

Curriculum Development  
In the Fairfield Public Schools

**FAIRFIELD PUBLIC SCHOOLS**  
FAIRFIELD, CONNECTICUT

**ENVIRONMENTAL EARTH SCIENCE 11**

APPROVED 05/22/2007

## **ENVIRONMENTAL EARTH SCIENCE 12**

### **Statement of Purpose**

Science education promotes essential understandings of the natural world and nurtures students' abilities to apply scientific knowledge to make informed and logical judgments about personal and societal issues. As such, this education requires that the fundamental approach to science be a creative and logical process for investigating, reasoning, critiquing and communicating about ideas, not just a static body of facts to be memorized. Understanding the interconnections between science and technology and their shared impact on the environment and societal issues is essential for all students. Environmental Earth Science gives students the knowledge of our dynamic Earth processes and the effect that these processes have on the entire population of our planet.

### **Audience**

Grade 9 students

### **Prerequisites**

Recommendation by Science Teacher and Guidance Counselor

### **Design and Description**

This laboratory-based course will provide students with a solid foundation in Environmental and Earth Sciences and will prepare them for entry into the Advanced Placement Program®. Topics that will be covered include energy sources and transformations, polymers and their uses, sources and impacts of pollution and preservation of our Earth. Students in this course are capable of handling primary source material for reference and can work independently.

### **Course Objectives**

Students will be able to:

- Relate basic components of an electrical circuit.
- Analyze the relationship among voltage, current and resistance.
- Predict the relationship between current and magnetism.
- Display data using appropriate visuals (graphs, charts).
- Create a simple series circuit.
- Trace the energy conversions involved in the production of electricity.
- Compare and contrast various types of energy sources used to produce electricity.
- Differentiate monomers and polymers.
- Trace the origins of monomers that create synthetic polymers.
- Connect that different monomers combine in long chains to form polymers with different physical properties.
- Categorize polymers according to their properties.
- Debate the use landfills and incineration as disposal methods.
- Analyze the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.
- Differentiate between acids and bases using the pH scale.
- Contrast various greenhouse gases ( CO<sub>2</sub>, NO<sub>x</sub>, methane, SO<sub>2</sub>, water vapor).

- Analyze sources of sulfur dioxide (SO<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>).
- Construct the chemical equations for sulfuric acid formed in the atmosphere.
- Debate the impact of acid deposition on organisms and human made structures.
- Summarize the impact of carbon dioxide on global climate change.
- Categorize the sources and effects of other types of water pollution (mercury, nitrates, and phosphates).
- judge the human impact on the air, land and water due to:
  - Electricity generation
  - Landfills and incineration
  - Agriculture
- Evaluate the efforts to reduce the impacts of these activities on our environment.
- Analyze the risks and benefits of possible solutions to pollution.

### **Science Standards**

#### ***Scientific Inquiry (used in all units)***

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
- Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation.
- Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.

#### ***Scientific Literacy (used in all units)***

- Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science.
- Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media.

#### ***Scientific Numeracy***

**Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.**

Students will identify questions that can be answered through scientific investigation.

Students will read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Students will formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Students will design and conduct appropriate types of scientific investigations to answer different questions.

Students will identify independent and dependent variables, including those that are kept constant and those used as controls.

Students will assess the reliability of the data that was generated in the investigation.

***Energy Transformations – Energy Transfer and Transformations***

**Energy cannot be created or destroyed; however, energy can be converted from one form to another.**

Students will describe the effects of adding energy to matter in terms of motion of atoms and molecules, and the resulting phase changes.

Students will explain how energy is transferred by conduction, convection and radiation.

Students will describe energy transformations among heat, light, electricity and motion.

***Energy Transformations - Energy Transfer and Transformations***

**The electrical force is a universal force that exists between any two charged objects.**

Students will explain the relationship among voltage, current and resistance in a simple series circuit.

Students will explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.

Students will describe the relationship between current and magnetism.

***Energy Transformations - Science and Technology in Society***

**Various sources of energy are used by humans and all have advantages and disadvantages**

Students will explain how heat is used to generate electricity.

Students will describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

Students will describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

***Chemical Structures and Properties – Properties of Matter***

**Due to its unique chemical structure, carbon forms many organic and inorganic compounds.**

Students will describe combustion reactions of hydrocarbons and their resulting by-products

***Chemical Structures and Properties - Science and Technology in Society***

**Chemical technologies present both risks and benefits to the health and well being of humans, plants and animals.**

Students will explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.

Students will explain how the chemical structure of polymers affects their physical properties.

Students will explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

### ***Global Interdependence – The Changing Earth***

**Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.**

Students will explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.

Students will explain how solar energy causes water to cycle through the major earth reservoirs.

Students will explain how internal energy of the Earth causes matter to cycle through the magma and the solid Earth.

### ***Global Interdependence – Science and Technology in Society***

**The use of resources by human populations may affect the quality of the environment.**

Students will explain how the release of sulfur dioxide (SO<sub>2</sub>) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human made structures.

