

SCIENCE 9th Grade PhyChem Pacing Guide

PhyChem is a required course for New Haven 9th grade students. It focuses on science literacy; a combination of understanding major science concepts and theories, using scientific reasoning and inquiry, and recognizing the complex interactions between science, technology and society. The major topics include chemical properties and plastics in the environment, earth materials and global interdependence, energy sources and electricity, and climate change. This is a full year laboratory science course where students will use science inquiry, literacy and numeracy skills.

Quarter 1

-UNIT 1 *Matter and Heat*

D1* - Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.

D2 - Explain how energy is transferred by conduction, convection and radiation.

-UNIT 2 *Atoms and Bonding*

D10* - Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.

D11 - Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

Quarter 2

-UNIT 3 *Chemical Bonding and Polymers*

D17* - Explain how the chemical structure of polymers affects their physical properties.

D13 - Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.

D14 - Describe combustion reactions of hydrocarbons and their resulting by-products.

D15 - Explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.

D16 - Explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.

STS – Plastic web sites ET – Plastics

-UNIT 4 *Chemical Cycles*

D19 - Explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.

D20 - Explain how solar energy causes water to cycle through the major earth reservoirs.

D24 - Explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

Quarter 3

-UNIT 5 *Earth Materials and Environmental Impact*

D12 - Explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.

D18 - Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.

D25* - Explain how land development, transportation options and consumption of resources may affect the environment.

D26 - Describe human efforts to reduce the consumption of raw materials and improve air and water quality.

ET – Acid Rain STS – Brownfield Sites PBA – Land Use Decision

Quarter 4

-UNIT 6 *Energy and Electricity Sources and Impacts*

D7* - Explain how heat is used to generate electricity.

D3 - Describe energy transformations among heat, light, electricity and motion.

D4 - Explain the relationship among voltage, current and resistance in a simple series circuit.

D5 - Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.
D6 - Describe the relationship between current and magnetism.

-UNIT 7 *Energy and Electricity Sources and Impacts*

D8* - Describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.

D22 - Explain how the release of sulfur dioxide (SO₂) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures.

D23 - Explain how the accumulation of carbon dioxide (CO₂) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes.

D9 - Describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

STS – Energy Use Graphics ET – Solar Cooker PBA - Energy Forum

DINQ1 Identify questions that can be answered through scientific investigation.

DINQ2 Read, interpret and examine the credibility and validity of scientific claims in different sources of information.

DINQ3 Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment.

DINQ4 Design and conduct appropriate types of scientific investigations to answer different questions.

DINQ5 Identify independent and dependent variables, including those that are kept constant and those used as controls.

DINQ6 Use appropriate tools and techniques to make observations and gather data.

DINQ7 Assess the reliability of the data that was generated in the investigation.

DINQ8 Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms.

DINQ9 Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation.

DINQ10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

I. 9th Grade Integrated Science

II. Unit 1 Matter and Heat

a. Unit Introduction

- In this unit, the students will be able to describe the effects of adding energy to matter. They will be able to explain phase changes in terms of motion. And be able to explain how energy is transferred by conduction, convection and radiation

b. Standards for unit

- D1* - Describe the effects of adding energy to matter in terms of the motion of atoms and molecules, and the resulting phase changes.
- D2 - Explain how energy is transferred by conduction, convection and radiation.

c. Essential Questions: How does adding energy affect the molecules of matter?

d. Essential Content:

- Heat consists of random motion and the vibrations of atoms, molecules, and ions. The higher the temperature, the greater the atomic or molecular motion. (NSES)
- Everything tends to become less organized and less orderly over time. Thus, in all energy transfers, the overall effect is that the energy is spread out uniformly. Examples are the transfer of energy from hotter to cooler objects by conduction, radiation, or convection and the warming of our surroundings when we burn fuels. (NSES)
- Heat transfer through matter occurs via radiation, conduction and convection.
- Adding energy to matter causes the molecules to move, changing the physical appearance of matter.

