THE CATKILLS
A Sense of Place

Standards-based lessons that promote appreciation and stewardship of the unique natural and cultural resources of the Catskill Mountain Region.

Module VI:
Sustainable Catskills

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RESOURCES

Books and Articles

McWilliams, James, E."*Food That Travels Well*" The New York Times. Aug 6, 2007.
Greenwashing: Schueller, Gretel. H. "Peeling Back the Label". Audubon. March-April 2011
Goff, Gary, R. et al. Timber Management for Small Woodlots. 1994. Cornell Publications.

Teaching Materials

Nature Conservancy Carbon Footprint Calculator - http://www.nature.org/initiatives/climatechange/calculator/
Carbon Footrprint Calculator- http://www.carbonfootprint.com/calculator.aspx
EPA Carbon Footprint Calculator - http://www.epa.gov/climatechange/emissions/ind_calculator.html
Kid Specific Carbon Footprint Calculator- http://calc.zerofootprint.net/youth/neew

Web Sites

The New York Power Authority - http://www.nypa.gov/
Catskill Mountain Wind Management Inc. - http://www.catskillwind.com/
New York City Department of Environmental Protection (DEP) -
http://www.nyc.gov/html/dep/html/home/home.shtml
Catskill Forest Association (CFA) - http://www.catskillforest.org/
New York State Department of Environmental Conservation: www.dec.ny.gov
Catskill Landowners Association – Catskilllandowners.com
Chesapeake – www.chk.com
Clip Art: http://www.freeclipartnow.com/science/energy/?g2_page=2
Greenhouse Gas Images: http://www.freedigitalphotos.net/
Sustainable School Images: http://www.freedigitalphotos.net
Decomposition Rates: Green Living Tips - http://www.greenlivingtips.com/articles/311/1/Waste-decomposition-rates.html
Carbon footprint: http://www.carbonfootprint.com/carbonfootprint.html
Consumption Images: http://www.freedigitalphotos.net/
Local Green Energy Companies: http://orangeenvironment.org/Contact/Contact
Sustainble Business: http://www.livingeconomies.org/
Forestry Products Analysis: http://www.eia.doe.gov/emeu/mecs/iab98/forest/index.html
Sustainable Forestry Practices & Functions of Forests: www.catskillforest.org
Silviculture: USDA Forest Service http://nrs.fs.fed.us/fmg/nfmg/fm101/silv/index.htm
Resources for finding locally grown food:
www.100milechallenge.com (Capital District 100 mile diet)
www.farmandfood.org (Regional Farm & Food Projects)
www.localharvest.org (to find CSA farms, farmers markets, etc. near you)
Honest Weight Food Co-op, 484 Central Ave., Albany, NY

Resource People

Places to Visit

Agritourism Lesson – Farm Tours:

Greenane Farms. 5637 Turnpike Road, Delhi NY. (607)-746-8878. greenanefarms.com
Catskill Revitalization Corporation. 21 Railroad Avenue, Stamford, NY. (607)-652-2821. gilboahome.com
Cooper's Ark Farm. 145 Ark Lane, Schoharie, NY. (518)-295-7662. coopersarkfarm.com
Miller Farms. 178 Main St. Windsor NY. (607)-655-1152 millerfarms.net
Catskill Mountain Foundation. 7950 Main St, Hunter, NY. (518)-263-4908. catskillmtn.org
Armstrong's Elk Farm. 936 Hervey Sunside Road, Cornwallville, NY. (518)-622-8452.
http://www.greenetourism.com/listings/armstrongs-elk-farm
Lazy S Ranch. 637 Hervey St. NY 12418. (518)-239-8995. lazysranchny.com

USING THIS BOOK

Vocabulary words are italicized throughout this module and are later defined in the glossary of each lesson activity. These are suggested words to know in order to maximize lesson comprehension.

Following each activity are listed NYS Learning Standards that are met by the activity. There is a possibility that the activity may meet more standards than those listed. The number of the standard, its title, and the topic heading are written out.

ACKNOWLEDGEMENTS

We would like to thank the following people, all of whom donated their time by reading through, evaluating, giving feedback, or suggesting content for the module. Without all of you, this educational tool would not be as complete and useful as it is. Thank you for your help.

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GLOSSARY

Agriculture: the production of food and goods through farming
Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Biltmore Stick: A tool of foresters and loggers that measures dimensions of a tree such as diameter at breast height (dbh) and height (h). It enables the user to estimate the number of board feet that a tree contains.
Biomass: a renewable energy source composed of biological material (from living or recently living organisms), such as wood, waste, hydrogen gas, and alcohol fuels. Biomass is commonly plant matter grown to generate electricity or produce heat.
Board Feet: Is the measurement of a single board 1 foot long, 1 foot wide, and 1 inch thick.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Carrying Capacity: Refers to the population of an organism that can be sustained in a given environment without degrading the resources available. Once a population increases above the carrying capacity, resources are consumed without replenishment, and the population decreases due to lack of resources. Human populations have risen far above this level by modifying their environment, but human population growth is not unlimited.
Clear Cutting: All trees in a stand are removed at one time regardless of value or ecosystem function.
Coal: A type of fossil fuel that was formed millions of years ago by the decay of ancient forests. Occurs in a fixed amount within the earth, once it is used up, it will be gone forever. Mined and burned to produce electricity.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Consumption*:* This is the ENGINE of the whole system. As we purchase items we create a demand, and production of that product continues.
Developed Countries: Highly industrialized countries with a high average income.
Developing Countries: A nation with a relatively low level of industrialization and often characterized by a reduced standard of living.
Disposal*:* Once we consume an item we discard the packaging that it came in, use the product until it serves its purpose, breaks, or goes out of style, then we discard it and get a new one.

Distribution: Once finished goods are completed at the factories they must be sent to the store shelves.

Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.

Extraction*:* The use of natural resources. All of the goods we buy are made of natural resources (wood, metals, plants, animal products, plastics, etc.) and they all required natural resources for their production and shipping (fossil fuels, water, etc). The natural resources that are ingredients for more complex products are often called "raw materials". Raw materials are harvested from the earth in order to be used (metals mined, wood cut, water collected).

Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.

Forest Products: A material that is derived from a forest for commercial use, such as lumber, nuts, paper.

Forestry: The science of managing forests for the production of timber.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Fracing/Fracking: See hydraulic fracturing

Geothermal Energy: This is heat energy that is harnessed from the core of the earth. It allows heating of buildings and water without using fossil fuels to generate heat.

Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.

Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

High Grading: the practice of removing most of the largest and fastest growing trees of the most valuable commercial species in order to meet short-term economic goals. This results in total disregard for the long-term viability of the forest stand or providing for future income and regeneration.

Hydropower: Created by harnessing the natural power of water. It can be harnessed by

constructing a dam. As water washes over the dam it turns turbines that create electricity.
Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.
Hydrogen Power: A power source created from splitting hydrogen atoms from naturally occurring molecules , like water, to create electicity.

Invasive Species: The term invasive species refers to a subset of introduced species or non-indigenous species that are rapidly expanding outside of their native range. Invasive species can alter ecological relationships among native species and can affect ecosystem function and human health. A species is regarded as invasive if it: (1) has been introduced by human action to a location where it did not previously occur naturally, (2) becomes capable of establishing a breeding population in the new location without further intervention by humans, and (3) spreads widely throughout the new location. In simple terms, an invader has to (1) arrive, (2) survive, and (3) thrive.
Macroinvertebrate: An organism that is large enough to see with the naked eye that does not have a backbone. Usually associated with judging the water quality of streams based on presence / absence and abundance.
Marcellus Shale: The Marcellus Shale region of the Mid-Atlantic is believed to contain the third largest natural gas reserve in the world. See map in Lesson 1: Activity 4.
Metals: Relatively rare minerals that are occur in fixed amounts within the earth. They are essential to survival and are mined from the earth for use. They are required for industry, energy, and even human consumption.
Natural Gas: Natural gas is a combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, it can also include ethane, propane, butane and pentane. It is used commonly to heat homes, as cooking fuel, and to generate electricity.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.

Petroleum: A liquid that is found underground. Sometimes we call it **oil**. Petroleum has a lot of energy. We can turn it into different fuels—like gasoline, kerosene, and heating oil. Most plastics and inks are made from petroleum, too. Most petroleum is made into gasolilne. We use more petroleum than any other fuel source.

Point Source Pollutant: A pollutant that has a single traceable source.

Production: Once the raw materials are extracted they are joined together in factories to become finished goods. This can be a simple process done completely by human hands, or can involve toxic chemicals, and complex industrial factories.

Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Riparian Buffer: A protective strip of land or timber adjacent to a waterway.

Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.

Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.

Solar Array: Solar panels that are constructed on rooftops to harness the power of the sun and turn it into electricity.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

Timber: Standing trees that are managed for sale of wood products.

Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.

Uranium: A naturally occurring radioactive substance that is mined from the earth because of the energy that it gives off in reactions. Used as a power source it creates a lot of toxic waste. This waste takes a long time to break down in the environment and must be disposed of where it will not pollute nearby water, soil, or air.

Vermicompost: A system of managing decomposition of organic matter using a worm bin.

Waste Products: An unusable or unwanted material that is produced as the result of a process.

Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.

Watershed: The entire area of land that collects and transports precipitation into a water supply.
Wind Power: Harnessing energy that wind creates with the use of large windmills. It is a clean, green way to create electricity without burning fossil fuels.
Wood Power: Used a fuel source, harvested from tress and burned for heat energy which can heat homes or heat water.

LESSON 1

Sustainable Energy

MODULE 6: Sustainable Catskills

Sustainable Energy

We must all use the earth's natural resources in order to survive. It can be difficult to see the connection between our daily activities and the resources that they require. In a given day our communities use resources to heat (or cool) our homes, schools, and places of business. We also consume resources in order to run vehicles and ship products and goods.

As we consume resources, we decrease the amount of non-renewable resources left for the next generation and create waste products. Sustainability is the idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) and that create less of an impact on the environment. We have the option to use renewable forms of energy for our daily needs, reduce the amount of products we use, reuse products that require energy to produce, and recycle products instead of adding them to the waste stream and mining for new materials.

This lesson will explore the way in which we use resources, how we can use resources more efficiently, and how we can use advances in technology to create and use cleaner, more efficient energy sources.

Energy: Using Earth's Natural Resources

Grades:

6^{th}-8^{th}

Objective:

- Students will gain an understanding of types of natural resources New York State residents consume in the activities of daily life.
- Students will use information to form opinions about what natural resources are better for their community.

Method:

- Students will discover a variety of natural resources, learn how they are used to produce energy, and describe how their use impacts the earth.

Materials:

- Images to supplement the list of natural resources (attached)
- NYS Electricity Generation Graph. (attached)
- Internet Access (to show videos – smartboard preferred)
- "Energy Basics" Fact Sheets (optional, attached)

Time:

Preparation Time: 5 minutes
Class Time: 40 minutes

Prep:

- Briefly research the school's main source of power. Who supplies the electricity? How is the building heated? Oil? Natural Gas?

Vocabulary:
Natural Resource, renewable energy source, non-renewable energy source, fossil fuel, waste products, Electricity, oil, hydropower, solar power, wind power, geothermal, natural gas.

Procedure:

What is a Natural Resource?

- Assessing Prior Knowledge: Pose question "What is a *natural resource*" to students. Students may brainstorm in pairs, or small groups, then generate answers as an entire class and have the students come to a consensus on a definition.
    - A *natural resource* is a general term for the materials we use from the earth to obtain energy. Examples include fossil fuels, wood, water, air, animals, plants, etc. These can be renewable or non-renewable.

Construct a Chart

- Fill in the provided *Resource Chart*. (See sample below).
    - Have students draw and fill in this chart along with you.
- Have students come up with a definition for each term; *renewable resources* and *non-renewable resources*.
    - *Renewable resources* include energy sources that will never run out, such as solar energy (sunlight), wind, solar, and geothermal (heat from the earth). Renewable resources also include energy sources that regenerate themselves if managed properly such as wood, animals and plants.
    - *Non-renewable resources* occur in fixed amount on earth, this means that as we continue to use them they become depleted, and will one day run out.
        - Examples of non-renewable resources are uranium (nuclear power), and fossil fuels such as coal, petroleum, oil, and natural gas.
- Where does the term "fossil fuels" come from?
    - Have students generate answers. If students cannot readily answer have them break the term down into 2 parts.
        - What is a fossil?
        - What is a fuel?
- *Fossil Fuels* – were created from the incomplete decay of ancient organisms that became trapped by layers of sediment. It has taken millions of years for these fuels to form in pockets underneath the earth's crust. They are rapidly being depleted from the earth, and once they have been used up, they are gone as an energy source forever.
    - PBS – NOVA calculated that it may have taken ~100,000 ancient plants to produce 1 gallon of gasoline.

- Have students determine where each of these resources comes from.
    - Non-renewable resources need to be extracted from the earth; by mining or drilling. These processes use a lot of energy and can severely degrade the surrounding ecosystem.
    - Renewable resources come from readily available sources, the energy source is constant, and technological improvements are needed to harness their full potential.

Waste Products

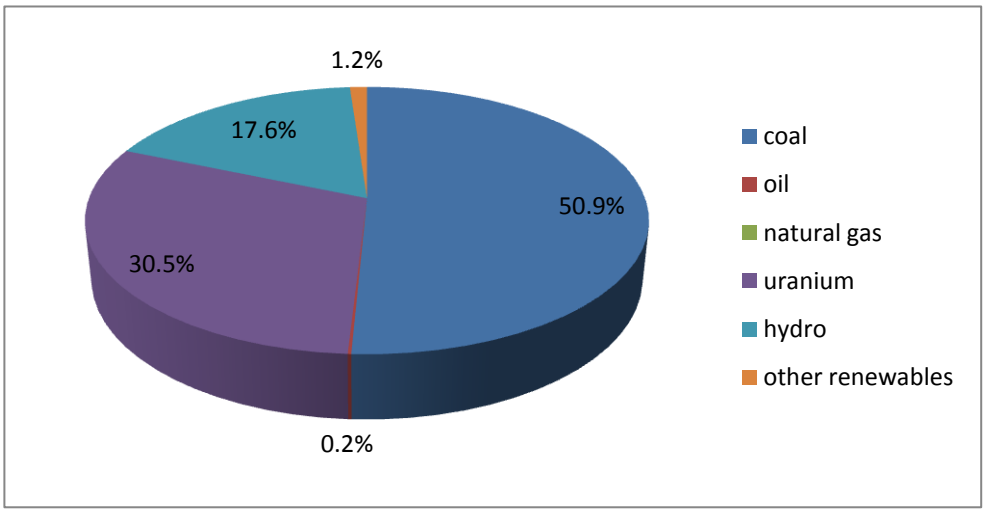
- Draw an additional column and label it WASTE PRODUCTS.
- Have students generate ideas for what waste could be produced from the use of each resource.