Students will explain how the accumulation of carbon dioxide (CO<sub>2</sub>) in the atmosphere increases Earth's greenhouse effect and may cause climate change.

Students will explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

**Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.**

Students will explain how land development, transportation options and consumption of resources may affect the environment.

Students will describe human efforts to reduce the consumption of raw materials and improve air and water quality.

### **Information and Technology Standards (to be added)**

#### **Essential Questions**

- How is scientific knowledge created and communicated?
- What is the role of energy in our world?
- How do materials cycle through the Earth's systems?
- How do science and technology affect the quality of our lives?

### **Focus Questions**

- What is electricity?
- Why is electricity important to us?
- How does electricity travel?
- How is electricity used in everyday life?
- How does the production of electricity impact global society?
- Where does electricity come from?
- How is electricity produced?
- What are the consequences of making and using plastics?
- Where do different types of plastic come from?
- Why should we recycle plastic?
- What happens to waste materials in landfills?
- What are the impacts of pollution on our environment?
- What are some different types of pollution?
- What are the effects of each of these types of pollution?
- What can humans do to help preserve their environment?
- What have humans done to their environment?
- Why do we need to conserve our resources?
- How can we improve our air, land and water quality?

## UNITS OF STUDY

### 1. Prologue - Electricity

#### Science Standards

##### *Scientific Inquiry*

- Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena.
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##### *Scientific Literacy*

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##### *Scientific Numeracy*

**Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.**

Students will identify questions that can be answered through scientific investigation.

Students will read, interpret and examine the credibility and validity of scientific claims in different sources of information.

Students will formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

Students will design and conduct appropriate types of scientific investigations to answer different questions.

Students will identify independent and dependent variables, including those that are kept constant and those used as controls.

Students will assess the reliability of the data that was generated in the investigation.

##### *Energy Transformations – Energy Transfer and Transformations*

**Energy cannot be created or destroyed; however, energy can be converted from one form to another.**

Students will describe the effects of adding energy to matter in terms of motion of atoms and molecules, and the resulting phase changes.

Students will explain how energy is transferred by conduction, convection and radiation.

Students will describe energy transformations among heat, light, electricity and motion.

### ***Energy Transformations - Energy Transfer and Transformations***

**The electrical force is a universal force that exists between any two charged objects.**

Students will explain the relationship among voltage, current and resistance in a simple series circuit.

Students will explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.

Students will describe the relationship between current and magnetism.

### **Essential Questions**

- How is scientific knowledge created and communicated?
- What is the role of energy in our world?

### **Focus Questions**

- What is electricity?
- Why is electricity important to us?
- How does electricity travel?
- How is electricity used in everyday life?

### **Core Topics**

- Ohm's law
- Series circuits
- Incandescent bulbs
- Current events (2 per month)

### **Unit Objectives**

Students will be able to:

- Relate basic components of an electrical circuit.
- Analyze the relationship among voltage, current and resistance.
- Predict the relationship between current and magnetism.
- Display data using appropriate visuals (graphs, charts).
- Create a simple series circuit.

### **Sample Assessment**

Who's the biggest resistor?

### **Pacing**

6 weeks



## 2. Energy Sources and Transformations

### Science Standards

#### *Energy Transformations - Science and Technology in Society*

**Various sources of energy are used by humans and all have advantages and disadvantages**

Students will explain how heat is used to generate electricity.

Students will describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

Students will describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

#### *Chemical Structures and Properties – Properties of Matter*

**Due to its unique chemical structure, carbon forms many organic and inorganic compounds.**

Students will describe combustion reactions of hydrocarbons and their resulting by-products.

#### *Global Interdependence – The Changing Earth*

**Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.**

Students will explain how internal energy of the Earth causes matter to cycle through the magma and the solid Earth.

### Essential Question

- How do science and technology affect the quality of our lives?

### Focus Questions

- How is electricity produced?
- How does the production of electricity impact global society?
- Where does electricity come from?

### Core Topics

- Energy conversions (chemical potential, thermal, mechanical, electrical)
- Origin of fuel sources & Earth history – rock cycle
- Environmental issues – mining of natural resources (fossil fuels, uranium)
- Current events (2 per month)

### Unit Objectives

Students will be able to:

- Trace the energy conversions involved in the production of electricity.
- Compare and contrast various types of energy sources used to produce electricity.

### Sample Assessment

Take a stance: Research project – choose an energy source for the future and defend your choice  
Solar Cooker (CAPT embedded performance task with STS)

<http://www.state.ct.us/sde/dtl/curriculum/science/s1energylabstudent.doc>

<http://www.state.ct.us/sde/dtl/curriculum/science/s1energyoriginalstudent.doc>

**Pacing**

8 weeks (MID-TERM COMPLETION POINT)

### 3. Polymers and Their Uses

#### Science Standards

##### *Chemical Structures and Properties - Science and Technology in Society*

**Chemical technologies present both risks and benefits to the health and well being of humans, plants and animals.**

Students will explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.