e. Essential Skills

- Using a thermometer determine energy transfer?
- Diagram each of the ways heat travels – radiation, conduction, convection.
- Demonstrate the phase changes of a substance.
- Use appropriate tools and techniques to make observations and gather data. (DINQ.6)

f. Vocabulary

- Thermal energy
- Heat
- Matter
- Phase change
- Radiation
- Convection
- Conduction
- Thermometer
- Temperature
- Molecules
- Solid
- Liquid
- Gas
- Phases

g. Science Misconception

- Temperature is the measure of heat.
- Larger ice cubes have a colder temperature.
- Cold is opposite to heat.
- Freezing and boiling are examples of chemical reactions.

h. List of recommended activities

- How Scientists Do Science (Neo Sci Kit #20-1043)
- Heat Convection – The Paper Snake (See Attachment)
- Hot and Cold Bottle of Water (See Attachment)
- Inquiry Lab – How do temperature and energy relate? (See Attachment)
- Inquiry Lab – What color absorbs more radiation? (See Attachment)
- Replicating Convection Currents (Frey Sci, Energy, Heat and Convection Kit)
- Determining Which Earth Material Absorbs Heat Best; Soil or Sand. (Frey Sci, Energy, Heat and Convection Kit)
- How Can We Use the Sun’s Energy to Heat a Home? (Frey Sci, Energy, Heat and Convection Kit)
- Coffee-Cream Problem (See Attachment)
- Keep it Hot (See Attachment)
- Phase Changes of H₂O (See Attachment)

i. Resources

- Textbook
- Internet
 - a. Chem4Kids.com: *Changing States of Matter*
http://www.chem4kids.com/files/matter_changes.html
 - b. Chemtutor: *States of Matter*
<http://www.chemtutor.com/sta.htm>
 - c. NASA: *Beat the Heat*
http://spaceplace.nasa.gov/en/kids/st8/thermal_loop/
 - d. EfunDa: *Principles of Heat Transfer*
http://www.efunda.com/formulae/heat_transfer/home/overview.cfm
- United Streaming
 - a. *Physical Science: States of Matter*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=1EFA5FB0-8A34-45B9-9111-B5C4115C1290>
 - b. *Matter and Energy: Matter: How Is It Put Together?*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=83CD65D4-0CB5-42BC-8F74-CFCBF3E541F1>
 - c. *Basics of Physics: Exploring Heat*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=3F0F9856-0921-43D1-BBB2-B11B13D8C319>
- State of CT website for significant tasks
 - a. None for this unit
- Current event articles

j. Required Significant Tasks

- Reading for Information article with question, *Blowing off Some Steam* (See Attachment)
- Phase Change Lab (See Attachment)

III. Significant Tasks

a. Significant Task Introduction – Phase Change Lab (See Attachment)

- Students will investigate the phase changes of water.

b. Length/Timing – 1 block period (90 minutes)

c. Essential Questions

- How does the addition of thermal energy affect the states of matter?

d. Assessment Tools (AT) – Lab Report (See Attachment)

e. Procedure – Phase Change Lab (See Attachment)

IV. Significant Task Resources (Teachers)

- Chemtutor: *States of Matter* <http://www.chemtutor.com/sta.htm>

ST Regular Attachments, Assessments

I. 9th Grade Integrated Science

II. Unit 2 Atomic Structure and Chemical Bonding

b. Unit Introduction

- The students will be able to describe the general structure of an atom and explain how the properties of the first 20 elements are related to their atomic structure in the Periodic Table. In the unit the students will also explain ionic bonding and covalent bonding.

c. Standards for unit

- D10* - Describe the general structure of the atom, and explain how the properties of the first 20 elements in the Periodic Table are related to their atomic structures.
- D11 - Describe how atoms combine to form new substances by transferring electrons (ionic bonding) or sharing electrons (covalent bonding).

d. Essential Questions: How is atomic bonding affected by an atom's chemical and physical properties?

e. Essential Content:

- Matter is made of minute particles called atoms, and atoms are composed of even smaller components. These components have measurable properties, such as mass and electrical charge. Each atom has a positively charged nucleus surrounded by negatively charged electrons. The electric force between the nucleus and electrons holds the atom together. (NSES)
- The atom's nucleus is composed of protons and neutrons, which are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element. (NSES)
- Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus. These outer electrons govern the chemical properties of the element.
- An element is composed of a single type of atom. When elements are listed in order according to the number of protons (called the atomic number), repeating patterns of physical and chemical properties identify families of elements with similar properties. This "Periodic Table" is a consequence of the repeating pattern of outermost electrons and their permitted energies. (NSES)
- Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically. (NSES)
- The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them. (NSES)
- Chemical reactions occur all around us, for example in health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies. (NSES)

f. Essential Skills

- Name simple ionic and covalent compounds.
- Describe how the chemical structure of a compound affects its properties.
- Differentiate between ionic, covalent, and metallic bonds.
- Compare the properties of substances with different types of bonds.
- Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment. (DINQ.3)

g. Vocabulary

- Atom
- Proton
- Neutron
- Electron
- Period Table
- Element
- Chemical bond
- Chemical structure
- Ionic bond
- Covalent bond
- Metallic bond
- Compound

h. Science Misconceptions

- Atoms can be seen with a microscope.
- Atoms are alive.
- Atoms can reproduce after the nuclei divide.
- Molecules are glued together.
- Electron pairs are equally shared in all covalent bonds.

i. List of recommended activities

- Atomic Structure (Attachment)
- Demonstration, Rutherford's Atom Experiment (Attachment)
- Class Periodic Table (Attachment)
- Copper Nail (Attachment)
- Chemical Bonding Bingo (Attachment)
- Protective Coatings (Attachment)
- CAPT Learning Activity, Salt (Attachment)

j. Resources

- **Text**
- **Internet**
 - a. Thinkquest: *Atomic Structure*
<http://library.thinkquest.org/10429/low/atomic/atomicbody.htm>
 - b. The Sourcebook for Teaching Science: *Periodic Table*
http://www.csun.edu/science/chemistry/periodic_table/index.html
 - c. Vision Learning: *Chemical Bonding*
http://www.visionlearning.com/library/module_viewer.php?mid=55
- **United Streaming**

- a. *Physical Science Series: Atomic Structure and the Periodic Table*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=298799C9-686A-461A-A060-851A721FB678>
 - b. *Physical Science Series: Chemical Bonding*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=547C7D47-0D64-4969-8EFF-AC94D18F1061>
- **State of CT website for significant tasks**
 - **Current Event Articles**
- k. **Required Significant Tasks**
 - RFI – *Chemical Weapons*
 - CAPT – *Ice Cold*
 - Quarterly Assessment
- III. **Significant Tasks**
 - l. **Significant Task Introduction**
 - Students will design and conduct an experiment to investigate what happens when salt and ice come together and to determine if one form of salt (table salt or rock salt) is better for melting ice on steps and sidewalks.
 - m. **Length/Timing**
 - 90 minute lab, plus time to write lab report
 - n. **Essential Questions**
 - Which form of salt is better for melting ice on steps and sidewalks?
 - o. **Assessment Tools (AT)**
 - p. **Procedure (Attachment)**
- IV. **Significant Task Resources**
 - a. http://www.sde.ct.gov/sde/lib/sde/Word_Docs/BESTseminars/sc/1995IceCold.doc
- V. **ST Regular Attachments, Assessments**

I. 9th Grade Integrated Science

II. Unit 3 Carbon: Bonding and Polymers

a) Unit Introduction

- In Unit 3, the students will be able to explain how the chemical structure of polymers affects their physical properties, They will be able to explain how the structure of the carbon atom affects the types of bonds it forms. The students will also describe combustion reactions of hydrocarbons and the resulting by-products. They will explain the general formation and structure of carbon-based polymers, including synthetic polymers, They will also explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers. All of this will lead into the embedded task on plastics and the STS activity on plastics websites.

a. Standards for unit

- **D17* - Explain how the chemical structure of polymers affects their physical properties.**
- D13 - Explain how the structure of the carbon atom affects the type of bonds it forms in organic and inorganic molecules.
- D14 - Describe combustion reactions of hydrocarbons and their resulting by-products.
- D15 - Explain the general formation and structure of carbon-based polymers, including synthetic polymers, such as polyethylene, and biopolymers, such as carbohydrate.
- D16 - Explain how simple chemical monomers can be combined to create linear, branched and/or cross-linked polymers.
- PBA –
- Quarterly Assessment

b. Essential Questions: How does the chemical structure of a polymers affect its physical properties?