Example:

NATURAL RESOURCES		Waste Products
Non-renewable	Coal	
	Oil & Petrolium	
	Natural Gas	
	Uranium (nuclear power)	
Non-renewable	Minerals / Metals	
Renewable	Wood	
	Water	
	Wind	
	Solar	
	Geothermal	

Our Energy Needs

- Use the following Link and a smartboard to discover the United States Energy Consumption System : Our Energy System : http://needtoknow.nas.edu/energy/interactive/energy-system.php
- What do we need energy for? (Think about what each type of fuel is used for).
  - Refer to the graph below to show how ELECTRICITY is generated in New York State. (Graph provided by NYSERDA)



- Have students come up with a list of energy needs in the community and create a class demographic by filling in the *Energy Needs Chart* provided.
- How many of you heat with electric? Heat with oil? Heat with wood?
- How many of you cook with a gas stove? An electric stove?
    - (Hint – a stove that heats with natural gas will light flames when ignited. An electric stove has glowing red coils)
- How many of you consume metals?
    - Metals and minerals are used in all kinds of goods like cell phones, televisions, monitors, paint, and toothpaste.
    - The United States uses 25,000 lbs of minerals and metals per person, per year!
- For homework have students fill in the chart below.
    - For each row divide the # of students (from the first column) by the total # of students in the class (the second column) and then multiply by 100 to obtain the percentage of the class (third column).

Energy Need	# Students	Total # Students	% of class
Electricity			
Electric Heat			
Oil Heat			
Wood Heat			
Electric Stove			
Gas Stove			
Vehicle (multiply by # of cars)			
Minerals / Metals			

Personal Use

- Have students try to identify which natural resources are used primarily in their home and surrounding community.
- How is the school primarily powered?
- Group the classes answers to find out how is their entire community powered?
- Do they use a majority of renewable or non-renewable resources?

Community Planning

- This is a possible interdisciplinary project and could be a cooperation between science and social studies subjects.
- Have students act as new community planners.
- If class time allows have students work in small groups, or work as individuals for a homework assignment.

- On poster paper have students design a new community.
    - How will citizens obtain the energy that they need?
    - Should renewable or non-renewable resources be used to generate power?
    - Where will the waste products go?
    - Make sure that students represent all of the power needed in the community; electricity, heat source, power vehicles.
    - Next class period have students present their poster ideas to the class. Display posters in class, around the school.

Extensions:

- Lights at Night Video. http://www.koshland-science-museum.org/exhib_lightsatnight/index.jsp
    - What countries use the most energy?
    - What are some reasons for change in energy usage from 1993 to 2003
- Make an energy diary. How can you make a difference in your energy use? Why would one care?
- For a more in-depth look at facts about fossil fuels read the "Energy Basics" pages supplied by NYSERDA with students.
    - Have a group of students read each one and summarize for the rest of the students, or read sections of them together as a class (or for homework).
    - Students can each analyze a NYSERDA poster featuring one type of natural resource to become an expert on that topic.
        - The information given can be summarized for the entire class..
        - Construct a Venn Diagram for positive and negative aspects of each natural resource.

Assessment:

- Are students able to define renewable and non-renewable resources?
- Are students able to identify examples of renewable and non-renewable resources?
- Can students state what types of natural resources fulfill their energy need?
- Can students think of realistic alternative energy options for their communities?

Glossary of Terms:

Coal: A type of fossil fuel that was formed millions of years ago by the decay of ancient forests. Occurs in a fixed amount within the earth, once it is used up, it will be gone forever. Mined and burned to produce electricity.

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.

Fossil fuel: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.

Geothermal: This is heat energy that is harnessed from the core of the earth. It allows heating of buildings and water without using fossil fuels to generate heat.

Greenhouse Gas: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
Hydropower: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.
Metals: Relatively rare minerals that are occur in fixed amounts within the earth. They are essential to survival and are mined from the earth for use. They are required for industry, energy, and even human consumption.
Natural Gas: Natural gas is a combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, it can also include ethane, propane, butane and pentane. It is used commonly to heat homes, as cooking fuel, and to generate electricity.
Natural Resource: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil*:* Also called petroleum. Oil can be as thick and black as tar or as thin as water. Petroleum based products are also derived from oil.
Renewable energy source: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Solar power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.
Waste products: An unusable or unwanted material that is produced as the result of a process.
Wind power: Harnessing energy that wind creates with the use of large windmills. It is a clean, green way to create electricity without burning fossil fuels.

NYS Learning Standards:

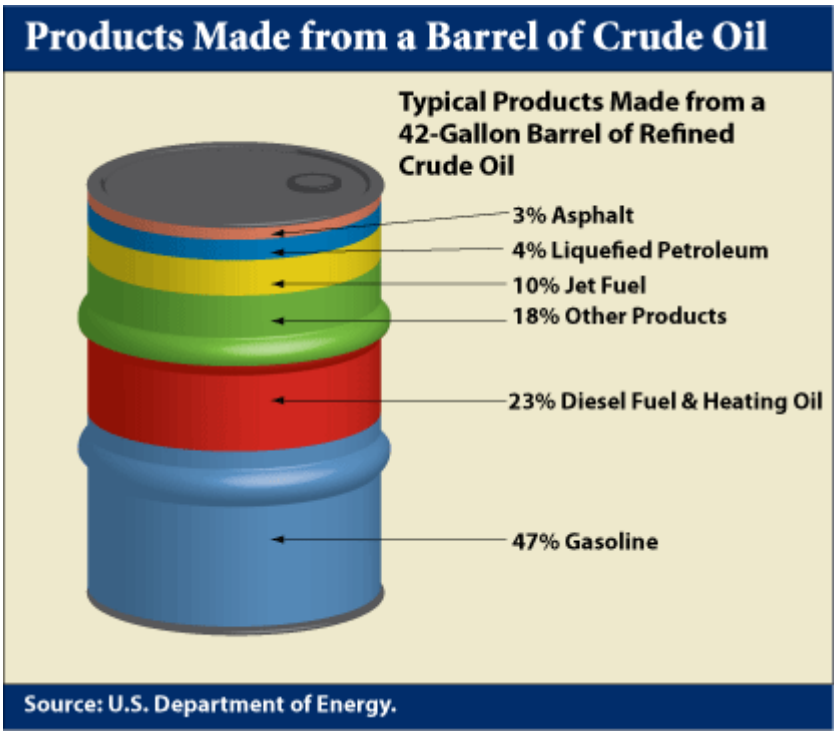
Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 7: Interdisciplinary Problem Solving

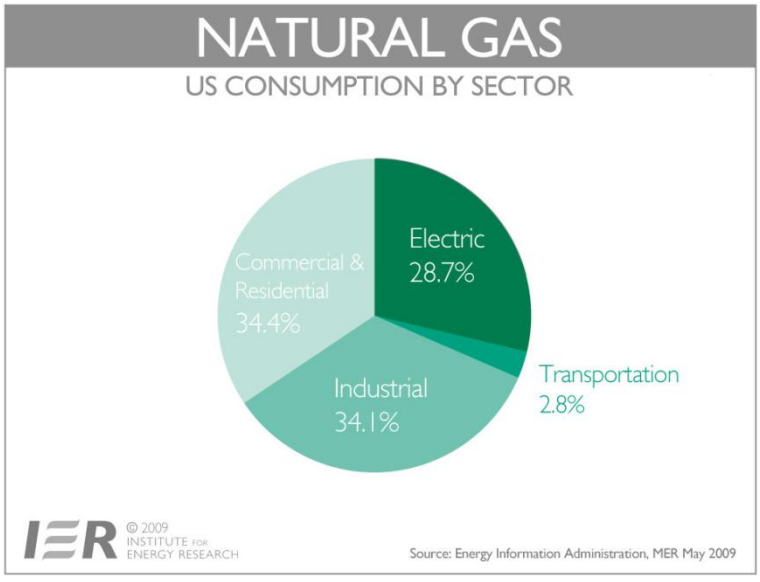
English Language Arts
Standard 1: Language for Information and Understanding

Natural Resource Images

Oil



Natural Gas




RADIOACTIVE
WASTE
Uranium


Coal

Natural Resources Chart

NATURAL RESOURCES		Waste Products
Non-renewable	Coal	
	Oil & Petrolium	
	Natural Gas	
	Uranium (nuclear power)	
Non-renewable	Minerals / Metals	
Renewable	Wood	
	Water	
	Wind	
	Solar	
	Geothermal	

What is a Carbon Footprint?

Grades:

8th-12th, Adult

Objective:

- Students will discover how their use of resources creates an environmental impact. They will be able to calculate that impact using a carbon footprint calculator.

Method:

- Students will use a carbon footprint calculator to estimate their environmental impact and will brainstorm ways to limit this impact with changes in their daily behavior.

Materials:

- Internet Access →Carbon Footprint Calculator

Time:

Preparation Time: 15 minutes
Class Time: 2 class periods (45 minute intro to fossil fuels and greenhouse gases, 45 minutes to calculating carbon footprints and reducing impacts)

Vocabulary:

Carbon Footprint, Coal, Conservation, Developed Countries, Developing Countries, Environmental Impact, Fossil fuel, Geothermal, Greenhouse Gas, Natural Gas, Natural Resource, Non-renewable Resource, Oil, Recycle, Renewable energy source, Solar power, Stewardship, Sustainability, Waste products, Wind power.

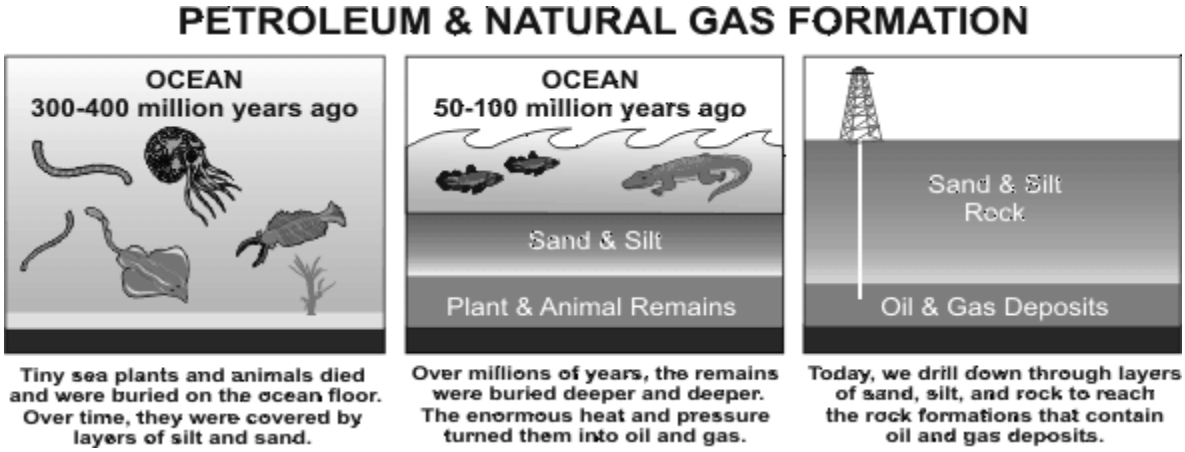
Procedure:

DAY 1

What is a carbon footprint? To understand this we must first understand fossil fuels.

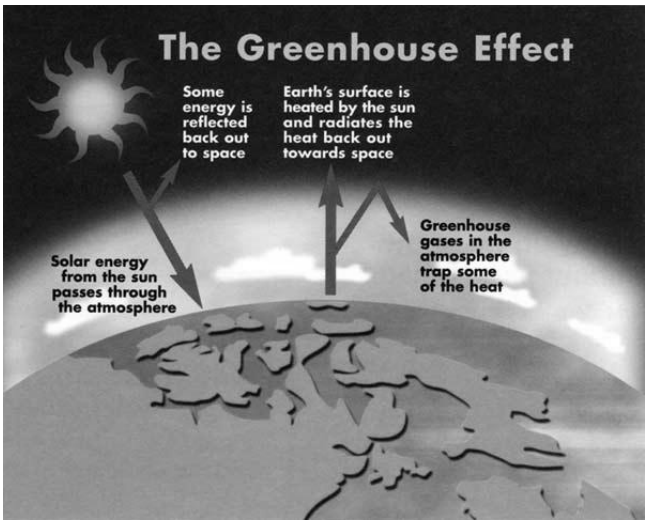
- The use of non-renewable resources, such as burning fossil fuels, creates waste products called *greenhouse gases*.

- *Fossil fuels*: Fuels like oil, natural gas, and coal were formed over millions of years below the earth's surface.
    - Fossil fuels were formed from the carbon in ancient organisms that were never able to break down and release their carbon because they were covered with layers of sediment after they died.
        - Display "Petroleum & Natural Gas Formation diagram. Have one student read each of the 3 picture captions for the class.
    - The carbon was trapped within the earth and is now mined and burned for energy.
    - Pose question to students: If it took millions of years for fossil fuels to form are they renewable or non-renewable?
        - Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available within the earth and once that supply is used up they are gone. They won't regenerate for millions of years, if ever.
    - PBS- NOVA calculated that it may have taken ~100,000 ancient plants to form just 1 gallon of gasoline.



- Fossil fuels like oil, or natural gas are burned to create energy. When they are burned, they release greenhouse gases, such as carbon dioxide or methane.
    - Think about when you fill your car with gasoline. The engine burns the fuel, and releases exhaust from your tail-pipe. Within the exhaust are greenhouse gases. Two examples of a greenhouse gases are carbon dioxide and methane.
- Are greenhouse gases bad?
    - All animals, including humans, produce carbon dioxide during respiration by exhaling and methane found in waste.
    - Plants require carbon dioxide as an ingredient in photosynthesis.
    - It is naturally occurring on this planet. Carbon dioxide and other gases create a protective layer around the earth, called our atmosphere.

- *The Greenhouse Effect:*



The thick layer of gases in the atmosphere acts like the glass windows of a greenhouse, or the windows of your car.

Rays from the sun filter through the atmosphere and hit the earth, warming it.
The greenhouse gases trap the some of the heat so it is not able to escape back out through the atmosphere. It is the same principle that forces you to open the windows in your car on a hot summer day.

Humans have rapidly increased the use of fossil fuels since the Industrial Revolution. Since then, the earth has been warming at an alarming rate. This is called global warming, or global climate change.

- Use the following links for a video that illustrates the greenhouse effect or search for videos using the internet.
  - http://www.youtube.com/watch?v=dP-tg4atr5M&feature=related
  - http://www.youtube.com/watch?v=Hi3ERes0h84
  - http://www.youtube.com/watch?v=3UeZ7tDR7l4&feature=related
  - http://www.youtube.com/watch?v=LFNKfWyGxHw&feature=related

Who cares?

- What affects can global climate change have on the planet and why would we want to prevent it?
- For homework, have students research at least 2 possible affects of global climate change.
  - Examples include, but are not limited to: sea level rise, flooding in some areas, droughts in already dry areas, changes in insect pest populations, change in weather patterns, extinction of species, migration of species, food shortages, increase in tropical storms.

DAY 2

Calculating our Carbon Footprint

- We can calculate how much greenhouse gas emission we (individually or as a household) create each year.

