X&stick=H4sIAAAAAAAAAGOovnz8BQMDAx8HsxKXfq6-QVJSRUZhlWLY6sc-_LtNw_Tvu_SJTH2onP_DBwBjqGn_KwAAAA&tbm=isch&tbo=u&source=univ&ei=HkH9UpWPMOrAyAGjtoGwBw&ved=0CDAQsAQ&biw=1680&bih=930 (Images for trophic levels)<br>http://www.globalchange.umich.edu/globalchange1/current/lectures/kling/energyflow/highertrophic/trophic2.html (Lesson for trophic levels and energy transfer)<br>Sinclair, A.R., Fryxell, J.M., and Caughley, G. (2006). *Wildlife Ecology, Conservation, and Management 2nd Edition.* Wiley-Blackwell: New York.<br>https://www.populationeducation.org/sites/default/files/the_pop_ecology_files_0.pdf (Worksheet with population data for graphs)<br>http://www.saps.org.uk/secondary/teaching-resources/258-ecology-practical-1-measuring-abundance-and-random-sampling (Student simulation for practicing random sampling)<br>http://www.biologycorner.com/worksheets/ecosystem.html#.UmmALpHDn7I (Construction an ecosystem) |

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<tr><td>Assessment:</td><td colspan="2">Students will revisit the industry or human activity from learning experience # 9 and communicate the types of impacts this activity has on local environments food webs and global ecosystems (e.g., presentation, oral report, extended essay, on-line poster, news broadcast, video, etc.)<br><br>http://www.postermywall.com/index.php/p/classroom-posters (Free classroom poster creator)<br><br>http://www.eisd.net/cms/lib04/TX01001208/Centricity/Domain/599/DoubleBubbleMap.pdf (Thinking map for comparing and contrasting)</td></tr>
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|---|---|
| **Critical Content:** | • Food webs are complex and include every organism within the ecosystem<br>• Organisms interact with each another in a variety of ways, and are dependent upon one another<br>• Removal of organisms from a food web can cause a dramatic impact on the other populations within the web<br>• Sustainable/non sustainable use of resources<br>• Long term or short-term impacts<br>• Local environmental impacts versus global impacts to major biogeochemical cycles.<br>• Understand a growth rate<br>• Limiting factors prevent a population from growing too large<br>• Carrying capacity is the size of the population that an ecosystem can support<br>• Change to a system (perturbation)<br>• Population measurement techniques/scientific method |
| **Key Skills:** | • Categorize<br>• Make connections<br>• Compare and contrast<br>• Evaluate and project impacts<br>• Measure and estimate population size |
| **Critical Language:** | Sustainable, sustainable yield, pollution, habitat, land use, carbon foot print, remediation, pollution controls, water quality, growth rate, limiting factor, carrying capacity, exponential growth, birth rate, death rate, extinction event, speciation, compare, contrast, measure, evaluate, categorize, connect, design, present |