# APS Science Curriculum Unit Planner

## Grade Level/Subject
10/11 - Environmental Science Unit 4 Earth’s Resources

## Enduring Understanding
We need to use Earth’s finite resources in a sustainable way.

## Correlations
### Unifying Understanding
- Our forests are important renewable resources which must be managed sustainably.
- Soil is a complex ecosystem and its maintenance and preservation is important to our food security.
- Agriculture has changed greatly throughout human history as we try to meet the growing needs of our population and make new technological advances.
- Rocks and minerals are mined in a number of different ways, all of which have varying environmental, health, and economic impacts.
- Freshwater is a very precious resource that is available in limited amounts.
- Freshwater supplies must be protected to prevent its pollution and overuse.
- Earth’s atmosphere is very important to its climate and weather patterns.
- Air pollution comes in many forms and must be reduced to prevent global warming, threats to human health, and undue changes to ecosystems.

### VA SOL
<p>| BIO.5 | The student will investigate and understand common mechanisms of inheritance and protein synthesis. Key concepts include j) exploration of the impact of DNA technologies. |
| BIO.8 | The student will investigate and understand dynamic equilibria within populations, communities, and ecosystems. Key concepts include d) the effects of natural events and human activities on ecosystems |
| ES.1  | The student will plan and conduct investigations in which a) volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools; b) technologies, including computers, probeware, and geospatial technologies, are used to collect, analyze, and report data and to demonstrate concepts and simulate experimental conditions; c) scales, diagrams, charts, graphs, tables, imagery, models, and profiles are constructed and interpreted; d) maps and globes are read and interpreted, including location by latitude and longitude; e) variables are manipulated with repeated trials; and f) current applications are used to reinforce Earth science concepts. |</p>
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| **ES.4** The student will investigate and understand how to identify major rock-forming and ore minerals based on physical and chemical properties. Key concepts include  
  b) uses of minerals.  
| **ES.5** The student will investigate and understand the rock cycle as it relates to the origin and transformation of rock types and how to identify common rock types based on mineral composition and textures. Key concepts include  
  a) igneous rocks;  
  b) sedimentary rocks; and  
  c) metamorphic rocks.  
| **ES.8** The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans. Key concepts include  
  a) processes of soil development;  
  c) relationships between groundwater zones, including saturated and unsaturated zones, and the water table;  
  d) identification of sources of fresh water including rivers, springs, and aquifers, with reference to the hydrologic cycle;  
  e) dependence on freshwater resources and the effects of human usage on water quality; and  
  f) identification of the major watershed systems in Virginia, including the Chesapeake Bay and its tributaries.  
| **ES.10** The student will investigate and understand that oceans are complex, interactive physical, chemical, and biological systems and are subject to long- and short-term variations. Key concepts include  
  e) economic and public policy issues concerning the oceans and the coastal zone including the Chesapeake Bay.  
| **ES.11** The student will investigate and understand the origin and evolution of the atmosphere and the interrelationship of geologic processes, biologic processes, and human activities on its composition and dynamics. Key concepts include  
  c) atmospheric regulation mechanisms including the effects of density differences and energy transfer; and  
  g) potential changes to the atmosphere and climate due to human, biologic, and geologic activity.  
| **ES.12** The student will investigate and understand that energy transfer between the sun and Earth and its atmosphere drives weather and climate on Earth. Key concepts include  
  h) weather phenomena and the factors that affect climate including radiation, conduction, and convection.  
| **Essential Questions** |
| - How can we manage renewable resources for sustainable use?  
- What are some examples of sustainable forestry?  
- What is soil and why is it important?  
- How do erosion, desertification, and soil pollution affect the productivity of soil?  
- How has agriculture evolved?  