- We can also find simple ways to cut this impact for future years!
- Have students log on to a carbon footprint calculator.
- Choose One (or search one from the internet):
  Nature Conservancy Carbon Footprint Calculator -
  http://www.nature.org/initiatives/climatechange/calculator/
  Carbon Footrprint Calculator- http://www.carbonfootprint.com/calculator.aspx
  EPA Carbon Footprint Calculator - http://www.epa.gov/climatechange/emissions/ind_calculator.html

How can we limit our carbon footprint?

- *Conservation* – is a change in our behavior that reduces the daily amount of resources that we use.
  - *Conservation* is something that we must do now in order to slow our consumption of fossil fuels, which are running out. If we choose to use them more slowly we can extend the amount of time that they will last.
- *Sustainability* – is a change in our behavior and infrastructure that makes a dramatic switch from relying on non-renewable resources to relying on renewable resources, which are unlimited.
  - Using renewable resources creates a more secure energy base.
  - Sustainability is something that we need to pursue with funding and research in order to ultimately solve the need for energy on our planet.

Environmental Solutions:

- For homework: Have students draft a plan to reduce their carbon footprint over the next 6 months. Make it a household or classroom challenge!
  - What are things they can do *today* to cut down on their CO_2 emissions?
    - Turn off the lights when they leave the room
    - Turn off & unplug any electronics that are not being used.
    - Shut down the computer after each use.
    - Only run the dishwasher, washing machine, and dryer when full.
  - What are things they can do in the *next month*?
    - Start a carpooling schedule with neighbors, walk, or take the bus.
  - What are things they can do by the *6 month mark*?
    - Replace their households light bulbs with compact florescent bulbs.
    - Take shorter showers (it takes energy to heat water).
    - Plan to make less trips by completing errands all at once: school pick up, grocery shopping, post office.
  - What is one thing they can do to become SUSTAINABLE?

Extensions:

The Wedge Game

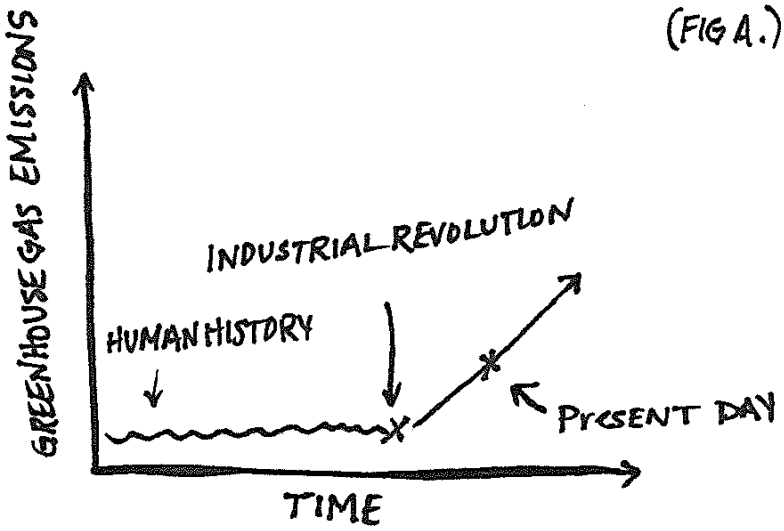
(The Wedge Theory was created by Stephen Pacala of Princeton University and was featured on PBS-NOVA in April 2011.)

- The Wedge Game allows you to demonstrate earth's total carbon emissions over time.

- Students begin by constructing a graph with "Greenhouse Gas Emissions" on the X-axis and Time on the Y-axis.

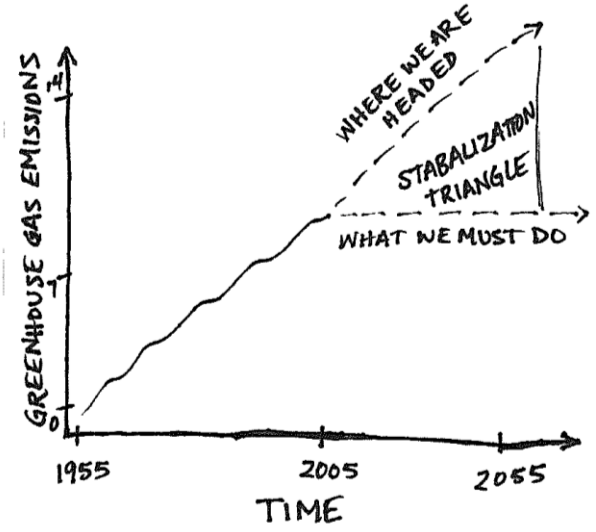
- Students plot the Historical Levels of greenhouse gas emissions, the industrial revolution spike, and present day levels. (Figure A)

(FIG A.)

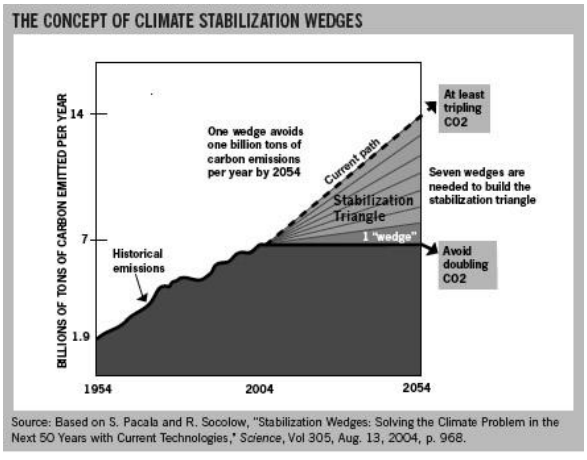


(FIG B.)

- Create another graph with a "zoomed in view" of the year 1955 to 2055. (Figure B)



- Have students "zoom in" on the *stabilization triangle*. This wedge



represents 7 billion tons of carbon per year that is emitted into the atmosphere.

- Have students redraw this wedge and break it up into 7 – 1 billion ton wedges.
- By breaking down that 7 billion tons of carbon into more manageable size pieces students can begin to tackle the problem of reducing the carbon output by using green technology.
    - Wedges may fall into 4 different categories:
        - Green: Efficiency
        - Yellow: Nuclear Energy
        - Blue: Carbon Capture
        - Red: Solar and wind energy.
    - *Efficiency*: This is the easiest and cheapest option for reducing carbon emissions because these are many simple changes that we can make to our lifestyle starting today. Increasing efficiency in heating our homes, the MPG of our vehicles, and use of our electronics can take a big bite out our energy consumption and production of greenhouse gases.
    - *Yellow*: Nuclear energy creates a great deal of energy without emitting greenhouse gases into the atmosphere, like the burning of fossil fuels. If we were able to replace 800 coal burning power plants throughout the world with nuclear energy we would eliminate one entire wedge! (1 trillion lbs)
    - *Blue*: Carbon capture refers to sucking carbon out of the atmosphere that we emit by burning fossil fuels. Natural gas plants in Insala, Algeria currently pipe the carbon dioxide gas that they produce miles underground to keep it out of the atmosphere. "Scrubbers" in smokestacks act like filters that suck up carbon before it can enter the atmosphere.
    - *Red*: Solar & wind energy. These technologies are extremely effective at generating clean and renewable energy. However, they still remain too costly for it to be feasible for the average person to take advantage of this energy source. A company called "SunTech" in China is busy working on making solar panels cheap to produce and install.
- Have students design their own Stabilization Triangle by coloring wedges to reflect the types of technology they think should be combined to solve the 7 billion ton per year problem.
    - There are not right or wrong answers here. Students can mix and match the technologies that they think will be cheapest, easiest to incorporate into existing infrastructure, the most effective, or the most sustainable.
    - Have students volunteer to share what combinations they chose and why.

Assessment:

- Are students able to navigate to a carbon footprint calculator and input data to come up with a logical output?

- Are students able to analyze their energy use and find ways to reduce it within their household or classroom?

Glossary of Terms:

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Coal: A type of fossil fuel that was formed millions of years ago by the decay of ancient forests. Occurs in a fixed amount within the earth, once it is used up, it will be gone forever. Mined and burned to produce electricity.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Developed Countries: Highly industrialized countries with a high average income.
Developing Countries: A nation with a relatively low level of industrialization and often characterized by a reduced standard of living.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil fuel: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.
Geothermal: This is heat energy that is harnessed from the core of the earth. It allows heating of buildings and water without using fossil fuels to generate heat.
Greenhouse Gas: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
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Natural Resource: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil*:* Also called petroleum. Oil can be as thick and black as tar or as thin as water. Petroleum based products are also derived from oil.
Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.
Renewable energy source: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Solar power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is

used to create electricity, heat homes, and heat water.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
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Wind power: Harnessing energy that wind creates with the use of large windmills. It is a clean, green way to create electricity without burning fossil fuels.

NYS Learning Standards:

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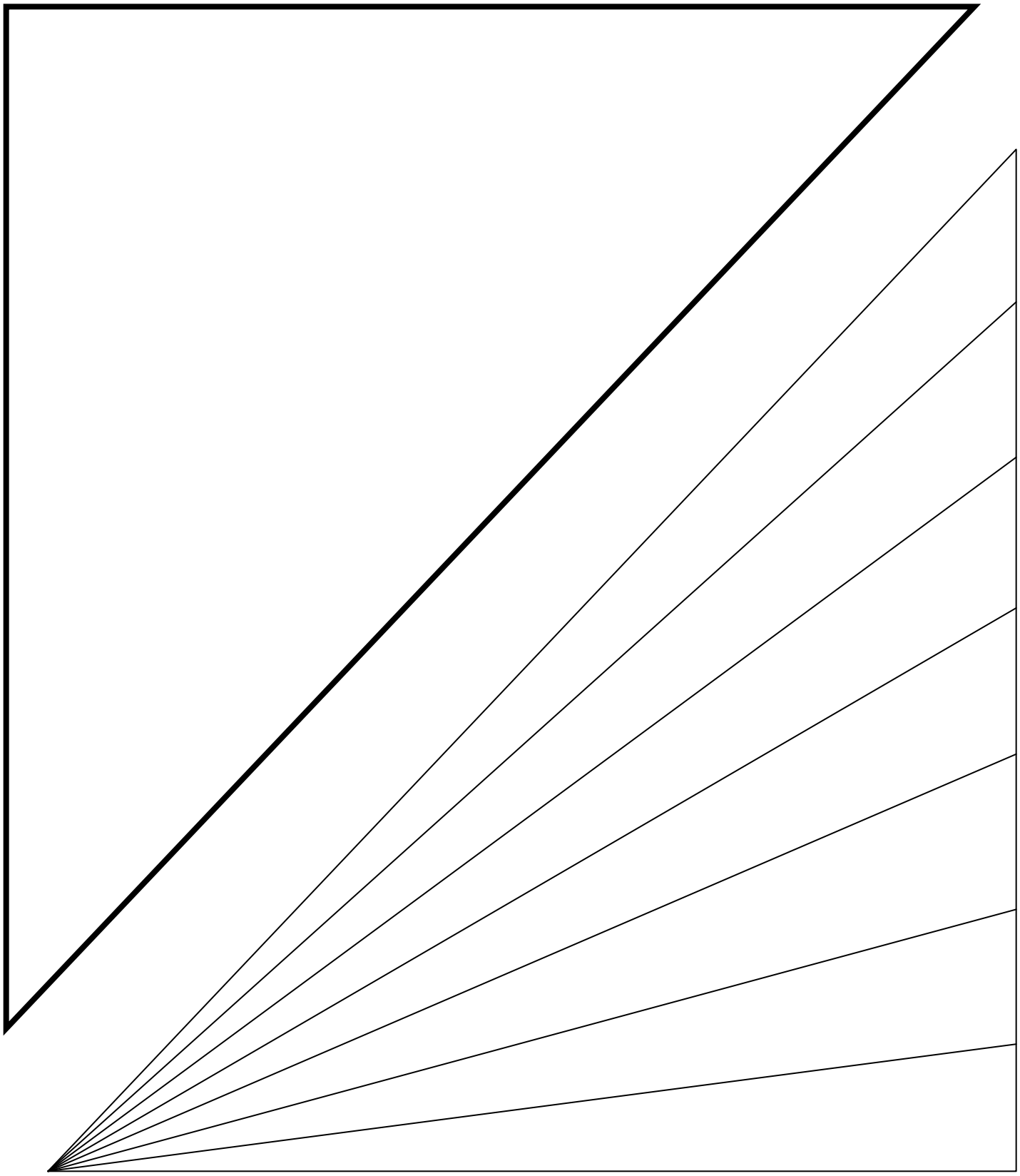
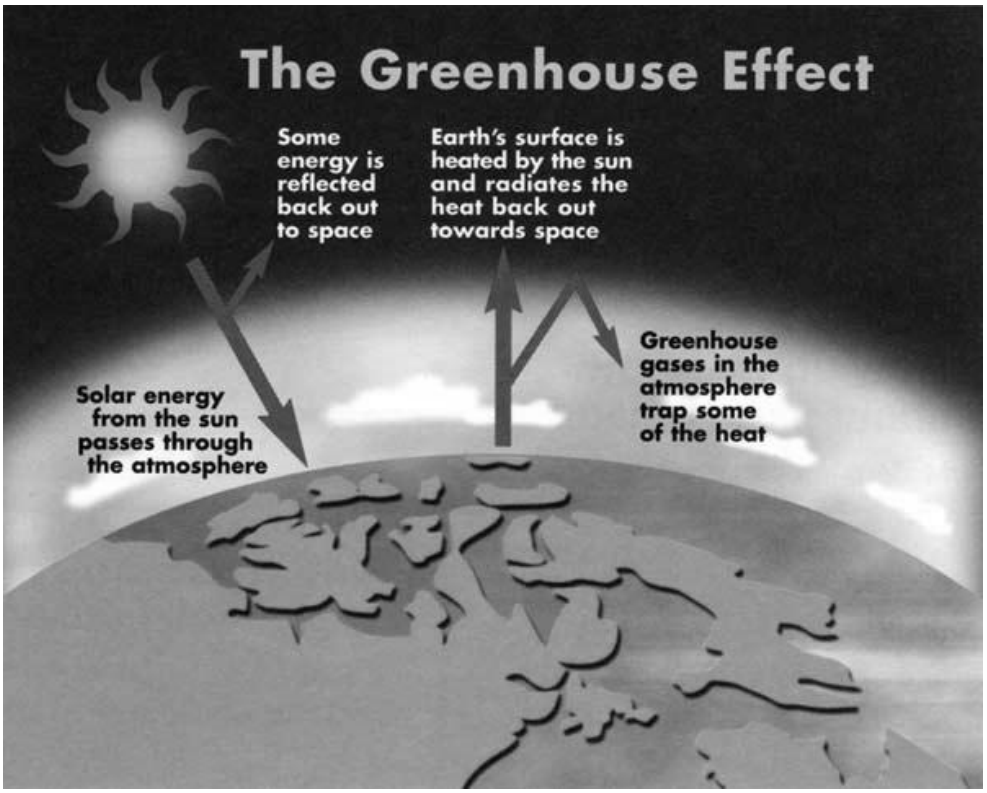
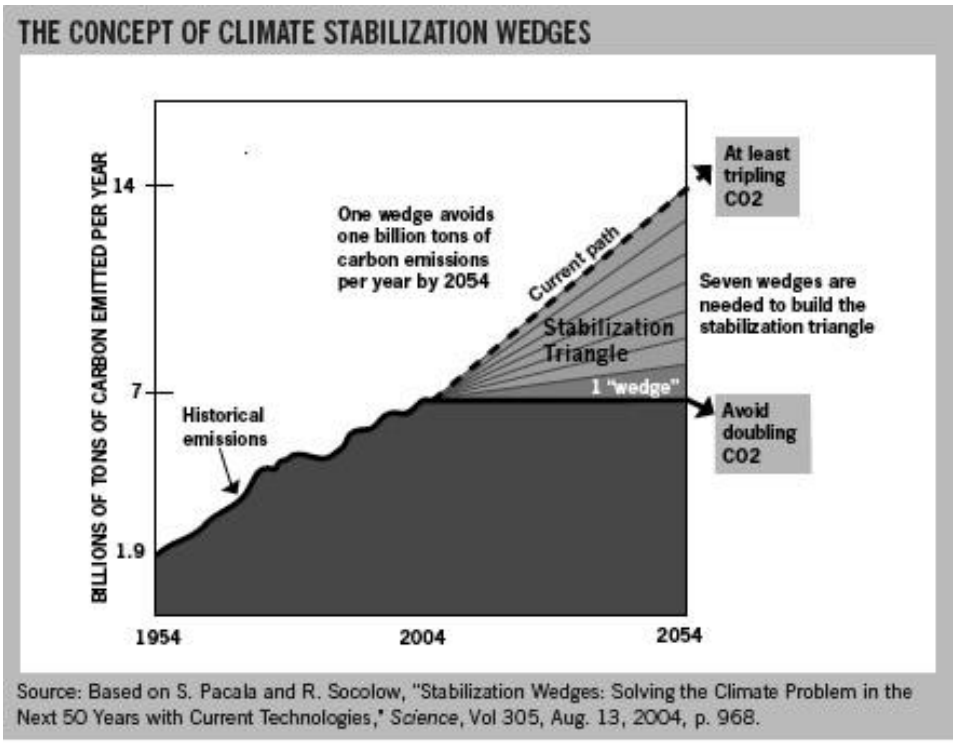
English Language Arts
Standard 1: Language for Information and Understanding