c. Essential Content:

- Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life. Byproducts of a combustion reaction. (NSES)
- A change in the structure of a polymer produces various characteristics

d. Essential Skills

- Explain the formation of synthetic polymers.
- Describe where plastics come from.
- Model linear, branched and cross-linked polymers.
- Compare the properties of substances with different types of bonds.
- Identify questions that can be answered through scientific investigation. (DINQ.1)
- Read, interpret, and examine the credibility and validity of scientific claims in different sources of information. (DINQ.2)

e. Vocabulary

1. polymer
2. monomer

3. plastic
4. HDPE
5. LDPE
6. Hydrocarbon
7. Combustion
8. Organic
9. Inorganic
10. Polyethylene
11. Stress
12. Strain

f. Science Misconceptions

1. Polymers are not found in nature.
2. Polymers are inorganic.
3. All plastics have the same structure.
4. Air is not needed for combustion.

g. List of recommended activities

1. Polymers as Straws (Neo Sci Kit #20-1773)
2. A Closer Look at Polymers – Making Slime (Neo Sci Kit #20-1753)
3. Recyclable Plastics (Lab-aids Kit #704)
4. Polymers Lab (Neo Sci Kit #20-3273)
5. Bucky Balls, <http://www.seed.slb.com/en/scictr/lab/buckyball/exp.pdf>
<http://www.seed.slb.com/en/scictr/lab/buckyball/images/pattern1.pdf>
<http://www.seed.slb.com/en/scictr/lab/buckyball/images/pattern2.pdf>
6. Water from a Match (Attachment)

h. Required Significant Tasks

1. RFI – *The Science of Slime*,
http://membership.acs.org/C/Chicago/statefair/CD-2007/Chematters/2004_12_smpissue.pdf
2. Lab - Chemical Structures and Properties
3. Lab - Science, Technology, and Society Activity

i. Resources

1. Text
2. Internet
 - a. NYU: *Carbon*
<http://www.nyu.edu/pages/mathmol/modules/carbon/carbon1.html>
 - b. NYU: *Hydrocarbons Page*
<http://www.nyu.edu/pages/mathmol/library/hydrocarbons/>
 - c. American Chemistry Council: Teaching Plastics
http://www.americanchemistry.com/s_plastics/doc.asp?CID=1123&DID=4982
 - d. http://www.americanchemistry.com/s_plastics/hands_on_plastics/activities/industrial_testing_lesson/industrial_testing_lesson.html
3. United Streaming
 - a. *Carbon: The Element of Life*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=BA12AD55-CCD2-4E14-8A5B-EC63626B0C5A>

4. State of CT website for significant tasks
 - a. Chemical Structures and Properties
 - i. <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320892>
 - b. Science, Technology, and Society Activity
 - i. <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320892>
 5. Current event articles
- III. Significant Tasks**
- a. State Embedded Task**
 - i. Chemical Structures and Properties
 - ii. Science, Technology, and Society Activity
 - b. Length/Timing**
 - i. Chemical Structures and Properties – 90 minutes plus time to write lab report
 - ii. Science, Technology, and Society Activity – 90 minutes
 - c. Essential Questions**
 - i. How can polymers be processed to produce products with different characteristics?
 - ii. What characteristics make a website credible?
 - d. Assessment Tools (AT)**
 - i. Lab Report – Test**
 - ii. Website checklist**
 - e. Procedure – (Significant Task Regular Attachment)**
- IV. Significant Task Resources**
- a. <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320892> , student sheets are available at this site.
 - b. http://teachingplastics.org/hands_on_plastics/activities/industrial_testing_lesson/industrial_testing_lesson.html#tensile
- V. Significant Task Regular Attachments, Assessments**

I. 9th Grade Integrated Science
II. Unit 4 Geochemical Cycles

a. Unit Introduction

- In this unit, the students will be able to explain how physical and chemical processes cause carbon to cycle through the major earth reservoirs. They will be able to explain how solar energy causes water to cycle through the major earth reservoirs. The students will also explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.