**NSES (grade level)**

**AAAS Atlas**

**Essential Questions**

- How can we manage renewable resources for sustainable use?  
- What are some examples of sustainable forestry?  
- What is soil and why is it important?  
- How do erosion, desertification, and soil pollution affect the productivity of soil?  
- How has agriculture evolved?
**How can we balance our growing demand for food with our need to protect the environment?**

**How do different methods of farming impact our society and environment?**

**Where do minerals come from and how are they mined?**

**How can we regulate mining to reduce its negative impacts?**

**Where are our sources of freshwater?**

**What are some threats to our freshwater supply?**

**How can we decrease our freshwater usage?**

**What watershed is Arlington, VA part of? What are the threats to our watershed?**

**How does water pollution affect humans and ecosystems?**

**How can we limit and prevent water pollution?**

**What are the properties and structure of Earth’s atmosphere?**

**How can we ensure everyone has clean air to breathe?**

**What are the sources of air pollution?**

**How can we limit and prevent pollution of the atmosphere?**

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<tr>
<td><strong>Students should know:</strong></td>
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<tr>
<td>- Forest resources have great ecological and economic value.</td>
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<td>- There are costs and benefits to every method of timber harvesting.</td>
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<td>- Logging in national forests is managed by the Forest Service, but profits go to timber companies.</td>
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<td>- Most logging in the U.S. occurs on tree plantations owned by timber companies.</td>
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<td>- Suppression of all wildfires can endanger ecosystems, property, and people.</td>
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<td>- Soil is a complex substance that forms through weathering, deposition, and decomposition.</td>
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<td>- Soil consists of different layers (horizons), which are comprised of different materials.</td>
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<td>- Soils can be classified by their color, texture, structure, and pH.</td>
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<td>- Certain farming, ranching, and forestry practices can erode soil, but other practices can protect it.</td>
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<td>- Desertification is the reduction of soil productivity in arid lands.</td>
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<td>- Agriculture began about 10,000 years ago.</td>
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<td>- Industrial agriculture and the green revolution have saved millions of people from starvation.</td>
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<td>- Different types of pest controls and their cost and benefits.</td>
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<td>- Insects and other animals are essential to the reproduction of many crops.</td>
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<td>- Some pollinators are threatened with extinction.</td>
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<td>- Genetically modified organisms contain genes from other organisms, which are meant to produce a desirable trait.</td>
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<td>- Genetically modified food is a promising way to increase food production, but with it come potential risks.</td>
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<td>- Industrial agriculture is efficient but has a number of disadvantages.</td>
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<td>- Monoculture has a negative effect on plant diversity and soil health.</td>
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<td>- Sustainable alternatives to industrial agriculture include organic agriculture and locally supported agriculture.</td>
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<td>- Minerals are naturally occurring, inorganic, and a solid with a variety of distinguishing properties.</td>
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<td>- Minerals can be produced in a number of different ways – cooling of lava, heat and pressure, or by organisms.</td>
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<td>- Rocks are solid mass of minerals. They can be made of one or many types of minerals bonded together.</td>
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<td>- The three types of rocks are sedimentary, metamorphic, and igneous and changes in Earth can cause rocks to cycle between the three types.</td>
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<td>- Mining can be done at Earth’s surface, deep underground, and even underwater.</td>
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<td>- Mined materials must be processed to get desired materials.</td>
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<td>- Environmental impacts of mining include increased erosion, sediment and debris, pollution, and social impacts.</td>
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<td>- Minerals are nonrenewable resources and must be regulated, reused, and recycled.</td>
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<td>- Freshwater is a renewable resource; however quantities are limited, and distributed unevenly throughout Earth.</td>
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<td>- Surface water is contained within watersheds.</td>
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• Groundwater can be accessed by wells.
• Because of overuse, surface water and groundwater resources are being depleted
• Desalinization, modified agricultural, industrial, and personal choices can decrease freshwater usage.
• Point-source water pollution comes from distinct locations; nonpoint-source pollution comes from many places spread over a large area.
• Groundwater pollution is particularly hard to clean up.
• Regulation and water treatment are ways of decreasing the effects of water pollution.
• Arlington, VA is part of the Chesapeake Bay Watershed.
• The Chesapeake Bay watershed is large and shallow and is threatened with overfishing and pollution.
• Earth’s atmosphere is composed of 4 distinct layers with different properties.
• The properties of the atmosphere include its composition, relative humidity, temperature, and air pressure.
• Weather is due to heat transfer and the interaction of air masses in the troposphere.
• Air pollution can be caused by natural processes such as forest fires and volcanic eruptions as well as by human sources such as the burning of fossil fuels.
• Air pollutants can cause damage to the respiratory system and can cause cancer.
• Smog is caused by temperature inversions that keep the pollution from dispersing.
• Acid deposition can have negative effects on ecosystems.
• The Clean Air Act has provision that have reduced air pollution in the U.S.
• Nations have taken successful steps to deal with the problem of ozone loss in the stratosphere.