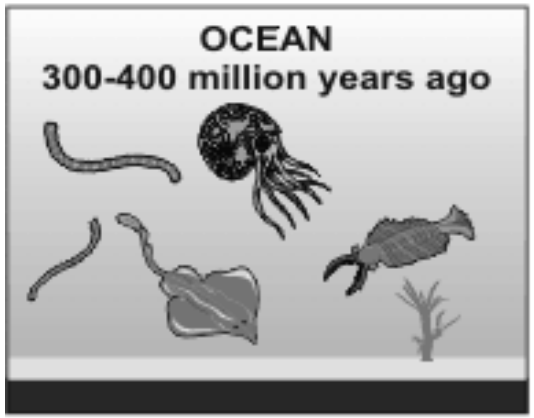
Cut out triangle. Cut out 7 wedges, color, and arrange within the triangle.



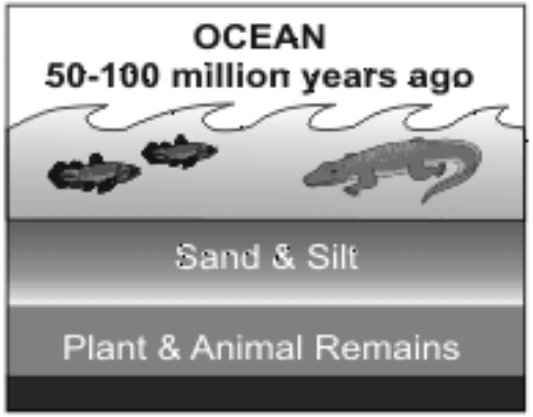

The Greenhouse Effect
Some energy is reflected back out to space
Earth's surface is heated by the sun and radiates the heat back out towards space
Greenhouse gases in the atmosphere trap some of the heat
Solar energy from the sun passes through the atmosphere


THE CONCEPT OF CLIMATE STABILIZATION WEDGES
BILLIONS OF TONS OF CARBON EMITTED PER YEAR
14
7
1.9
1954
2004
2054
Historical emissions
One wedge avoids one billion tons of carbon emissions per year by 2054
Current path
Stabilization Triangle
1 "wedge"
Seven wedges are needed to build the stabilization triangle
At least tripling CO2
Avoid doubling CO2
Source: Based on S. Pacala and R. Socolow, "Stabilization Wedges: Solving the Climate Problem in the Next 50 Years with Current Technologies," Science, Vol 305, Aug. 13, 2004, p. 968.

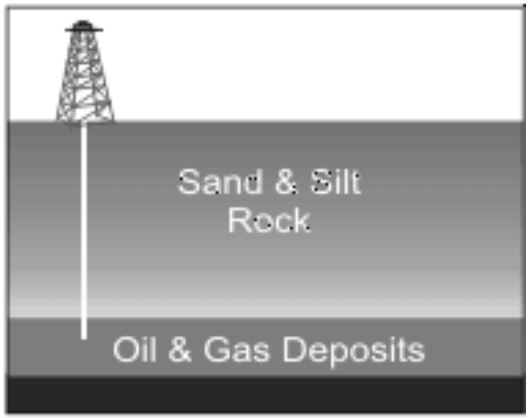
PETROLEUM & NATURAL GAS FORMATION



Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of silt and sand.



Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.



Today, we drill down through layers of sand, silt, and rock to reach the rock formations that contain oil and gas deposits.

What is Green Energy?

Grades:

6th-12th, Adult

Objective:

- Students will discover alternatives to conventional fossil fuel use with green energy.

Method:

- Students will use different examples of green energy alternatives to realize recent advances in energy technology.

Materials:

- Poster paper
- Markers
- Internet access.

Time:

Preparation Time: 15 minutes
Class Time: 2 class periods

Vocabulary:

Carbon Footprint, Coal, Conservation, Environmental Impact, Fossil fuel, Geothermal, Green Collar Jobs, Green Energy, Greenhouse Gas, Hydropower, Natural Gas, Natural Resource, Non-renewable Resource, Oil, Recycle, Renewable energy source, Solar power, Stewardship, Sustainability, Waste products, Wind power.

Procedure:

Introduce Green Energy

- Ask students to define what they think green energy is. (Allow students to brainstorm in pairs, or small groups).
- Then, generate a definition of green energy as an entire class.

  - Green Energy is the use of renewable energy sources to meet our need for power, which often have less of a negative impact on the environment.
- Generate some examples with the entire class.
  - Solar Energy (sunlight), Hydropower (water), Geothermal Energy (heat from the earth's core), Wind Power, Biomass (burning plant and animal waste to create energy), Hydrogen (using an abundant gas),Biodiesel (mixing restaurant waste with standard fuel).

Green Energy Research

- Divide students into groups to research one green energy alternative to fossil fuels.
- Each group will choose a green energy label from the bag without looking.
- Their group will then have the rest of the class period to research that green energy source and create an informative poster to present to the class.

Solar power
Hydropower
Windpower
Geothermal
Biomass
Hydrogen
Biodiesel

Information Systems

- When using internet sources to research green energy the students must make sure to use credible sources for their information.
- Personal web pages are usually not appropriate for scientific research.
- A list of notable sources is listed below.

Environmental Protection Agency: http://www.epa.gov/energy/renwenergy.html
Renewable Energy: http://www.renewable-solarenergy.com/
New Energy Portal: http://www.new-energy-portal.com/index.php/information.html

Presenting Research

- During the next class period each group will have 5-8 minutes to present their energy source. Posters must include the following:
  - Title. (Name of Energy Source)
  - Where does the energy comes from?
  - What type of construction is needed?
    - Dam for hydropower, wind turbines for wind, solar panels for solar, farm for biomass, fuel cells for hydrogen, etc.
  - What type of waste products are created from its USE, (You can choose to also list waste products from the construction process)?

- Hydrogen = water, solar, wind, water = none, biomass = ash.
- How is the power used?
  - Heat?, Electricity?
- Other groups may each ask one relevant question to each presenting group.

Discussion

- Attached to this lesson plan is a "Background for Teachers" sheet that summarizes the main points of each green energy type. This is designed to give teachers a knowledge base to gauge the students' thoroughness in research. Answers may include these points but are not limited to them.
- Teacher may pose the following questions to the class to debrief and summarize lesson:
- How is wind energy really solar energy?
  - Solar energy is responsible for the warming and cooling of the earth as it spins on axis and rotates around the sun. This warming and cooling creates the wind currents that produce wind energy.
- How is biomass really solar energy?
  - Biomass is created from burning plant material for fuel. Plants use the energy from the sun to make sugar. It is this sugar that can be fermented into fuel. Carbon that is fixed by plants can be burned to create energy.

Extensions:

- Students can research what local sources of energy their communities employ.
- Where does their energy come from?
- It is powered solely by fossil fuels, or is it primarily one of these green sources?

Assessment:

- Are students able to present accurate information about each green source of energy?
- Are students able to ask thoughtful and relevant questions to their classmates?

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Geothermal: This is heat energy that is harnessed from the core of the earth. It allows heating of buildings and water without using fossil fuels to generate heat.
Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
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Solar Power

Hydropower

Wind Power

Geothermal

Biomass

Hydrogen

Green Energy Background for Teachers

What is Solar Energy?

Solar energy accounts for the majority of energy on earth.

- Fossil fuels are really stored chemical energy. They are made up of broken down plants that got their energy from the sun, or from animals that ate those plants.
- Wind energy is formed by the uneven heating of the Earth by the sun.
- Hydropower comes from the water cycle which is driven by the sun.
- Biomass (including wood), and biofuels are stored chemical energy from photosynthesis, driven by the sun.

The sun as heat.

- Much of the sun's energy can be used readily as heat. This is often known as *passive heating.* Attaching a greenhouse to produce heat, solar ovens, solar showers, solar collectors produce water for swimming pools, homes and industry.

The sun as radiation.

- The sun's rays travel through space as electromagnetic radiation. Light waves occur at many different wavelengths. Solar radiation within the visible spectrum can be converted directly into electricity by solar panels

Solar panels (photovoltaics).

- Solar panels are constructed from a material (most often silicon mixed with other elements) that is a semiconductor of electricity. There are 2 layers of silicon in a PV cell that are mixed with other elements such as boron or gallium on one side, and phosphorous or arsenic on the other side.
- When these materials are mixed they become positively or negatively charged. Then the sides will share electrons creating an electric field.
- When photons (light) hit the panel the energy causes the shared electrons to jump from one side to the other across a wire. The electron flow provides the current, and the cells junction causes a voltage.
- A multimeter is a device that measures how much voltage (measured in volts) a solar panel is producing.
- Include picture of a solar panel. Include diagram of how a solar panel works including sun, solar panel, and appliance in the diagram. Include actual solar panels that students can measure with a watt meter.

Green Energy Background for Teachers

What is wind energy?

- Wind energy is a form of solar energy. It occurs due to uneven heating and cooling of the earth's surface. As hot air rises and cool air falls wind currents are created.
- Wind energy is captured with turbines. Non electric turbines exist that pump water and provide aeration in ponds. But, turbines that are hooked up to the electrical grid create energy that is actually decreasing in price as technology advances. Use of fossil fuels to create electricity will only increase in price as these resources become more scare.
- Wind energy moves large blades that turn a turbine creating electrical energy. This is an alternative to burning fossil fuels to heat water to create steam, to turn a turbine.
- Wind energy is the world's fastest growing renewable energy. The energy payback time (the time for a wind turbine to generate the same amount of electricity that was used to manufacture it) is three to eight months.

What is hydropower?

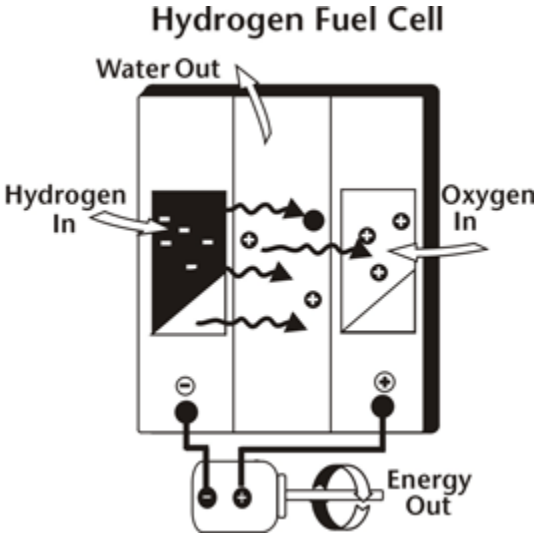
- Hydropower is energy created by harnessing the power of water. The power of flowing water will move large turbines creating electricity. There is a shift from mechanical energy to electrical energy.
- Power can be created by wave action along the coast or by rivers flowing over a dam.

What is Biomass?

- Biomass is energy that is created by burning materials from plants.
- Fast growing species of plants such as grasses and corn are grown in fields and then harvested to create pellets. These pellets are then burned in stoves to heat homes, or are burned to create electrical energy.
- These plants (if fields are managed properly) can regenerate year after year (unlike fossil fuels). Many plants are often weedy species that can be grown easily.

What is Hydrogen? (taken from the National Energy Education Project – public domain)

- Hydrogen is an atom that occurs in water molecules: H_2O.
- A Hydrogen Fuel Cell is required to capture the energy from the hydrogen in a water molecule and turn it into electricity.
- Electrolysis (or water splitting) is used to separate hydrogen from oxygen. It creates energy without



any emissions but is extremely costly. New technologies are being developed to bring costs down.

What is Geothermal Energy?

- Geothermal energy means harnessing heat from center of the earth to use as power.
- In new buildings, a tube similar to a well can be drilled in order to tap into the relatively constant temperature under the earth's crust. This energy can keep a house around 70 degrees Farenheight year round. This can greatly reduce heating and cooling costs throughout the year.
- It is expensive to install a geothermal heating & cooling system in standing buildings, but it is very easy to install in houses as they are built.

What is biodiesel? (Taken from the National biodiesel Board)

- A renewable, clean-burning fuel.
- Made from an increasingly diverse mix of resources such as agricultural oils, recycled cooking oil and animal fats.
- It is the only commercial-scale fuel used across the U.S. to meet the Environmental Protection Agency's definition as an advanced biofuel.
- Its production, distribution and use will support more than 30,000 U.S. jobs in 2011 and replace nearly 1 billion gallons of petroleum diesel.

In-class Debate: Energy Options
Natural Gas Drilling in the Catskills?

Grades:

6^{th}-12^{th}, Adult

Objective:

- Students will gain an understanding of different energy *stakeholder* groups within their community.
- Students will understand that this mock-debate represents a realistic example of how communities come together to deal with conflicts involving natural resource use/extraction due to their growing energy demand.