b. Standards for unit

- D19 - Explain how chemical and physical processes cause carbon to cycle through the major earth reservoirs.
- D20 - Explain how solar energy causes water to cycle through the major earth reservoirs.
- D24 - Explain how the accumulation of mercury, phosphates and nitrates affects the quality of water and the organisms that live in rivers, lakes and oceans.
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c. Essential Questions: Explain what is meant by the phrase, “Earth is a closed system.”

d. Essential Content:

1. The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical reservoirs. Each element on earth moves among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geochemical cycles.
2. Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.
3. There is a fixed amount of resources that cycle through earth's reservoirs.
4. Earth's reservoirs include the solid earth, oceans, atmosphere and organisms.
5. Earth has both an internal (radioactive decay) and external (the sun) source of energy.
6. Movement of matter through earth's reservoirs is driven by these energy sources.

e. Essential Skills

1. Explain how carbon cycles through earth's reservoirs.
2. Explain how water cycles through earth's reservoirs.
3. Explain earth's energy sources.
4. Explain how accumulation of chemicals in our reservoirs is hazardous to the environment.

5. Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation. (DINQ.9)

f. Vocabulary

1. Carbon
2. Carbon cycle
3. Carbon dioxide
4. Carbonate
5. Respiration
6. Water cycle
7. Evaporation
8. Precipitation
9. Condensation
10. Sink
11. Reservoir

g. Science Misconception

1. There is an unlimited amount of resources.
2. Carbon in a rock is different than the carbon in the human body.
3. All water on earth is drinkable.
4. Nutrients that help plants grow must improve water quality.
5. Water disappears when it evaporates.

h. List of recommended activities

1. Carbon Trip Through the Cycle (Attachment)
2. Changes and Cycles (Attachment)
3. Make a Model Aquifer (Attachment)
4. Surface Tension of Water (Attachment)
5. Muddying the Waters -
<http://www.pen.k12.va.us/VDOE/LFB/lessonplans/muddy/muddy.pdf>

i. Resources

1. Text

2. Internet

- a. Earth Observatory: *The Carbon Cycle*
<http://earthobservatory.nasa.gov/Library/CarbonCycle/>
- b. Earth Observatory: *The Water Cycle*
<http://earthobservatory.nasa.gov/Library/Water/>
- c. University of Missouri Extension: Nitrogen in the Environment, Nitrogen Cycle
<http://extension.missouri.edu/explore/envqual/wq0252.htm>
- d. USGS: *Eutrophication*
<http://toxics.usgs.gov/definitions/eutrophication.html>
- e. UCONN: *The Mad Hatter Mercury Mystery*
<http://www.seagrant.uconn.edu/HATTER.HTML>

3. United Streaming

- a. *The Cycle Series: The Carbon Cycle*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=71192B42-8058-4A7F-885C-BFCDC6C76962>
- b. *The Cycle Series: The Water Cycle*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=DA282111-DDDE-4BA7-AE55-DBC4761A147B>

- c. *Natural Focus with Laurie Sanders, A: Water Quality*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=AC4775BB-83C7-4742-B386-91B2784418BE>
- d. *Ecosphere, The: Where All Life Exists*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=5EE26B9C-9922-402E-A219-4BAAD40235D5>

4. State of CT website for significant tasks

5. Current event articles

- 6. http://www.visionlearning.com/library/nses_view.php?nid=36&l=&c3=**

j. Required Significant Tasks

- 1. RFI – A Dire Shortage of Water
- 2. Labs – None for this unit
- 3. Quarterly Assessment

III. Significant Tasks

k. Significant Task Introduction

l. Length/Timing

m. Essential Questions

n. Assessment Tools (AT)

o. Procedure

IV. Significant Task Resources

V. ST Regular Attachments, Assessments

9th Grade Integrated Science

Unit 5 Earth Materials and Environmental Impact

a) Unit Introduction

- The students will explain the chemical composition of acids and bases, and explain the changes of pH in neutralization reactions. They will be able to explain the short and long term impacts of landfills and how incineration of waste materials affects the quality of the environment. They will also explain how land development, transportation options and consumptions of resources may affect the environment. The students will describe how humans try to reduce the consumption of raw materials and improve air and water quality. They will finish the unit by doing the required embedded task of the unit.