Students should be able to:
• Explain the importance of managing specific renewable resources.
• List some of the ecological and economic values of forest resources.
• Describe the costs and benefits of the different methods of timber harvesting.
• Compare and contrast deforestation in the United States and in developing nations.
• Explain how logging is managed in the U.S. and where it takes place.
• Discuss the potential effects that fire suppression may have on an ecosystem and on future fires.
• Explain three processes by which soil forms.
• Compare and contrast the horizons that make up a soil profile.
• List the four characteristics used to classify soil.
• Analyze a soil sample to determine its characteristics.
• Describe some practices that can lead to soil erosion and some that can prevent it.
• Discuss the causes and effects of desertification.
• Explain how irrigation and pesticide use can cause soil pollution.
• Compare and contrast traditional, industrial, and sustainable agriculture.
• Explain the importance of industrial agriculture and the green revolution.
• Compare and contrast different types of pest control.
• Explain the importance of pollinators to agriculture and that many are threatened with extinction.
• Infer the consequences of pollinator extinction.
• Explain and give examples of genetically modified organisms.
• Evaluate the safety of genetically modified food – environmentally and health wise.
• Discuss different types of sustainable agriculture.
• Discuss the costs and benefits of industrial agriculture.
• Judge the advantages and disadvantages to organic agriculture and locally supported agriculture.
• Compare and contrast rocks and minerals.
• Identify types of rocks and the stages of the rock cycle.
• Identify the types of resources that are mined.
• Describe different methods used for mining.
• Explain how metals are processed.
• Describe the negative impacts of mining.
• Explain how mining is regulated.
- Discuss how fresh water can be both renewable and limited
- Explain the significance of a watershed.
- Describe the physical characteristics of the Chesapeake Bay Watershed.
- Evaluate how the Chesapeake Bay Watershed has been affected by overfishing and pollution.
- Discuss ways the Chesapeake Bay Watershed can be saved.
- Explain how most groundwater is accessed.
- Describe the major causes and effects of groundwater depletion.
- Describe solutions for freshwater depletion.
- Discuss the main categories of water pollution and their challenges.
- Discuss the sources and effects of major pollutants found in the ocean.
- Describe how water is regulated and treated.
- Describe the properties and structure of Earth’s atmosphere.
- Explain what causes weather.
- Explain natural processes and human activities that can cause air pollution.
- Describe how air pollutants affect human health.
- Explain the causes and effects of smog and acid rain.
- Explain how the provisions of the Clean Air Act have reduced air pollution in the U.S.
- Describe international efforts to reduce the ozone hole.
## Stage 2: Assessment Evidence

### Prior Knowledge and Skills
Successful completion of two out of three of Biology, Chemistry, or Earth Science

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## Stage 3: Learning Plan

### References to Adopted Materials
- Pearson-Environmental Science (textbook)
  - Chapter 11 pg 324-349
  - Chapter 12 pg 350-389
  - Chapter 13 pg 390 – 417
  - Chapter 14 pg 418 – 449
  - Chapter 15 pg 450 - 480
- Cartoon Guide to the Environment

### Chapter 12 Supplemental Reading Materials
- **Grapes of Wrath** (John Steinbeck) – Chapter 1 (description of American Dust Bowl)
- **Botany of Desire** (Michael Pollan) – The Natural History of 4 plants and how they relate to humans
  - The Apple - gives truth about Johnny Apple Seed, Importance of Pollinators, really interesting natural history.
  - The Potato – discusses the pros and cons of genetically modified food and monoculture.
- **Omnivores’ Dilemma Young Readers Edition** (Michael Pollan) – Interesting investigation and comparison of industrial, big organic and local sustainable agriculture. Highlights Polyface Farms which is only 3 hours from Arlington! (Field Trip!)