Method:

- Students will take on the role of various stakeholders within their community and represent their viewpoints at a mock town meeting focusing on energy issues.
- Students will ask each other questions with the goal of reaching a consensus on the issue.

Materials:

- Stakeholder Cards
- "Issue" cards for each group
- Poster paper
- Markers.

Stakeholder Groups:
Chesapeake Energy
New York Power Authority
Catskill Landowners Association
New York State Department of Environmental Conservation
Catskill Mountain Wind Management Inc.
New York City Department of Environmental Protection
Catskill Forest Association

Time:

Preparation Time: 20 minute materials prep

30 minutes background info for students
Class Time: 40 minutes

Vocabulary:

Carbon Footprint, Environmental Impact, Fossil Fuel, Fracing/Fracking, Green Energy, Greenhouse Gases, Hydraulic Fracturing, Marcellus Shale, Natural Gas, Natural Resources, Non-point Pollutant, Non-renewable Resource, Runoff, Stakeholder, Stewardship, Waste Products, Wastewater, Watershed.

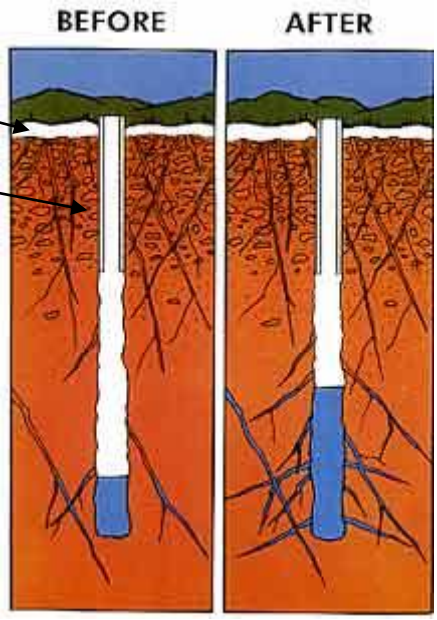
Prep:

- Students will require a background on the process of Hydraulic Fracturing in Marcellus Shale. Hydraulic fracturing is nicknamed "fracing"(prounced frack-ing) and can be spelled either fracking or fracing.
- Students may be able to research fracing as a homework assignment prior to this lesson.
- Students can look for videos of hydraulic fracturing and read basic facts pages on the internet.

Cover the following basic review of natural gas, Marcellus shale, and hydraulic fracturing. Have students draw a diagram of hydraulic fracturing and label any details of the picture.

What is natural gas? Natural gas is a type of fossil fuel that can be mined from the earth through drilling deep wells. Natural gas is abundant inside the earth in a formation of rock called Marcellus Shale. It is mined through a complex process called Hydraulic Fracturing. Once extracted, natural gas burns cleaner than other fossil fuels, emitting less CO_2 into the atmosphere and reducing our carbon footprint.

Marcellus Shale: The Marcellus Shale region of the Mid-Atlantic is believed to contain the third largest natural gas reserve in the world. Drilling domestically for an abundant natural resource is an attractive option when foreign oil sources are located in areas of political unrest.



Hydraulic Fracturing "Fracing" – A concrete slab is poured called a "pad".

From here a large hole is dug and a concrete drill tube inserted.

Water, sand, and a mixture of chemicals (called fracking fluid) are squirted at high pressure into the shale. Ask students if they know what fracturing is (i.e. What happens if you fracture your arm?) Fracturing means to break or crack. The water and fracking fluid shooting into the shale causes cracks or fractures in the shale that allows the natural gas (shown in blue) to leak into the drilled hole.

Natural gas is sucked out of the hole along with the 30-50% of the waste liquid from the fracing process. The majority of drilling liquid remains in the ground and is not biodegradable. On average it requires 5 million gallons of water per frac.

Wells can be drilled anywhere from 80 to 8000 feet deep.

Halliburton Loophole: In 1974, the Safe Drinking Water Act (SDWA) was passed by Congress to ensure clean drinking water free from both natural and man-made contaminates. In 2005, the Bush/ Cheney Energy Bill exempted natural gas drilling from the Safe Drinking Water Act. It exempts companies from disclosing the chemicals used during hydraulic fracturing. Essentially, the provision took the Environmental Protection Agency (EPA) off the job. It is now commonly referred to as the Halliburton Loophole.

Procedure:

Stakeholder Groups

- Divide students into groups of 4-5.
- Distribute a stakeholder card to each group.
- Distribute "The Issue" card to each group.

Debate Format

- Remind students that they will be taking part in an in-class debate that functions as a mock-town meeting to discuss energy options.
- During this debate their group is to represent the viewpoint of their stakeholder group (and not their personal opinion).
- Remind students that a "debate" doesn't mean an argument. These groups must present their opinions with respect to the other groups.

The Issue

- Read "The Issue" card as students read along in their groups.
- Have students then read their group's stakeholder card.
- During this time is it is important to check in with each group to make sure they understand their group's position, understand the task at hand, and to answer any immediate questions.

Poster Preparation

- Students have 15 minutes to generate a poster for their group stating whether they support the natural gas drilling, or do not support natural gas drilling within the Catskill Park.
- They must all include bullet points of their opinions, supporting facts, and any alternatives (if necessary).

Stakeholder Group Name
Approve, or Do Not Approve * Reasoning *Supporting Facts *Alternatives

← Poster Template

Poster Presentation

- Each group will have approximately 5 minutes to read their posters to the rest of the class, and take 2 questions from the other groups.

Stakeholder Group Vote

- Take a group vote (still acting as your stakeholder) to see if the power plant would be approved.

Class Vote

- Once all of the groups have presented take a few moments to regroup.
- Now give your personal opinion.
- Raising hands, how many of the students were part of a group that they personally agreed with?
- How many were part of a group that held opinions they didn't personally agree with?
- Take a real vote. Would natural gas drilling be approved if it was up to the students in this class?
    - If not, what would this class see as a suitable alternative for our power needs?

Is this debate realistic?

- Do communities ever come together to deal with conflicts in how to meet their growing energy demands?
- What other environmental issues could bring up conflict between stakeholders?
- Why is it important to be able to face an issue with someone else's viewpoint or opinion?

The Future of Energy

- It is important to stress to students that the Catskills will face decisions about natural gas drilling in the near future.

Extensions: (for High School – Adult audiences)

1. Show the film "Gasland" for students, a documentary on Natural Gas Drilling in Pennsylvania and beyond. http://www.gaslandthemovie.com/whats-fracking
2. Students write a one page report on the current status of the Natural Gas Drilling process in the Catskills. Has it been approved? Has an environmental impact statement been obtained?
3. You may include more of a dialogue between the groups to make it more of a true debate format.
4. Have students research another current issue in their area that affects the supply of energy in New York State.

- What is the issue?
- Who are the stakeholders?
- Who will eventually get to decide the outcome?

Assessment:

- Are students able to participate in the class debate while representing the viewpoint of their stakeholder group?

Glossary of Terms:

Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Fracing/Fracking: See hydraulic fracturing
Green Energy: Often associated with renewable resources, these are environmentally friendly methods

of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.

Marcellus Shale: The Marcellus Shale region of the Mid-Atlantic is believed to contain the third largest natural gas reserve in the world. See map in Lesson 1: Activity 4.

Natural Gas: Natural gas is a combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, it can also include ethane, propane, butane and pentane. It is used commonly to heat homes, as cooking fuel, and to generate electricity.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Point Source Pollutant: A pollutant that has a single traceable source.

Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Waste Products: An unusable or unwanted material that is produced as the result of a process.

Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.

Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation
Standard 4: Language for Social Interaction

Social Studies
Standard 5: Civics, Citizenship, and Government

Cut along the dotted lines and laminate cards.

The Issue:

As the human population within the Catskills grows so does the need for power. We are at an important step in the history of the Catskills. As we run out of fossil fuels we must come together to decide how to meet our need for energy.

The Catskill Park sits on top of a natural gas field called Marcellus Shale. Natural gas is an abundant resource in the United States and would help our economy to break away from its dependence on foreign oil. Companies offer large sums of money to landowners for the rights to drill for natural gas on their land. This process is called Hydraulic Fracturing or "Fracing". Courts and government agencies across several states have documented over 1,000 cases of water contamination near areas of water and gas drilling. Adequate testing has not been done sufficiently to link these environmental impacts directly to fracing.

Does your group support natural gas drilling in the Catskills? If so, why? If not, state why and offer energy alternatives.

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Does your group support natural gas drilling in the Catskills? If so, why? If not, state why and offer energy alternatives.

Catskill Forest Association (CFA)

The goal of the Catskill Forest Association is to maintain healthy forest ecosystems in order to provide wood & fiber to industry world-wide. By maintaining a demand for wood fuel the CFA can ensure protection of lands within the Catskills. Forestry is a sustainable fuel source. Protecting forests for management also protects the watershed, diversity of plants and animals, tourism and recreation, and local economy (employing loggers). In order to drill for natural gas, land needs to be cleared, roads constructed, and large trucks hauling materials in and out. It also creates wastewater that can pollute remaining forests.

New York City Department of Environmental Protection (DEP)

We provide funding for and carry out a protection program for the NYC Watershed. This program protects the high quality source of drinking water for nine million people in NYC (half of New York's total population). The DEP must protect the local streams, rivers, and reservoirs that make up the watershed.

Clearing land and constructing roads for natural gas drilling will cause erosion of sediment into the water supply. Any chemicals released from "fracing" or accidental spills will leech into NYC's water supply. Our existing wastewater treatment facilities are not capable of treating the chemicals that are used in the fracing process.

Catskill Mountain Wind Management Inc.

Catskill Mountain Wind Management is a local company that relies on landowners to install windmills to generate power. Wind power is clean, safe, and efficient. The government offers money to farmers and homeowners in exchange for installing a windmill. This money helps to boost our local economy.

Wind companies do not offer as much money to landowners as natural gas companies do for the rights to drill. If we choose to drill for natural gas in the Catskills we will continue to rely on a nonrenewable resource (fossil fuels) instead of renewable resources like wind.

New York State Department of Environmental Conservation

Our goal is to conserve, improve and protect New York's natural resources and environment. To prevent, reduce and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well being. We are currently conducting a study to determine potential environmental impacts due to natural gas drilling in Marcellus shale. We will not know the environmental risks of drilling until our study is complete. NYSDEC has suspended gas drilling until the study is complete.

New York Power Authority

We operate 17 generating facilities within New York State and are a top supplier of electricity to our state. Power plants are run on hydropower and fossil fuels like oil and natural gas to create electricity. These power plants provide 337,000 jobs for New Yorkers.

Drilling locally will provide cheaper power to the region by eliminating shipping costs. It will also create new jobs for people in the local community drilling, constructing roads, and driving trucks.

Catskill Landowners Assocation

It is a tough time economically. Natural gas companies offer $10,000 per acre for the mineral rights to our land. Construction of large roads on our property would create noise pollution and ruin landscapes. However, gas companies might hire locals to perform construction jobs and we definitely need jobs in the area. The gas companies say that our drinking water will remain perfectly safe to drink. However, over 1,000 cases of drinking water contamination have been found in homes around fracing sites. The price of oil keeps going up and we need an alternative!

Chesapeake Energy

Natural gas is an abundant resource that occurs just below our nation's soil. By using natural gas we cut our reliance on oil from foreign countries. Fracing is a safe way to obtain natural gas from Marcellus Shale formations. Natural gas burns cleaner than other fossil fuels and will help to reduce our CO_2 emissions and cut our carbon footprint. Fracing is the only way to extract natural gas from deep shale formations. The chemicals that we use in fracing are also found in common household products like paint, and cleaning supplies. Chesapeake compensates $10,000 per acre for the mineral rights on a landowner's property.

Sustainable Schools

Grades:

6^{th}-12^{th}

Objective:

- Students will gain an understanding of how to assess the environmental impacts of daily operations of their school building.
- Students will be able to brainstorm ways to lessen their school's environmental impact by making it function more sustainably.

Method:

- Students brainstorm sustainable energy uses for their schools and grounds and may choose to propose these constructive changes to the school board, faculty, and staff.

Materials:

- List of subject areas where easy changes might be made.
- List of recyclable materials for your local area.

Time:

Preparation Time: 15 minutes
Class Time: 20-30 minutes

Vocabulary:

Carbon Footprint, Compost, Eco-Friendly, Ecosystem Services, Environmental Impact, Fertilizer, Fossil Fuel, Green Collar Jobs, Green Energy, Greenhouse Gases, Natural Resources, Non-renewable Resource, Pesticide, Renewable Resource, Recycle, Riparian Buffer, Runoff, Solar Power, Solar Array, Stakeholder, Stewardship, Sustainability, Vermicompost, Waste Products, Wastewater.

Procedure:

Choose a Focus

- Divide students into groups of 2-3.

- Each group will pick one area (more if time permits) to assess by choosing a labeled image from a hat.
    - List: Cafeteria, Busing, Office/Administration, Classrooms, Auditorium, Sports fields, Parking lot, Playground, Garden, Roof.

Research Environmental Impacts

- Students determine how each aspect of school function creates an environmental impact.
- Make a list for each area.

Research Environmental Solutions

- What are ways that we can cut down this impact for each section?
- Add ideas to list.
- Students answers may include, but are not limited to, the following list of examples.

Examples:

Cafeteria Impacts

Impact: There is an increased amount of plastic in the waste stream.

Conservation Solution: Have school contract with brands that only serve beverages in recyclable containers and start a recycling program at your school. Have schools recycle all recyclable items from food preparation as well.

Sustainability Solution: BREAK the bottled water cycle! America's demand for bottled water requires more than 1.5 million barrels of oil annualy, enough to fuel some 100,000 cars for an entire year! For water on the go, invest in a safe, reusable bottle! → 40% of bottled water is just tap water anyway!

Busing

Impact: Buses are releasing greenhouse gas pollution in the parking lot while students are arriving and being dismissed.

Conservation Solution: Create resolution that buses, once parked, may no longer idle in the parking lot. If they are turned off while they wait for students to exit / enter the bus they will reduce the amount of greenhouse gas pollution they emit. (And save gas too!)
Conservation Solution: Propose the bus company supplement their fuel with biodiesel.

Office/Administration

Impact: paper is wasted on print jobs.

Conservation Solution: Switch the default on the printers and copiers to print *double-sided* prints to save paper.

Classroom

Impact: Classroom computers get left on at night or over the weekend.
Conservation Solution: Have a student volunteer each week to check computers at the end of the day to make sure they have been turned off.
Impact: Paper is wasted during free time or project activities.
Conservation Solution: Paper that has only been used on one side, or has stray marks can be used instead of new paper during free time / during projects. Have the school only purchase recycled paper.

Auditorium
Impact: The auditorium requires a lot of energy to heat in the winter and cool in the summer. That uses a lot of fossil fuels and releases greenhouse gases.
Conservation Solution: Only heat and cool the auditorium on days that it is going to be used. Turn the heat, or air conditioning on just a couple of hours before the space will be used.
Sustainable Solution: Propose constructing a greenhouse attached to your school building to create a passive solar heating system for the rest of the school during winter months.