j. Standards for unit

- D12 - Explain the chemical composition of acids and bases, and explain the change of pH in neutralization reactions.
- D18 - Explain the short- and long-term impacts of landfills and incineration of waste materials on the quality of the environment.
- **D25*** - Explain how land development, transportation options and consumption of resources may affect the environment.
- D26 - Describe human efforts to reduce the consumption of raw materials and improve air and water quality.

k. Essential Questions: What impact does human existence have on the environment?

l. Essential Content:

1. Normal adjustments of earth may be hazardous for humans. Humans live at the interface between the atmosphere driven by solar energy and the upper mantle where convection creates changes in the earth's solid crust. As societies have grown, become stable, and come to value aspects of the environment, vulnerability to natural processes of change has increased. (NSES)
2. Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change. (NSES)
3. Some hazards, such as earthquakes, volcanic eruptions, and severe weather, are rapid and spectacular. But there are slow and progressive changes that also result in problems for individuals and societies. For example, change in stream channel position, erosion of bridge foundations, sedimentation in lakes and harbors, coastal erosions, and continuing erosion and wasting of soil and landscapes can all negatively affect society. (NSES)
4. Natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards--ranging from those with minor risk to a few people to major catastrophes with major risk to many people. The scale of events and the accuracy with which scientists and engineers can (and cannot) predict events are important considerations. (NSES)

m. Essential Skills

1. Determine level of acidity using the pH scale.

2. Where does our garbage go?
3. How do our land use decisions affect the environment?
4. Describe the efforts being made at both the municipal and federal levels to reduce pollution.
5. Design and conduct appropriate types of scientific investigations to answer different questions. (DINQ.4)
6. Identify independent and dependent variables including those that are kept constant and those used as controls. (DINQ.5)

n. Vocabulary

1. Acid
2. Base
3. Salt
4. pH scale
5. Indicator
6. Acid rain
7. Brownfield site
8. Landfill
9. Municipal Solid Waste
10. Waste to energy
11. Leachate

o. Science Misconceptions

1. Acids are found in the lab or have to be made.
2. All acids dissolve or burn other objects.
3. Waste is stored in a remote area.

p. List of recommended activities

1. Cabbage Juice Indicator (Attachment)
2. Simulating the Effects of Acid Rain (Neo Sci Kit #20-1493)
3. CAPT Inquiry Lab – Fire Extinguisher
http://www.sde.ct.gov/sde/lib/sde/PDF/BESTseminars/sc/fire_ext.pdf
4. Cookie Mining (Attachment)

q. Resources

1. **Text**
2. **Internet**
 - a. Chem4Kids.com: *Acids and Bases are Everywhere*
http://www.chem4kids.com/files/react_acidbase.html
 - b. U.S. Food and Drug Administration: *Approximate pH Values of Foods and Food Products*
<http://www.cfsan.fda.gov/~comm/lacf-phs.html>
 - c. EPA: *pH scale*
http://www.epa.gov/acidrain/education/site_students/images/p_hscale.gif
 - d. CT DEP: *Brownfield Sites in Connecticut*
<http://www.ct.gov/dep/cwp/view.asp?a=2715&q=324930>
 - e. EPA: *Wastes*
<http://www.epa.gov/osw/>
 - f. BRRFOC: Waste to Energy Facility
<http://www.brrfoc.org/about.php>
3. **United Streaming**

- a. *Elements of Chemistry: Acids, Bases, and Salts*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=F87F5C05-EDC4-40EF-92E0-D62BC7EE66D6>
- b. *Garbage Story, The: Dealing with Solid Waste Disposal*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=13E647B8-0AD4-45AE-A3E0-7395EB81A80C>
- c.

