# APS Science Curriculum Unit Planner

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<th>Grade Level/Subject</th>
<th>10/11-Environmental Science Unit 2 Ecology</th>
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## Enduring Understanding

Organisms interact with each other and their environments, have certain needs, and can survive only in environments where their needs can be met.

### Correlations

- Changes in population sizes relate to environmental conditions
- Organisms effect one another’s survival and environment
- The environment effects where and how and organism lives
- It is important to protect biodiversity
- Our universe is composed of various forms of matter and energy that exist, interact, and change in a variety of ways.
- Our world is comprised of a multitude of interrelated systems.
- Patterns and cycles exist in nature.
- Living things have survival needs.
- Humans have both positive and negative impacts on the earth.

### VA SOL

**BIO.7**

The student will investigate and understand how populations change through time. Key concepts include:

- how genetic variation, reproductive strategies, and environmental pressures impact the survival of populations;
- how natural selection leads to adaptations;
- emergence of new species; and scientific evidence and explanations for biological evolution

**BIO.8**

The student will investigate and understand dynamic equilibrium within populations, communities, and ecosystems. Key concepts include:

- interactions within and among populations including carrying capacities, limiting factors, and growth curves;
- succession patterns in ecosystems;
- the effects of natural events and human activities on ecosystems; and
- analysis of the flora, fauna, and microorganisms of Virginia ecosystems.

### NSES (grade level)

### AAAS Atlas

## Essential Questions

- What factors interact to determine population size?
- What are the key mechanisms of evolution and speciation?
- How do ecosystems change over time?
- What are the Earth’s major ecosystems/biomes and how are they changing now?
- How do living things and their environment interact?
- Does the earth have a carrying capacity?
• How are most living things dependent on the sun?
• How is energy transferred through a system? How does energy move? Where does it go?
• What is a system? How do systems interact?
• How do living things obtain and use energy?
• Why is biodiversity important? How does evolution impact biodiversity?
• How do humans impact the stability and diversity of their environment? Specifically, how have humans impacted the Chesapeake Bay and its tributaries?
• Is it possible for humans to live without adversely impacting the environment?
• How is the work of an ecologist different from the work of a cell biologist? How is their work similar?
• Who is responsible for protecting the environment?

Knowledge and Skills
Students should know:
• Ecologist study life at various levels, including individual organisms, species, populations, communities, ecosystems, and the entire biosphere
• Ecosystems include both biotic and abiotic factors
• Organisms utilize resources that exist in their habitat for survival
• The health of a population can be estimated by following how its size changes
• Population density is the number of organisms in a given and describes crowding
• Population can be distributed randomly, uniformly, or in clumps
• Age structure diagrams show the number of females and males in various age categories within a population
• Population growth rate is determined by births, deaths, immigration and emigration
• Populations growth can be exponential or logistic
• Exponential growth rarely persists for long periods of time
• The growth of most populations remains close to its carrying capacity due to limiting factors in the environment
• Limiting factors and biotic potential determine a population’s growth capacity
• Limiting factors can be density dependent or density independent
• Biological evolution can occur through mutation, migration, genetic drift, and natural selection
• Natural selection occurs when more organisms are born than can survive, heritable variation exists, and there is variable reproduction among those organisms
• Speciation and extinction are the two processes that combine to produce the diversity of life on Earth
• An organism’s niche is affected by both its environmental tolerances and competitive interactions
• Predation, herbivory, and parasitism are interactions in which one species benefits while the other is harmed
• Mutualism and commensalism are relationships in which neither species is harmed
• Organisms are classified as autotrophs (producers) or heterotrophs (consumers) based on how they nutrients and energy
• Only about 10% of energy is transferred from one trophic level to the next
• Feeding relationships have both direct and indirect effects on organisms in the community
• Following a disturbance, communities may undergo ecological succession
• Without limiting factors, species introduced to a new area may become invasive
• Biomes are characterized by their typical plant and animal life which is determined by climate
• Annual temperature and rainfall patterns are reflected in climatographs
• Net primary productivity varies depending on biome type.
• Warm wet biomes are more productive than cold dry ones
• There are ten major biomes; tundra, boreal forest, chaparral, temperate grassland, temperate forest, temperate rain forest, tropical rain forest, desert, and savanna
• Organisms show specific adaptations to the biomes in which they live
• Polar ice and mountains are not classified as biomes
• Most polar life is aquatic
- Environmental conditions on mountains change drastically with altitude
- Salinity, depth and rate of flow are used to help classify aquatic ecosystems
- Lakes, ponds, wetlands, and inland seas are all forms or standing freshwater ecosystems
- Rivers and streams represent flowing freshwater ecosystems
- Estuaries are important, diverse ecosystems that help protect coastal areas from flooding and erosion
- The three main divisions of the ocean biomes are based on their distance from shore and are intertidal, neritic, and open ocean
- There are three key types of diversity: species diversity, genetic diversity, and ecosystem diversity
- Biodiversity varies by geographic location and taxonomic group
- Biodiversity contributes to a region’s ability to provide clean water, food, medicine, recreation, and other valuable services
- Scientists have tracked significantly higher rates of extinction in recent decades
- Endanger species are likely to become extinct and threatened species are likely to be soon be classified as endanger
- Key causes of biodiversity loss are over harvesting, habitat destruction, pollution, and invasive species
- Climate change is a factor that is affecting biodiversity and may become the dominant factor in the future
- Laws may help protect biodiversity
- A variety of approaches are being used to help protect biodiversity, including the hotspot approach, wildlife corridors, and conservation concessions