Computer Lab
Impact: Computers are left on overnight or on weekends. Monitors use a lot of energy to keep the computer screens lit all day.
Conservation Solution: Have one student per week volunteer to check the computer lab before they leave the school each day to make sure that all of the computers have been shut down and monitors are off. Have each student that uses a computer make sure the monitor is turned off at the end of each class.

Sports fields
Impact: Chemical pesticides and fertilizers used to keep the sports fields green is carried by rainwater into local waterways.
Sustainable Solution: Instead of using chemical pesticides release native lady bugs to eat insect pests that are killing the grass. Instead of using chemical fertilizers, begin a school compost pile in the garden and create fertilizer from the organic compost to be applied only in troublesome spots on the field.

Parking lot
Impact: Runoff of pollutants (gas, oil, road salt) is carried by rainwater from the paved areas and seeps into local waterways.
Sustainable Solution: Have students raise money for seedlings in order to plant a buffer zone of trees along the paved parking areas to prevent runoff from seeping into streams.

Garden
Impact: There has been an increase in the amount of water usage at the school to water the garden during dry seasons.

Sustainable Solution: Install rain barrels at the drainage spouts from the school's roof and use that water for the garden.

Roof
Impact: Heat is lost from the roof during the winter, while cold air is lost in summer.
Conservation Solution: Have roof re-insulated to save on heating and cooling costs. It will save energy too!
Impact: Drinking water is being wasted to water plants on school property.
Sustainable Solution: Save water that runs from the roof by collecting it in a rain barrel. Use this water to water school plants or gardens instead of drinking water.

Extensions:

- Students can propose constructive ideas at the next school board meeting.
    - Have the class bring posters that explain their sustainable school class project.
    - Students as a group can hold their posters and answer questions from parents and staff on how to help the school cut down on their energy use.

Assessment:

- Are students able to define an environmental impact from a school function such as busing?
- Are students able to find alternatives to daily school functions that mitigate environmental impacts?

Glossary of Terms:

Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.

Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.

Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Riparian Buffer: A protective strip of land or timber adjacent to a waterway.

Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.

Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.

Solar Array: Solar panels that are constructed on rooftops to harness the power of the sun and turn it into electricity.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

Vermicompost: A system of managing decomposition of organic matter using a worm bin.

Waste Products: An unusable or unwanted material that is produced as the result of a process.

Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.

NYS Learning Standards:

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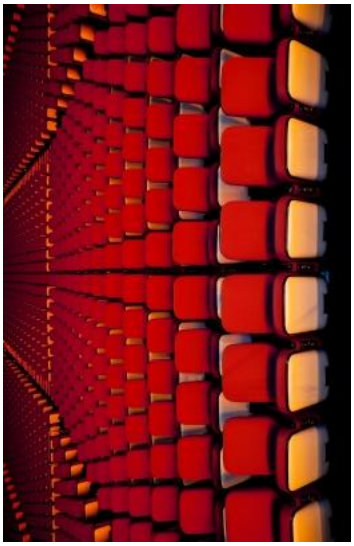

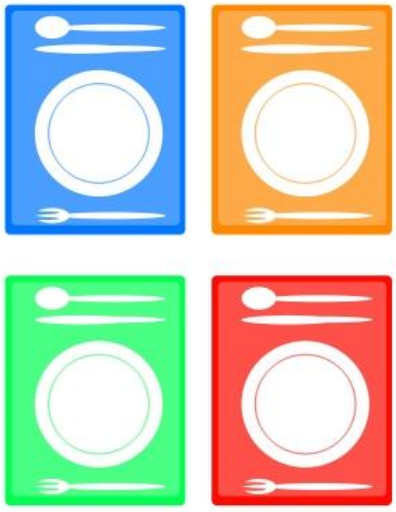

Local Green Energy:
Exploring Green Collar Jobs

Grades:

6th-12th, Adult

Objective:

- Students will discover the green energy alternatives available in their area by highlighting local companies that produce clean, efficient energy.
- Students will be able to compare and contrast types of green energy with fossil fuel use and determine which methods are best for a stable economy.

Method:

- Students will research local businesses to identify green companies in their community and local green jobs that those companies provide.

Materials:

- Internet access
- Green Energy Company Questionnaire
- Access to a phone (optional)

Time:

Preparation Time: 5 minutes
Class Time: 40 minutes

Vocabulary:

Biomass, Carbon Footprint, Compost, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Fossil Fuel, Geothermal Energy, Green Collar Jobs, Green Energy, Greenhouse Gases, Hydropower, Natural Resources, Non-renewable Resource, Renewable Resource, Recycle, Solar Power, Solar Array, Stewardship, Sustainability, Waste Products, Wind Power, Wood Power.

Procedure:

Introduce Green Energy.

- You may wish to use Lesson 1, Activity 3 to introduce green energy options. Review energy sources and their relationship to sustainability.

Explore a local green energy company.

- Ask if students are familiar with any local green energy companies.
- Students, (individually or in small groups) research one green energy company.
- Each group will choose a type of green energy and search for a local company to examine and present on.
- Students may choose an energy source from the following Catskill Mountain Region list to explore.

Solar power	Geothermal
Hydropower	Biomass
Windpower	Hydrogen

- There is another aspect to the green energy industry. Many companies do energy audits or energy efficiency inspection of buildings.
- These audits and inspections can help homeowners or businesses identify areas that waste energy, or could be upgraded to a more efficient and sustainable method.
- There are incentives to have these audits, as well as system upgrades.

Research your own Catskill Mountain Region company or use the following master list:

Solar Power

- *Energy Alternatives - Scott Gould* – Arkville, NY. (845)-586-5247. Solar, wind and backup energy systems.
- *Solar Generation* – Woodstock, NY. http://www.solargeneration.net/ (845)-679-6997
- *Mountaintop Greene Clean Energy* – Hunter NY. (518) 989-6361 - Category: Solar Energy Equipment Supplier - photovoltaic systems commercial, photovoltaic systems building integrated BIPV, solar electric power systems, solar lighting systems, Solar Pool Heating.
- *Catskill Solar* – Solar systems. Delhi, NY . http://www.catskill-solar.com/index.html (607)-746-7041
- *New York Power Authority* - http://www.nypa.gov/solar/default.htm
- *Larry Brown,* Solar Contractor, Sun Mountain, PO Box 1364 Olive Bridge NY 12461, 845-657-8096, sunmountain@netstep.net
- *John Calhoun,* PE: Consulting engineer specializing in solar and renewable energy, 191 Otens Road, Ellenville, NY 12428, 845-647-3205, jcpe1@msn.com
- *Lloyd Hoffstatter,* Sunstruck Design, 202 Mill Rd., Olive Bridge, NY 12461. Offers consultation, system design, installation and maintenance of both on and off-grid solar electric and renewable energy systems. 845-657-8132
- *Lightup Co* – Solar Energy Contractor – Summit, NY. (518)-287-1934
- *Great Brook Solar NRG, LLC.* – 819 County Rte. 28 S. New Berlin, NY. www.great-brook-solar.com (607)-847-6366

- *Solar Alchemy* –Evan Yavne, Photovoltaics & Solar Thermal – (845)-434-5187. solaralchemy@live.come, www.SolarAlchemyPV.com
- *EWS Corporation* – 3695 New York 28A West Shokan, NY – (845)-657-6655

Hydropower

- *New York Power Authority* – Blenheim/Gilboa - http://www.nypa.gov/facilities/blengil.htm, Ashokan - http://www.nypa.gov/facilities/hydros.htm

Windpower

- *Catskill Mountain Wind* – Hunter NY - http://www.catskillwind.com/
- *Invenergy* – Stamford NY. (607) 652-4015 - http://www.invenergyllc.com/
- *Energy Alternatives - Scott Gould* – Arkville, NY. (845)-586-5247. Solar, wind and backup energy systems.

Geothermal

- *Geothermal Energy of Oneonta* - http://www.h2ogeo.net/faq.htm - (607) 432-8080
- *Deep Green Geothermal - Boiceville*, NY, http://deepgreengeo.com/ (845) 657-6536
- *Knoth Plumbing & Heating* – Geothermal Heat. http://www.relevantyellow.com/Air-Conditioning-Plumbing-in-Shandaken-NY (845)-688-5901
- *Total Green* – Paul Auerbach, Monroe, NY. Geothermal.
- *Aqua-Tec. Water Services Inc.* – Geothermal Heating & Cooling. Gilboa, NY. (607) 588-9413 http://www.waterwellsandpumps.com/

Biomass

- *New England Wood Pellet LLC (NEWP)* – Deposit, NY (877) 981-9663, http://www.pelletheat.com/
- *Enviro Energy LLC* – Wood & Grass Pellet Fuel. Unadilla, NY (607)-988-9013 http://www.enviroenergyny.com/
- *The Catskill Grass Bio-Energy Project* – Cornell Cooperative Extension of Delware County. http://www.ccedelaware.org/Agriculture-Natural-Resources/CatskillGrassBioenergy.aspx

Hydrogen

- *Plug Power Inc* – Albany, NY (518)782-7700, thehydrogencompany.com

Energy Audits /Efficiency

- *Catskill Windmill Inc.* – BPI Energy Audits. Fleischmanns, NY. (845)-254-6599. http://www.catskillwindmill.com/
- *Primo Construction* – BPI Energy Audits. Franklin, NY. http://www.primoconstruction.com/ (607)-892-8284.
- *Knoth Plumbing & Heating* – Energy Audits. Shandaken, NY. http://www.relevantyellow.com/Air-Conditioning-Plumbing-in-Shandaken-NY (845)-688-5901
- *Global Dwelling* – BPI Energy Audits. Olivebridge, NY. http://www.globaldwelling.net/ (845)-679-7289
- Building Performance Contractors: http://www.home-performance.org/contractors/current.htm
- *Mid-Hudson Energy Smart Community* – Energy Audits – Kingston, NY www.sustainhv.org. (845)-331-2238

- *Ulster Construction Co.* – Certified Energy Auditor. Kingston, NY. http://www.ulsterconstruction.com/ (845)-687-4025

Information Systems

- Students research local company by using the internet or calling the company.
- Students fill out the questionnaire sheet for each company.

Present Findings

- During a future class period students present their findings to the rest of the class by summarizing their "Green Energy Company Questionnaire".

Take a class vote.

- Has anyone in the class considered working for a green energy company as their future career?
- Debrief with student discussion.
    - What are the benefits of working for a company that produces sustainable energy?
    - Which green energy field do students think is most reliable?
    - Most likely to become widely-used in the Catskills?
    - Which green energy field do students think is most cost effective?
    - What are the benefits of having sustainable energy sources as the base of our economies energy production as opposed to having an economy that is based on the use of fossil fuels?

Extensions:

- Invite a speaker from one of the local green companies to come to your class and discuss what their business does, why they think green energy is important for our future, what progress they have made in the past few years, and how students can pursue employment in green jobs.
- Are there students interested in pursuing this job market?
    - Students can research necessary education requirements. College degree? Training certification?

Assessment:

- Are students able to name a local company and describe their role in green energy?
- Are students able to describe the benefits of having sustainable energy sources as the base of our economy's energy production?

Glossary of Terms:

Biomass:

Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

Compost: The decomposition of organic matter.

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.

Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Geothermal Energy: This is heat energy that is harnessed from the core of the earth. It allows heating of buildings and water without using fossil fuels to generate heat.

Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.

Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Hydropower: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.

Solar Array: Solar panels that are constructed on rooftops to harness the power of the sun and turn it into

electricity.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Waste Products: An unusable or unwanted material that is produced as the result of a process.
Wind Power: Harnessing energy that wind creates with the use of large windmills. It is a clean, green way to create electricity without burning fossil fuels.
Wood Power: Used a fuel source, harvested from tress and burned for heat energy which can heat homes or heat water.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 2: Information Systems
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation
Standard 4: Language for Social Interaction

Career Development and Occupational Studies
Standard 1: Career Development

Green Energy Company Questionnaire

Company Name:

_____

What is the company's logo?

Type of Green Energy:

_____

Where are they located?

_____

How much energy do they produce? Or what are their services?

_____

_____

Who are their customers?

_____

What are their goals as a company?

_____

_____

Do they offer any deals or incentives?

_____

Do they supply any local jobs? Will they be hiring in the near future?

_____

Catskill Center for Conservation & Development Checkup: Solar Array

Grades:

6th-12th, Adult

Objective:

- Students will use The Catskill Center for Conservation & Development as a model for sustainability and use real-time information systems to see how green energy technology is being employed to reduce their carbon footprint.

Method:

- Students will use the internet to obtain real-time data from the Catskill Center for Conservation & Development's solar array to determine how much power it is able to produce.

Materials:

- Internet Access
- Kwh production caluculation sheet.
- Calculator
- Pencil
- Mini solar panels (optional)
- Light bulb or fan (optional)
- Volt Meters (optional)

Time:

Preparation Time: 10 minutes
Class Time: Field Trip – 40 minutes

Prep:

- Introduce Green Energy and Carbon Footprint information (Lesson 1: Activity 2, Lesson 2: Activity 3)
- Log on to http://enlighten.enphaseenergy.com/public/systems/n3Sp17200 and navigate through page in order to be familiar enough to answer students questions about the site.

- Students will need a background in how voltage is measured (kWh – kilowatt hour) as well as how solar energy works.

Vocabulary:

Carbon Footprint, Conservation, Eco-Friendly, Environmental Impact, Fossil Fuel, Green Collar Jobs, Green Energy, Greenhouse Gases, Natural Resources, Non-renewable Resource, Renewable Resource, Solar Power, Solar Array, Stewardship, Sustainability, Procedure.

Electricity

- Electricity is measured in Watts.
- 1000 Watts equals 1 kilowatt.
- How many kilowatts your home consumes per hour is called a kilowatt hour (kWh).
- The electric company charges per kilowatt-hour of energy used.
- Energy in watt hours is the multiplication of power in watts and time in hours.
- A kilowatt is equivalent to 1000 watts.

Solar Power

- Conduct and introduction to solar power with the students using mini-solar panels.
    - These panels are available from KidWind http://www.kidwind.org/xcart/home.php?cat=2#panels and start at $4.00 per panel. You will also need a measurement device, such as a an led light bulb or fan, also available from the website above. Led bulbs start at $1.50 each and fans are various prices depending on the components.
- Students, in groups of 3-4 students, can try to connect their PV (photovoltaic) panel to their led bulb using the wires. They can try this experiment in the classroom with the lights off, and then outside in the sun. What do they notice?
    - Students can also connect their PV cells to a volt meter and change the dial to measure Watts (instead of volts) since they will be working with kilowatts and megawatts on the worksheet. Seeing how many watts their tiny panels produce will allow them to imagine how large the panels must be to power entire homes.
- Teachers may wish to include a thorough explanation of how solar energy works. This explanation is available in *Lesson 1: Activity 3 – What is Green Energy?.*
- Have students observe that solar panels do produce electrical energy from energy they receive from sunlight.
- Now they can imagine a solar array, which is a series of panels, often placed on a rooftop that capture the sun's energy in order to power an entire building. Use the Catskill Center's recently installed solar array to calculate power production.