- 4. **State of CT**
- 5. **Current Events**

r. Required Significant Tasks

- 1. RFI – *Soil Contamination* (Attachment)
- 2. Acid Rain Lab
- 3. Brownfields Lab
- 4. Quarterly Assessment

Significant Tasks

f. State Embedded Task

- i. Global Interdependence – Acid Rain
- ii. Global Interdependence – CT Brownfield Sites

g. Length/Timing

- i. **Acid Rain** – 90 minutes, plus time to write lab report
- ii. **Brownfield Sites** – 90 minutes

h. Essential Questions

- i. Which building materials are more resistant to acid rain?
- ii. Where are Brownfield sites in your area and what is being done about them?

i. Assessment Tools (AT)

j. Procedure (Attachment)

Significant Task Resources

- i. <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320892> , students materials available at this site.
- ii. CT DEP: *Brownfield Sites in Connecticut*
<http://www.ct.gov/dep/cwp/view.asp?a=2715&q=324930>

Significant Task Regular Attachments, Assessments

9th Grade Integrated Science

Unit 6 Energy: Electricity and Magnetism

a. Unit Introduction

- In this unit the students will be able to explain how heat is used to generate electricity. They will describe energy transformations among heat, light, electricity and motion. The relationship among voltage, current and resistance in a simple series circuit will be explained. An explanation on how electricity is used to produce heat and light in incandescent bulbs and heating elements will be in the unit. Also the students will describe the relationship between current and magnetism.

b. Standards for unit

- **D7* - Explain how heat is used to generate electricity.**
- D3 - Describe energy transformations among heat, light, electricity and motion.
- D4 - Explain the relationship among voltage, current and resistance in a simple series circuit.
- D5 - Explain how electricity is used to produce heat and light in incandescent bulbs and heating elements.
- D6 - Describe the relationship between current and magnetism.

c. Essential Questions: How is electricity produced?

d. Essential Content:

1. Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter. (NSES)
2. Electromagnetic waves result when a charged object is accelerated or decelerated. Electromagnetic waves include radio waves (the longest wavelength), microwaves, infrared radiation (radiant heat), visible light, ultraviolet radiation, x-rays, and gamma rays. The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength. (NSES)
3. Each kind of atom or molecule can gain or lose energy only in particular discrete amounts and thus can absorb and emit light only at wavelengths corresponding to these amounts. These wavelengths can be used to identify the substance. (NSES)
4. In some materials, such as metals, electrons flow easily, whereas in insulating materials such as glass they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures some materials become superconductors and offer no resistance to the flow of electrons. (NSES)

e. Essential Skills

1. Describe how heat is used to generate electricity.
2. Describe the different types of energy and how they transform from one form to another.
3. Explain how a series circuit work.
4. Explain the relationship between current and magnetism.
5. Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms. (DINQ.8)

f. Vocabulary

1. Energy
2. Electricity
3. Heat
4. Light
5. Kinetic Energy
6. Potential Energy
7. Series Circuit
8. Voltage
9. Current
10. Resistance
11. Incandescent
12. Magnetism

g. Science Misconception

1. Energy can be made, used, and lost.
2. Energy is an object.
3. Energy is confined to its origin.
4. Energy is only in living things.
5. Static electricity is the opposite of current electricity.
6. Only magnets have magnetic fields.

h. List of recommended activities

1. Investigating Electricity (Neo Sci Kit #20-1623)
2. Series and Parallel Circuits (Attachment)
3. Magnet and Magnetism (Neo Sci Kit #20-1633)

i. Resources

4. Text

5. Internet

- a. *Energy Story* <http://www.energyquest.ca.gov/story/index.html>
- b. IPPEX, *Electricity and Magnetism*
<http://ippex.pppl.gov/interactive/electricity/>
- c. PBS, *Generate Electricity*
<http://www.pbs.org/weta/roughscience/series1/challenges/generator/>
- d. NDT Resource Center: *Series Circuit* <http://www.ndt-ed.org/EducationResources/HighSchool/Electricity/seriescircuit.htm>

6. United Streaming

- a. *Electricity and Magnetism*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=A6EE0014-C72D-4520-8F29-51C053F799D7>

7. State of CT

8. Current Events

j. Required Significant Tasks

1. RFI – *Power Problems Persist* (Attachment)
2. Solar Cooker
3. Energy Uses In Connecticut

VI. Significant Tasks

- i. Solar Cooker
- ii. Energy Uses in Connecticut

k. Significant Task Introduction

l. Length/Timing

- i. Solar Cooker – 3-45 minutes periods plus time to write lab report
- ii. Energy Uses in Connecticut – 90 minutes

m. Essential Questions

- i. How can solar energy captured and used as a heating source?

n. Assessment Tools (AT)

i. Lab

o. Procedure (Attachment)

VII. Significant Task Resources

- i. <http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320892> , student materials can be found at this site.
- ii. <http://kb.wisc.edu/helpdesk/page.php?id=1231> , directions for making a scatter plot with Excel.