Students will explain how the chemical structure of polymers affects their physical properties.

Students will explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

#### Essential Question

- How do science and technology affect the quality of our lives?

#### Focus Questions

- What are the consequences of making and using plastics?
- Where do different types of plastic come from?
- Why should we recycle plastic?
- What happens to waste materials in landfills?

#### Core Topics

- Non-renewable resources
- Examples of polymers to sort
- Carbon cycle
- Biodegradability
- Environmental issues:
  - Environmental impact from manufacturing produces liquid & solid waste
  - Use of fossil fuels
- Current events (2 per month)

#### Unit Objectives

Students will be able to:

- Differentiate monomers and polymers.
- Trace the origins of monomers that create synthetic polymers.
- Connect that different monomers combine in long chains to form polymers with different physical properties.
- Categorize polymers according to their properties.
- Debate the use landfills and incineration as disposal methods.
- Analyze the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

**Sample Assessment**

Synthetic Polymers (CAPT embedded STS)

<http://www.state.ct.us/sde/dt/curriculum/science/s2stspolymerstudent.doc>

**Pacing**

6 weeks

#### **4. Sources and Impact of Pollution**

##### **Science Standards**

##### ***Energy Transformations – Energy Transfer and Transformations***

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Students will describe the effects of adding energy to matter in terms of motion of atoms and molecules, and the resulting phase changes.

Students will explain how energy is transferred by conduction, convection and radiation.

##### ***Global Interdependence – The Changing Earth***

**Elements on Earth move among reservoirs in the solid earth, oceans, atmosphere and organisms as part of biogeochemical cycles.**

Students will explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.

Students will explain how solar energy causes water to cycle through the major earth reservoirs.

##### ***Global Interdependence – Science and Technology in Society***

**The use of resources by human populations may affect the quality of the environment.**

Students will explain how the release of sulfur dioxide (SO<sub>2</sub>) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human made structures.

Students will explain how the accumulation of carbon dioxide (CO<sub>2</sub>) in the atmosphere increases Earth's greenhouse effect and may cause climate change.

Students will explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

##### **Essential Question**

- How do materials cycle through the Earth's systems?
- How do science and technology affect the quality of our lives?

##### **Focus Questions**

- What are the impacts of pollution on our environment?
- What are some different types of pollution?
- What are the effects of each of these types of pollution?

##### **Core Topics**

- Acid rain
- Greenhouse effect/climate change
- Biogeochemical cycles – water, carbon, nitrogen
- Air pollution - sulfates
- Water pollution

- Runoff of fertilizer – phosphates, nitrates
- Current events (2 per month)

### **Unit Objectives**

Students will be able to:

- Differentiate between acids and bases using the pH scale.
- Contrast various greenhouse gases ( CO<sub>2</sub>, NO<sub>x</sub>, methane, SO<sub>2</sub>, water vapor).
- Analyze sources of sulfur dioxide (SO<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>).
- Construct the chemical equations for sulfuric acid formed in the atmosphere.
- Debate the impact of acid deposition on organisms and human made structures.
- Summarize the impact of carbon dioxide on global climate change.
- Categorize the sources and effects of other types of water pollution (mercury, nitrates, and phosphates).

### **Sample Assessment**

Acid Rain (CAPT embedded performance task)

<http://www.state.ct.us/sde/dtl/curriculum/science/s3studentlab.doc>

### **Pacing**

5 weeks

## **5. Preservation of Our Earth**

### **Science Standards**

#### ***Global Interdependence – Science and Technology in Society***

**Some materials can be recycled, but others accumulate in the environment and may affect the balance of the Earth systems.**

Students will explain how land development, transportation options and consumption of resources may affect the environment.

Students will describe human efforts to reduce the consumption of raw materials and improve air and water quality.

### **Essential Question**

- How do science and technology affect the quality of our lives?

### **Focus Questions**

- What can humans do to help preserve their environment?
- What have humans done to their environment?
- Why do we need to conserve our resources?
- How can we improve our air, land and water quality?

### **Core Topics**

- Alternative energy sources
- Non-renewable resources
- Heavy metal contamination
- Risk vs. benefit of cleaner alternatives
- Current events (2 per month)

### **Unit Objectives**

Students will be able to:

- judge the human impact on the air, land and water due to:
  - Electricity generation
  - Landfills and incineration
  - Agriculture
- Evaluate the efforts to reduce the impacts of these activities on our environment.
- Analyze the risks and benefits of possible solutions to pollution.

### **Sample Assessment**

Letter to member of Congress

Connecticut Brownfield Sites (CAPT embedded STS)

<http://www.state.ct.us/sde/dtl/curriculum/science/s3stsbrownfieldstudent.doc>

### **Pacing**

9 weeks