Solar Array in Real-time

- Students Log onto the website: http://enlighten.enphaseenergy.com/public/systems/n3Sp17200
- Have students fill out worksheet to make inferences about the solar array system.
- Have students determine whether or not solar power is a reliable source of energy for homes or businesses.

Extensions:

- Locate another local business that has incorporated green energy initiatives to reduce their environmental impact.
- Interview this business and find out what type of alternative energy they employ, how much energy it produces, and how they supply their remaining energy need.

Assessment:

- Are students able to describe why solar energy is important to the future of our environment?
- Are students able to use a PV cell to create electricity?
- Are students able to calculate the amount of power that is being generated by the Catskill Center in real-time?
- Are students able to calculate the electricity costs saved by the Catskill Center so far?

Glossary of Terms:

Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods

of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.

Solar Array: Solar panels that are constructed on rooftops to harness the power of the sun and turn it into electricity.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

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Standard 4: Science
Standard 5: Technology
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding

CCCD's Steps toward Sustainability

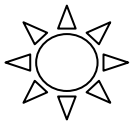
Phase 1

- Installation of a new energy efficient lighting system with compact florescent bulbs,
- Installation of energy efficient and water conserving appliances.
- Water conserving measures will save upwards of 30,000 gallons of water annually.
- Insulation of the attic, basement, and exterior walls.
- In addition to supporting local businesses and contractors through installation of these energy saving measures, we will also save an estimated $10,000 annually in electric and heating bills, with a five-year payback on all work completed to date.

Phase 2

- Installation of solar panels on our adjacent Red Shed Building
  - The solar array alone is designed to produce 35% of the average annual usage, and will save over $46,000 in its lifetime.
- Biomass – Grass Pellet Stove
  - Supports local business, heats with sustainable fuel source.

What is something that you can do to reduce the energy use of your home or school?

Solar Array Worksheet 

Name: _____ Date: _____

Log onto: http://enlighten.enphaseenergy.com/public/systems/n3Sp17200

How many solar panels make up the array? _____

ENERGY PRODUCTION

How much energy did the array produce:

Today _____

In the past 7 days _____

This Month _____

In its lifetime _____

ENVIRONMENTAL BENEFITS

Lifetime power produced is equivalent to:

_____

Lifetime carbon offset is equivalent to:

_____

$AVINGS

Calculate the amount of money **saved**:

(Multiply kwh useage X supply charge)

Today's kWh_____ X 0.0488 = _____

In the past 7 days kWh_____ X 0.0488 = _____

This Month kWh_____ X 0.0488 = _____

Lifetime Savings MWh_____ X 1000 = _____ kWh

kWh _____X 0.0488 = _____.

LESSON 2

Sustainable Water Use

Introduction to Water Use

Water is a vital resource for all living things. Human beings can live for only a few days without water. But, we need water for more than just drinking. Water is used for virtually every process in our daily lives. We drink water, our food is made of water, we use water to grow our food and livestock, to operate our homes, vehicles, modern day machines, and factories, and to power our modern way of life.

Harnessing Water

The water that we use on a daily basis may seem abundant but it is actually a scarce resource on our planet. Water sources for human use include surface water like lakes and rivers, and groundwater like aquifers and wells.

In order to understand our overall water usage we must not only know our daily processes that require water, we must also be able to calculate about how much water is used in each of these processes.

Faucet on: 1gallon per 1 minute.

Flushing the Toilet: 3 gallons per flush.

Showering = 2.5 gallon per 1 minute.

Bath = 50 gallons per bath.

Load of Laundry: = 10 gallons per load.

Running the dishwasher: 20 gallons per load.

Dishwashing by hand: 5 gallons per wash.

Washing the Car = ? gallons per wash.

Drinking Water = 8oz. per glass (1/16 gallon per glass)

Ways to reduce:

- Most households use standard fixtures, but many new homes are outfitted with low-flow or water-saving fixtures.
- If you keep an object in your toilet tank to reduce water use, you can count it as low-flow.
- Water-saving fixtures can save several gallons of water a day. Low-flow shower heads only spray about 2.3 gallons a minute, while standard shower heads spray 3.8 gallons a minute.
- If you use a low-flow shower head, you can save 15 gallons of water during a 10 minute shower! After a year of daily showering, that adds up to almost 5,500 gallons—not just a drop in the bucket!

How much water does it really take?

You may be surprised to learn how much water it really takes to produce everyday items.

Latte
It takes 53 gallons to make every latte.
Coffee – grown using water, shipped
Sugar – grown using water, shipped
Paper Cup – tree grown using water, water to make paper pulp, shipped
Plastic Lid – water and oil to create, shipped
Paper Sleeve – tree grown using water, water to make cardboard, shipped.

Gallon of Paint: Takes 13 gallons of water to make.

Individual Bottled Water: It takes 1.85 gallons of water to manufacture the plastic for the bottle in the average commercial bottle of water. Imagine how much more efficient it is to drink your tap water. Not to mention that in some places, like New York City bottled water is 1000 times more expensive than tap water, and it's not any cleaner than NYC tap water.

One Ton of . . .
Steel: 62,000 gallons of water
Cement: 1,360 gallons

One Pound of . . .
Wool: 101 gallons of water
Cotton: 101 gallons
Plastic: 24 gallons
Synthetic Rubber: 55 gallons

Car: It takes an estimated 39,090 gallons of water to make a car. It's unclear if that includes the more 2,000 gallons used to make its tires--each tire takes 518 gallons to make.

Pair of Jeans: It takes around 1,800 gallons of water to grow enough cotton to produce just one pair of regular ol' blue jeans.

Cotton T-Shirt: Not as bad as jeans, it still takes a whopping 400 gallons of water to grow the cotton required for an ordinary cotton shirt.

Single Board of Lumber: 5.4 gallons of water are used to grow enough wood for one lumber board.

Coffee Beans: It takes about 37 gallons of water to grow the coffee beans and process them to make one cup of coffee.

Steak: More than 1,300 gallons is required to produce a 12oz steak.

Chicken: 1lb. of chicken takes 500 gallons.
Water is not only needed for the chicken to drink and to maintain the "chicken house" but also to grow the grains that the chicken eats.

Hamburger: It takes between 4,000-18,000 gallons of water to produce one pound of hamburger beef. Estimates vary a lot due to different conditions of raising cows and to the extent of the production chain of water that is used. It take a lot of water to grow grain, forage, and roughage to feed a cow, as well as water to drink and to service the cow.

Milk: It takes 52 gals of water to produce one glass of pasteurized milk. The ratio is 1,000:1 so to produce 1 gallon of milk in the fridge takes 1,000 gallons out in the fields.

Bread: It takes more than 10 gallons of water to produce one slice of wheat bread. Producing wheat takes about 150 gallons per pound. If you eat the bread with a slice of cheese then you add another 13 gallons.

Corn: It takes 110 gallons of water to grown 1 pound of corn.

Water / No Water Relay

Grades:

6^{th}-8^{th}

Objective:

- Students gain an understanding of how water is used to create virtually all products.

Method:

- Students take part in an organized relay of everyday products.

Materials:

- Laminated cards with pictures of everyday materials.
    - Half of the cards will have a blue dot on the back, and the other half will have a red dot on the back. One optional (tie-breaker) image is included.
- One container labeled 'Water'' and one container labeled 'No Water'.
- Masking tape.

  List of card items: scissors, ink pen, photo film, paper notebook, calculator, sneaker, light bulb, key, clothes pin, dog bone, razor, toilet paper, aluminum can, feather, lock, pocket watch, cd, medicine bottle, tickets, post card, golf ball, die, toothbrush.

Time:

Preparation Time: 15 minutes
Class Time: 30 minutes

Vocabulary:

Agriculture, Conservation, Environmental Impact, Forest Products, Fossil Fuel, Metals, Natural Gas, Natural Resources, Non-renewable Resource, Oil.

Procedure:

Relay Teams & Directions

- Review the directions for the organized relay.

- Divide the students into two groups.
- Each group will stand behind the masking tape line in a straight line.
- On the floor in front of the masking tape line place the 2 stacks of laminated picture cards face down.
    - In one stack are all of the cards with blue dots on the back.
    - In the other stack are all of the cards with the red dots on the back.
    - This is in case you want to keep score between the 2 teams.
- Situate yourself or an aid at the front of the room with the *water*, and *no water* containers.

Play Relay

- The first student in line (when time begins) will walk (or skip) from behind the line, choose the first card off the top of their teams stack and continue walking (or skipping) to the containers at the front of the room.
- Here they decide whether the item they are holding required water to create, or contains water itself.
- If the item required or contains water they will place it in the *water* container.
- If they item did not require or does not contain water they will place it in the *no water* container.
- They will then walk (or skip) back to the lines of classmates and the next person in line can go once the person in front of them tags their hand.

End Game

- The game ends when all of the cards are gone and the students are all sitting in their lines on the floor without making any noise.

Debrief

- Gather students around to go through each container and debrief.
    - Ask students why each item ended up in each container.
    - Is that where it really belongs?

Water

- Students will discover that all of the items belong in the *water* container.
- All of these objects have ingredients that required water, or required water to be manufactured or shipped.
- Remind students that plastic is made of oil, which requires water to mine from the earth.
- Remind students that anything containing metal (like all electronics) also required water to mine from the earth.
- It also takes water to manufacture, run, and maintain vehicles in shipping.

- Anything made of paper or cotton was once a living plan and anything living requires water.

Extensions:

- Students can brainstorm items that do not require freshwater to manufacture or can use gray water (waste water) in their production to conserve drinking water.

Assessment:

- Are students able to define products by what materials they are made from?
- Can students describe how water was needed for production of materials, manufacturing of products, or shipping?

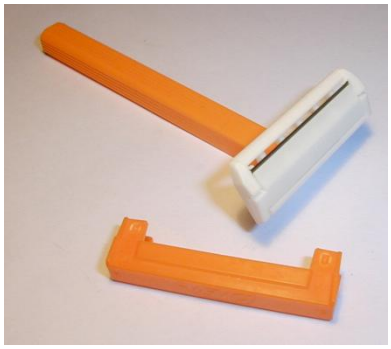
Glossary of Terms:

Agriculture: the production of food and goods through farming
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Forest Products: A material that is derived from a forest for commercial use, such as lumber, nuts, paper.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Metals: Relatively rare minerals that are occur in fixed amounts within the earth. They are essential to survival and are mined from the earth for use. They are required for industry, energy, and even human consumption.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.

NYS Learning Standards:

<u>Mathematics, Science, and Technology:</u>
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 6: Interconnectedness: Common Themes

Cut along the dotted lines and laminate images. Half of the images should be marked with a blue dot and half should be marked with a red dot.



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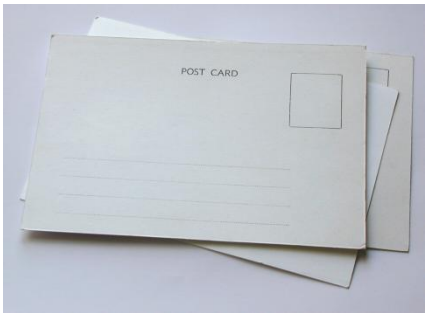

How Much Does It Take?

Grades:

6^{th}-8^{th}

Objective:

- Students gain an understanding of how water is used to create virtually all products.
- Students will be able to rank household items into which require the least and most amount of water to produce raw materials for, manufacture, and ship.

Method:

- Students rank laminated pictures of household products by water requirement.

Materials:

- Laminated cards with images of everyday materials.
    - Sample list of images: Cotton t-shirt, steak, hamburger, chicken, gallon of milk, pair of jeans, cup of coffee, car, bread, corn, board of lumber, bottle of water, sneaker.

Time:

Preparation Time: 10 minutes
Class Time: 30 minutes

Vocabulary:

Agriculture, Coal, Conservation, Environmental Impact, Forest Products, Fossil Fuel, Metals, Natural Gas, Natural Resources, Non-renewable Resource, Oil, Recycle, Wastewater, Watershed.

Procedure:

Introduction

- Show students a plastic water bottle and ask the class how much water it contains. Students may wish to inspect the bottle to read the amount of water inside the bottle.
- Now ask students how much water it took to make the bottle of water and get it to us.

- Have students begin by writing WATER BOTTLE at the top of a piece of paper. Underneath it they can write all of the ingredients of the bottle of water (including plastic bottle, plastic cap, paper label with glue), then they can write how it got to us (shipment on a truck).
- Do any of those ingredients require water? (Explain to students that plastic is made from oil, does it require water to drill for oil in the earth? YES. A paper label came from a once living tree, does that need water? YES. Did it take water to make the glue? YES. As for shipment, once again that uses oil which was drilled in the earth using water!)
- This example will be what students use to work in small groups and investigate different items and the water it took to create and ship them.

Activity

- Divide students into groups of 2 or 3.
- Divide laminated cards among groups of students (ideally 3-4 cards per group).
- Have students rank their cards in order from requiring the least amount of water, to most amount of water needed.
- Give students 5 minutes to brainstorm.

How much water does it take?

- Begin by having students write their object at the top of their paper.
- Underneath the object write one ingredient or process of manufacturing on each line below.
- Next to each ingredient write if water was needed and for what process? (Refer to example below).

Pencil	
Wood	Water to grow tree
➔	Water to run machines that cut tree
➔	Water to ship tree
Paint	Water to make paint
Eraser	Water to make synthetic rubber
Metal Clasp	Water to mine metal
➔	Water to manufacture metal
➔	Water to ship metal
Cardboard Box	Water to grow tree
➔	Water to make cardboard pulp
➔ Ink on box	Water to make ink
Ship Pencils	Water to ship pencils

Present Items

- Then, go around the room and have each group present their items to the rest of the class and explain their rationale for ranking them the way they did.
- Do they other students agree? Are there any changes they would make?

Class Vote

- Once all the groups have presented, have the entire class combine their lists.
- Write a list on the board (or tape up the images).

Reveal Answers

- Reveal the chart of answers.
- Do any of the group answers need to be shifted? Why?
- Are there any processes during manufacturing that you forgot about?

  Remember: Any fabric material requires washing, natural fabrics come from thirsty plants, and the farther an items ships the more water it uses.
- List of sample items ranked in order from least amount of water used to greatest amount of water used:

1bottle of water: 1.85 gallons
1 slice of bread: 10 gallons
1gallon of milk: 52 gallons
Cup of Coffee: 53 gallons
1 lb. of Corn: 110 gallons
Cotton T-Shirt: 400 gallons
1 lb. of Chicken: 500 gallons
12 oz. Steak: 1,300 gallons
1 lb. Hamburger: 1,800 gallons
Car: 39,090 gallons

Extensions:

- For homework, students can search for the product in their house that required the least amount of water to produce, and the product that required the most amount of water to produce.