VIII. ST Regular Attachments, assessments

Unit Resources/Attachments

I. 9th Grade Integrated Science

II. Unit 7 *Energy Use and Environmental Impact*

a. Unit Introduction

- In Unit 7, the description of the availability, current uses and the environmental issues related to the use of fossil and nuclear fuels to produce electricity will be introduced. The students will be able to explain how the release of sulfur dioxide into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures. They will explain how the accumulation of carbon dioxide in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes. The students will also describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity. At the end of the unit, the students will have completed the solar cookers, energy use graphics, and the energy forum tasks.

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b. Standards for unit

- **D8*** - Describe the availability, current uses and environmental issues related to the use of fossil and nuclear fuels to produce electricity.
- D22 - Explain how the release of sulfur dioxide (SO₂) into the atmosphere can form acid rain, and how acid rain affects water sources, organisms and human-made structures.
- D23 - Explain how the accumulation of carbon dioxide (CO₂) in the atmosphere increases Earth's "greenhouse" effect and may cause climate changes.
- D9 - Describe the availability, current uses and environmental issues related to the use of hydrogen fuel cells, wind and solar energy to produce electricity.

c. Essential Questions: What are the causes and effects of global climate change?

d. Essential Content:

1. Human populations use resources in the environment in order to maintain and improve their existence. Natural resources have been and will continue to be used to maintain human populations. (NSES)
2. The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed. (NSES)
3. Humans use many natural systems as resources. Natural systems have the capacity to reuse waste, but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically. (NSES)
4. Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans. (NSES)
5. Materials from human societies affect both physical and chemical cycles of the earth. (NSES)

6. Many factors influence environmental quality. Factors that students might investigate include population growth, resource use, population distribution, overconsumption, the capacity of technology to solve problems, poverty, the role of economic, political, and religious views, and different ways humans view the earth. (NSES)

e. Essential Skills

1. Explain the consequences, both good and bad, of using fossil fuels to produce electricity.
2. Explain the formation of acid rain and its effects on the environment.
3. Describe various alternative energy sources and their consequences.
4. Assess the reliability of the data that was generated in the investigation. (DINQ.7)
5. Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic. (DINQ.10)

f. Vocabulary

1. Fossil Fuels
2. Nuclear Fission
3. Greenhouse Effect
4. Renewable Energy
5. Nonrenewable Energy
6. Conservation of Energy
7. Global Climate Change

g. Science Misconception

1. Fossil fuels only come from dinosaur remains.
2. Fossil fuels resources are unlimited.
3. The greenhouse effect is hazardous.
4. A single act will not make a difference in protecting the environment.

h. List of recommended activities

1. Earth as Home: An Island Home (Attachment)
2. Tracking Pollution (Attachment)
3. Need more.

i. Resources

1. Text

2. Internet

- a. *EPA: Energy Kids Page*
<http://www.eia.doe.gov/kids/index.html>
- b. *Energy Star*
<http://www.energystar.gov/>
- c. *EPA: Climate Change Kids Site*
<http://epa.gov/climatechange/kids/greenhouse.html>
- d. *Energy Information Administration* <http://www.eia.doe.gov/>

3. United Streaming

- e. *Power Up: Energy in Our Environment*
<http://www.unitedstreaming.com/search/assetDetail.cfm?guidAssetID=E0B2ECD3-2634-42F5-8414-5B487D7DE5AD>

4. State of CT

5. Current Events

j. Required Significant Tasks

1. RFI – Shrinking Glaciers (Attachment)
2. Energy Sources Debate

III. Significant Tasks

k. Significant Task Introduction

l. Length/Timing – 4-5 45 minute periods

m. Essential Questions

1. What is the most effective and efficient source of energy?

n. Assessment Tools (AT)

1. Debate rubric

o. Research Paper

IV. Significant Task Resources

V. ST Regular Attachments

Attachment: Unit Assessment