**Students should be able to:**

- Compare and contrast an organism’s ecosystem and its habitat.
- Predict the growth future growth of a population based on an age structured diagram.
- Infer the needs and possible life styles of organisms that live in various distribution patterns.
- Compare and contrast the lives of organisms with each type of survivorship curve (I, II, and III).
- Analyze ecological case studies.
- Discuss carrying capacity and various population growth curves typical of different species.
- Explain symbiosis and site examples of the various types.
- Draw and label food webs showing trophic levels, energy flow, and types of consumers or producers
- Explain the mechanisms that drive evolution and speciation.
- Compare and contrast cellular respiration and photosynthesis.
- Analyze the effects of invasive species. Use Virginia as an example.
- Model ecological succession.
- Describe the major terrestrial and aquatic biomes.
- Explain why rainforest only remains ecologically productive as rainforest, not when cleared for farmland while the same is not true for grassland.
- Explain how climate change is affecting the tundra.
- Explain the ecological importance of wetlands and estuaries and predict the effects of their disappearance.
- Explain the fact that the open ocean is one of the least productive places on Earth but it contributes greatly to Earth’s overall productivity.
- Describe where and why on Earth (what biome) is habitat disappearing most quickly since 1950.
- Explain ecotourism and analyze the helpful and harmful effects it may have on an area.
- Analyze evidence showing we are in the sixth mass extinction and the major causes.
- Describe how declining biodiversity relates to medicine and agriculture.
- Analyze the effects of removing a top predator from and ecosystem.
- Read and interpret environment protection law as it relates to the Endanger Species Act
- Analyze real environmental problems and issues faced by the community and the world.

### Stage 2: Assessment Evidence

**Prior Knowledge and Skills**

- Successful completion of two of the three following courses Biology, Chemistry, or Earth Science

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### Stage 3: Learning Plan

#### References to Adopted Materials

- **Pearson – Environmental Science (textbook)**
  - Chapter 4 pg 98-123
  - Chapter 5 pg 124-161
  - Chapter 6 pg 162-197
  - Chapter 7 pg 198-224

#### Suggested Investigations

- Real Data pg 112
- Fishing for the future
- Lesson of the Kaibab
- Oh Deer!
- Cloudless Forest pg 118-119
- Ecological Footprints pg 123
- Broken Mutualism pg 156-157
- Ecological footprints pg 161
- Real data pg 179
- Ecological footprint pg 197
- Real data pg 214

#### Outdoor Education Applications

- Stream studies/ water quality
- Erosion and soil sampling
- Quadrant studies

#### Resources

#### Web Sites

- [http://www.learner.org/courses/envsci/](http://www.learner.org/courses/envsci/)
- [http://www2.epa.gov/learn-issues](http://www2.epa.gov/learn-issues)
- [http://www.hippocampus.org/](http://www.hippocampus.org/)
- [http://www.eoearth.org/](http://www.eoearth.org/)
- [http://www.youtube.com/user/APESinaBOX?feature=mhee](http://www.youtube.com/user/APESinaBOX?feature=mhee)
- [http://cnx.org/content/col10548/latest/](http://cnx.org/content/col10548/latest/)
- [http://www.bbc.co.uk/learning/subjects/environmental_studies.shtml](http://www.bbc.co.uk/learning/subjects/environmental_studies.shtml)
- [http://video.sciencemag.org/Featured/0/1/environmental_science](http://video.sciencemag.org/Featured/0/1/environmental_science)
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