### Suggested Investigations

#### Chapter 11 (Forestry and Resource Management)
- Making Recycled Paper Lab (myenvironmentalscience.com)
- Your National Forests Research (myenvironmentalscience.com)
- Research the Green Belt Movement and Wangari Maathai’s efforts to reforest Africa

#### Chapter 12 (Soil & Agriculture)
- **Properties of Soil Lab** – students collect soil samples, analyze them (see websites below for hands-on texture test), and compare.
- Testing Soil Properties Lab (myenvironmentalscience.com)
- Combating Erosion Modeling Lab (myenvironmentalscience.com)
- Local Planting Conditions Research Lab (myenvironmentalscience.com)
- **Research a Pest** – Online activity
- **Genetically Modified Food Mock-Congressional Hearing** – Students research the different sides of the debate about GMFs and represent perspectives on the issue at a mock-congressional hearing. Afterward, they come up with their own personal statement regarding the topic.
- **Soil and Agriculture Open Inquiry Lab** (Level 4) Students explore salinization, acid rain, etc. They choose the topic, design the experiment, and report out.
Chapter 13 (Mineral Resources and Mining)
- Mineral Identification Lab (myenvironmentalscience.com)
- Cookie Mining Lab (www.geocities.com/hotspur311/cookielab3.pdf)
- Mountaintop Coal Mining Role Play – students research different sides of the debate and form arguments for or against it based on their role.

Chapter 14 (Water Resources)
- Watershed Boundaries Topographic Map Activity (myenvironmentalscience.com)
- The Water You Drink – Internet research activity (myenvironmentalscience.com)
- Testing Water Quality Outdoor Lab (myenvironmentalscience.com)
- Water Use Inventory (http://teachers.sduhsd.k12.ca.us/bbodas/Water%20Use%20Inventorybodas%202012.pdf)
- Oil Spill Inquiry Lab – students devise the best methods and materials to clean up a simulated oil spill.

Chapter 15 (The Atmosphere)
- Acid Rain and Seeds Lab (myenvironmentalscience.com)
- What’s in the Air Lab – Air particulate monitoring (myenvironmentalscience.com)
- Troposphere Ozone Lab (http://teachers.sduhsd.k12.ca.us/bbodas/Bodas%20ozone%20lab%202009.pdf)
- Smog City 2 Online Lab (http://www.smogcity2.org/)

Outdoor Education Applications
- Start a schoolyard garden
- Take soil samples from around school and analyze them
- Visit a local farm (see field trips below)
- Test the water quality of local streams
- Go on a field trip through the Chesapeake Bay Foundation
- Do a “rock walk” field trip at Great Falls Park
- Air particulate monitoring lab around school grounds

Resources
Web Sites
- Earth as and Apple – shows how much available soil is on Earth (http://www.farmland.org/images/flash/apple.swf)
- Guide to hands-on soil texture test (http://www.savesfbay.org/sites/default/files/Soil%20Texture%20Feel%20Test.pdf)
- The Hidden Water We Use – National Geographic Online Interactive (http://environment.nationalgeographic.com/environment/freshwater/embedded-water/)

Videos
Chapter 11 (Forestry and Resource Management)
- THE LORAX – quintessential film about unregulated resources use and its environmental and social effects.
Chapter 12 (Soil & Agriculture)
- KING CORN 2007 - King Corn is a feature documentary about two friends, one acre of corn, and the subsidized crop that drives our fast-food nation. In the film, Ian Cheney and Curt Ellis, best friends from college on the east coast, move to the heartland to learn where their food comes from. With the help of friendly neighbors, genetically modified seeds, and powerful herbicides, they plant and grow a bumper crop of America’s most-productive, most-subsidized grain on one acre of Iowa soil. But when they try to follow their pile of corn into the food system, what they find raises troubling questions about how we eat—and how we farm.
- **FOOD INC 2008** - The rock stars of the ethical eating movement — Michael Pollan and Eric Schlosser — weigh in on all that is wrong in America’s industrialized food system. Methinks my son summed up this film best: “Sometimes the scariest films are the ones that are real.”

- **QUEEN OF THE SUN: What Are the Bees Telling Us?** – 2010 - This film documents the surprising importance of the lowly honeybee, describing how bees’ pollinating activities play a crucial role in the food chain and how recent catastrophic “colony collapses” could interrupt global food production.

- **THE GARDEN** – 2008 - Award-winning documentary about a highly-politicized patch of green and the community who cultivated it in South Central Los Angeles. The saga of this urban garden and its people. A group of mostly working class, Latino South Central Farmers fought the good fight — and they’re still at it — for the basic human need to grow food.

- **BOTANY OF DESIRE MOVIE** – 2009 - Featuring Michael Pollan and based on his best-selling book, this special takes viewers on an eye-opening exploration of the human relationship with the plant world, seen from the plants’ point of view. The program shows how four familiar species -- the apple, the tulip, cannabis and the potato -- evolved to satisfy our yearnings for... Full video can be found here ([http://video.pbs.org/video/1283872815/](http://video.pbs.org/video/1283872815/))

Chapter 13 (Mineral Resources and Mining)

- **GASLAND** – 2010 - In this Oscar-nominated documentary, director Josh Fox journeys across America to examine the negative effects of natural-gas drilling, from poisoned water sources to kitchen sinks that burst into flames to unhealthy animals and people.

- **HARLAN COUNTRY U.S.A.** – 1976 – Award winning documentary chronicling the social, health, and economic impacts that mining can have in small, poor, coal-mining towns.

Chapter 14 (Water Resources)

- **TAPPED** – 2009 - The high cost -- to both the environment and our health -- of bottled water is the subject of this documentary that enlists activists, environmentalists, community leaders and others to expose the dark side of the bottled water industry. Americans may rethink their obsession with bottled H2O when they learn of the unregulated industry’s willingness to ignore environmental and health concerns, and the problems that arise as a result.

- **FLOW: For the Love of Water** FLOW is an award-winning documentary investigation by Irena Salina into the growing privatization of the world’s dwindling fresh water supply.

- **POISONED WATERS** – PBS special with sections highlighting the Chesapeake Bay and DC ([http://www.pbs.org/wgbh/pages/frontline/poisonedwaters/view/](http://www.pbs.org/wgbh/pages/frontline/poisonedwaters/view/))

Chapter 15 (The Atmosphere)

- **THE ISLAND PRESIDENT** – 2011 - After bringing democracy to his country, President Mohamed Nasheed of the Maldives, the lowest-lying country in the world, takes up the fight to keep his homeland from disappearing under the sea due to global warming and the burning of fossil fuels.

- **INCONVIENT TRUTH**
### Online clips

- **Wangari Maathai Tribute Film.** Nobel Laureate started the Green Belt movement, critical to reforestation efforts in Africa. - [http://www.youtube.com/watch?v=BQU7JOxKGvo](http://www.youtube.com/watch?v=BQU7JOxKGvo)
- **Polyface Sustainable Farm Video.** [http://www.youtube.com/watch?v=KxTfQpv8xGA](http://www.youtube.com/watch?v=KxTfQpv8xGA)
- **Dust Bowl Video.** [http://www.history.com/topics/dust-bowl/videos#black-blizzard](http://www.history.com/topics/dust-bowl/videos#black-blizzard)
- **Great Pacific Garbage Patch (Water Pollution) news clip.** [http://www.youtube.com/watch?v=WtewmJ78hzw](http://www.youtube.com/watch?v=WtewmJ78hzw)

### Field Trips

Visit a local, sustainable farm

- **Potomac Vegetable Farm** is very close. The farm is small but they do give very nice tours. - [http://www.potomacvegetablefarms.com/](http://www.potomacvegetablefarms.com/)
- **Polyface Farm.** The most famous farm in the U.S. right now and only 3 hours from D.C. If you can get your kids here, you will not regret it. They give a really nice, inexpensive, hands-on tour. [http://www.polyfacefarms.com/farm-tours/](http://www.polyfacefarms.com/farm-tours/)

- **“Rock Walk”** Guided tour at Great Falls Park
- **Water Quality Stream Study** – there are numerous opportunities at parks in the County such as Potomac Overlook Park.

- **Visit the Chesapeake Bay Watershed** – check out 1 and 3 day field trip opportunities through the Chesapeake Bay Foundation. The 3-day trips are fantastic. There is also a 1 day trip that leaves out of DC. ([http://www.cbf.org/join-us/education-program/student-field-programs](http://www.cbf.org/join-us/education-program/student-field-programs))

- **Outdoor Lab** – Stream study, water quality testing, forest study