Assessment:

- Can students distinguish between materials that are easily produced and those that require a lot of resources (increasing the demand for water)?
- Can students distinguish between items that require shipping back and forth between factories / stores, and those that were produced locally?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Coal: A type of fossil fuel that was formed millions of years ago by the decay of ancient forests. Occurs

in a fixed amount within the earth, once it is used up, it will be gone forever. Mined and burned to produce electricity.

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.

Forest Products: A material that is derived from a forest for commercial use, such as lumber, nuts, paper.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Metals: Relatively rare minerals that are occur in fixed amounts within the earth. They are essential to survival and are mined from the earth for use. They are required for industry, energy, and even human consumption.

Natural Gas: Natural gas is a combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, it can also include ethane, propane, butane and pentane. It is used commonly to heat homes, as cooking fuel, and to generate electricity.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.

Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 6: Interconnectedness: Common Themes

English Language Arts:
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Cut along the dotted lines and laminate images.

Drinking Water Dilemma

Grades:

6th-12th, Adult

Objective:

- Students will discover alternatives to using the tap!

Method:

- Students will play a matching game exercise in order to rank their needs for tap water.

Materials:

- Matching game cards (attached).
- Voting Labels (attached)

Time:

Preparation Time: 20 minutes
Class Time: 30 minutes

Prep:

- Make a copy for each group of the cards for the matching game, and the voting labels.
- Cut out the cards and labels for each group.
- You may wish to laminate the cards and labels so that they can be used again. (You can also print them on heavier paper stock to make them hold up against multiple classes).
- You can attach a Popsicle stick to each voting label, in order for students to hold them up and vote.

Vocabulary:

Conservation, Environmental Impact, Graywater, Natural Resources, Wastewater, Watershed.

Procedure:

Introduce Tap Water

- Have student consider the water that flows from their tap?
- Clean, drinkable water is abundant where we live (we are lucky) but, the majority of homes in the world do not have access to readily available drinking water.
- The pipes that carry water into our house provide clean drinking water to our sink, shower, toilet, and even outdoor hose!
    - Propose question to students: Why on earth would we "do our business" into water that is clean enough to drink?
    - While we are at it, why do we use drinking water for lots of our household activities? Do we need to?

Types of Water

- *Tapwater*: Ready-to-drink water that comes right from the tap.
- *Gray Water*: Using water that has already been used for a domestic task. This water could contain soapy water from showering, washing clothes, or washing dishes.
- *Rainwater*: free, falls from the sky, can be collected in clean rain barrels at the base of a house rain spout.

How Can We Use Each?

- Ask students to define how we can collect each type of water.
- Using Tapwater: just turn on that tap.
- Using Rainwater: Collect it using a rain barrel at the base of the rain spouts on your home, garage, or shed. (Note: to keep insects like mosquitoes from breeding in your rain barrel put a hardy fish or two in it! You will want to take them out during freezing temperatures!)
- Using Graywater: Take a bucket with you in the shower to collect water that would otherwise just flow down the drain. Save dishwater or water from doing laundry in a bucket or large plastic container.

Drinking Water - Match Game

- Divide students into groups of 2-3.
- Have students divide their "Task" cards into the correct piles. (Go through each picture card and have students tell you what household 'task' it represents).
    - Think about each task, do you require water that is clean enough to drink for each job?
    - Sort the tasks between the categories of:
        - DRINKING WATER
        - GRAY WATER
        - RAIN WATER

Class Vote

- Once each group has piled tasks go through each task as a class.
- Have each group vote holding up their labels (drinking water, gray water, rainwater).

Debrief

- Do all students agree?
- Do all student's have to agree? Some students might be willing to use rainwater instead of drinking water to wash their face, for example.
- How you use water is a personal choice! Which group was the most sustainable?
- Flushing-how-to: Ask a student to demonstrate for the rest of the class how they "flush". Some students might not realize that all that little lever does is release water into the toilet bowl creating enough flow pressure to flush your waste. Using a bucket and dumping water down the toilet bowl does the same function! Using shower water or rainwater can save drinking water.
- Have students write out one thing that they can do around the house to conserve drinking water.

Tasks

Watering indoor plants	Flushing the toilet	Cooking water (boiling food)
Watering the garden	Bathing	
Drinking	Rinsing produce	Rinsing the sidewalk
Washing your face	Washing windows	Washing the dishes
Washing the car	Mopping the floor	Washing Pets
Washing your clothes	Watering your animals	Washing your hands

Extensions:

- *Bottled Water Activity*: Construct a bottled water versus tap water taste test.
  - How many students drink bottled water instead of tap water? Why?
  - With 2 labels have students label the cup they think is bottled water, and the cup they think is tap water, then label which one they liked best. (Use paper cups instead of plastic).
  - See if students can tell the difference between bottled water and tap water in the taste test by revealing the identity of each cup.
  - Does it surprise students that 40% of bottled water you buy off the shelf is actually just tap water from somewhere else, including Aquafina and Dasani brand bottled water.
  - Does it surprise students that bottled water is 2,000 times more expensive than tap water?
- Have students draft a list of changes they can make to their current household.

- Have student bring this list home and discuss with their parent or guardian.
- Is there room for change in their current water usage?

Assessment:

- Did students participate in matching game and class voting?
- Were students able to assess their current water usage in order to make it more sustainable?

Glossary of Terms:

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Graywater: Greywater is wastewater generated from domestic activities such as laundry, dishwashing, and bathing which can be recycled on-site for uses such as landscape irrigation, and constructed wetlands.
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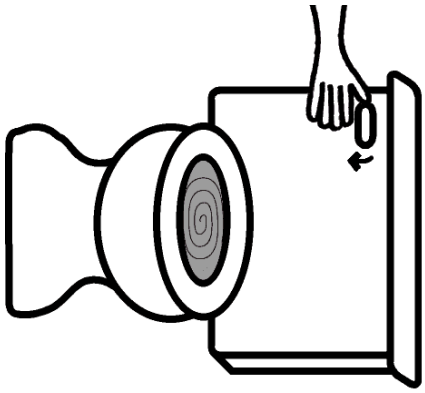
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

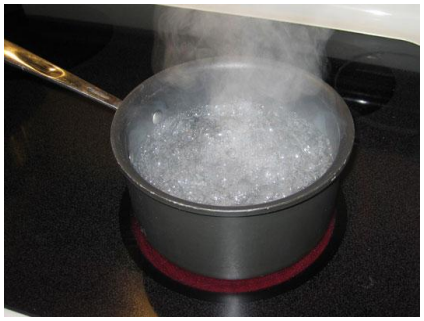
NYS Learning Standards:

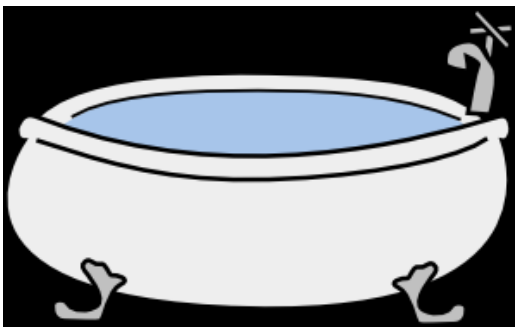
Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 4: Language for Social Interaction



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Rain Water

Drinking Water

Gray Water

Water Use Log (Week Long Journal)

Grades:

6th-12th, Adult

Objective:

- Students gain an understanding of their daily, and weekly water use.
- Students will be able to determine everyday processes that require water.

Method:

- Students keep a week long journal of their water use.

Materials:

- Printed Journal pages for students to fill in throughout the week.
- Water use estimates for a range of typical activities.

Time:

Preparation Time: 10 minutes
Class Time: 40 minutes per week. (20 intro, 20 debrief)

Vocabulary:

Conservation, Environmental Impact, Graywater, Natural Resources, Wastewater, Watershed.

Procedure:

Water Use Journal

- Hand out journal pages and water use table to students.
- Go through journal pages with students and do a fictional example of daily use with a sheet on the board.
- Have students begin to fill in the activities section with processes they do on a daily basis.

- Have students agree to take the time to write in how much water they use each day for a week.
- At the end of the week have students add up their data from each day and compare it to classmates.
    - Who used the most water?
    - What processes required the most water?

Extensions:

- For homework, students can record the water use on the same sheets for their entire household. Who in their house uses the most water each week?
- 9^{th}-12^{th} grade & Adult extension: Create the same water use list but break down each activity that requires water into how many gallons are used per activity. Calculate gallons per activity, gallons per week for their household, gallons per week for each person in the household.

Assessment:

- Have students kept their weekly log books for water use?
- Are students able to calculate how much water was used for simple daily processes?

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Standard 3: Resource Management

<u>Mathematics, Science, and Technology:</u>
Standard 1: Analysis, Inquiry, and Design

Standard 3: Mathematics
Standard 4: Science
Standard 5: Technology

English Language Arts
Standard 1: Language for Information and Understanding

Weekly Water Use Log

Day #	Weekday	Activity	Water Used (gallons)
Day 1			
		Daily Total:	
Day 2			
		Daily Total:	
Day 3			
		Daily Total:	
Day 4			
		Daily Total:	
Day 5			
		Daily Total:	
Day 6			
		Daily Total:	
Day 7			
		Daily Total:	
Week 1		**Weekly Total:**	

NAME:

Water Use Challenge
(Weekly Journal Comparison)

Grades:

6^{th}-12^{th}, Adult

Objective:

- Students gain an understanding of their daily, and weekly water use.
- Students will determine how to reduce the water requirement of everyday processes.
- Students will be able to evaluate effectiveness of their water conservation methods by comparing weekly data.

Method:

- Students keep a week long journal of their water use.
- Students limit their water use by decreasing their current use by time, or eliminating tasks that require water.
- Students compare data from their normal weekly water use, and their limited weekly water use to determine how effective their conservation methods were.
- Students then make decisions about how they can apply these concepts to the rest of their lives.

Materials:

- Printed Journal pages for students to fill in throughout the week.
- The journal page from their normal water usage week.

Time:

Preparation Time: 10 minutes
Class Time: 40 minutes per week.

Vocabulary:

Conservation, Environmental Impact, Graywater, Natural Resources, Wastewater, Watershed.

Procedure:

Water Use Journal

- Hand out journal pages to students.
- Go through journal pages with students and do a fictional example of daily use with a sheet on the board.
- Have students begin to fill in the activities section with processes they do on a daily basis.
- Have students agree to take the time to write in how much water they use each day for a week.
- Now have students brainstorm a list of ways that they will try to conserve water. Have students design their own "Water Use Pledge" by listing ways they can reduce their water use and signing it.

Sample List:

- Turn off the water while brushing your teeth.
- Limit shower time to 10 minutes, once a day.
- Turn the shower water off while soaping up, shaving, shampooing, using conditioner.
- Only wash clothes when they are dirty, (not after you tried them on once!)
- Only run washing machine with a full load of clothes.
- It is okay to wear some articles of clothing more than once without washing them (like jeans, towels, sweatshirts)
- Only run the dishwasher when it is completely full of dishes to cut down on the number of loads
- Replace one meal of meat per week with a salad or fruits and vegetables
- Wait for the rain to wash the family car
- Water plants and pets with water from rain barrels at your drainage spouts instead of tap water.
- Place a brick in the water tank of the toilet.
- Sweep the patio, walkway, or driveway instead of cleaning of off with the hose.

Conserve Water

- Students now go through their week with water conservation in practices in action.
- At the end of the week have students add up their data from each day and compare it to classmates.
    - Who used the most water?
    - What processes required the most water?

- Have students compare their weekly logs. Was there a change in the amount of water used?
- Were students successful in sticking to any of the goals they set for themselves in their water challenge?
- Were the strategies to save water difficult to follow? Seeing how much water was saved, are the students likely to stick to those strategies in the future?

Extensions:

- For homework, students can record the water use on the same sheets for their entire household. Who in their house uses the most water each week? Create a water use challenge at home and see which family member can cut their water usage the most.
- Use this water use calculator to get even more specific and to get great water saving tips. http://www.h2oconserve.org/?page_id=503
- Igniting Creative Energy (ICE) – A national Student Challenge to motivate learning, ignite the imagination, and fuel the creative potential in youth. www.ignitingcreativeenergy.org
- 9^{th}-12^{th} grade & Adult extension: Have students fill out the water use log and complete the journal comparison using gallons needed for water related activity.
    - Have them calculate gallons per activity, gallons per week, gallons per household, gallons per individual.
    - Compare this information with a copy of their water bill.
    - Calculate the cost of water per gallon.
    - Was there a noticeable difference in their water bill during the week when they were trying to conserve water?

Assessment:

- Have students kept their weekly log books for water use?
- Are students able to calculate how much water was used for simple daily processes?

Glossary of Terms:

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Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 5: Technology

English Language Arts
Standard 1: Language for Information and Understanding

Weekly Water Use Log

Day #	Weekday	Activity	Water Used (gallons)
Day 1			
		Daily Total:	
Day 2			
		Daily Total:	
Day 3			
		Daily Total:	
Day 4			
		Daily Total:	
Day 5			
		Daily Total:	
Day 6			
		Daily Total:	
Day 7			
		Daily Total:	
Week 1		**Weekly Total:**	

NAME:

Water Saving Tips Checklist

Grades:

6th-12th, Adult

Objective:

- Students gain an understanding of their daily, and weekly water use.
- Students will be able to determine how to reduce the water requirement of everyday processes.

Method:

- Students complete a checklist of water saving tips to determine easy ways that they can save water in their homes.

Materials:

- Water Saving Tips Checklist.

Time:

Preparation Time: 2 minutes
Class Time: 10 minutes

Vocabulary:

Conservation, Environmental Impact, Graywater, Natural Resources, Wastewater, Watershed.

Procedure:

Checklist

- Hand out *Water Saving Tips Checklist* to students.
- Have students check off the boxes of tips they already accomplish at home.
- Have students circle the tips that they do not yet do but will now strive to do at home.
- Have students underline tips that they do not yet do but would like to do in the future.
- Brainstorm and write in any additional water saving tips that you can come up with.

Extensions:

- Use this awesome water use calculator to get even more specific and to get more great water saving tips. http://www.h2oconserve.org/?page_id=503

Assessment:

- Are students able to complete their checklist?
- Do students understand the importance of using water more wisely at home?
- Will students strive to use water more wisely at home?

Glossary of Terms:

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
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NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences:
Standard 3 – Resources Management

Mathematics, Science, and Techonology:
Standard 1 – Analysis, Inquiry and Design
Standard 3 – Mathematics
Standard 4 – Science
Standard 5 – Technology
Standard 7 – Interdisciplinary Problem Solving

English Language Arts:
Standard 1 – Language for Information and Understanding

H2O Saving Tips Checklist

Instructions: √ Check off the boxes of tips they *already accomplish* at home. Circle the tips that they *do not yet do* but will *now* strive to do at home. Underline tips that they *do not yet do* but would like to do *in the future.*

BATHROOM

- ☐ If you don't have a low-flow toilet, put a plastic bottle filled with water (or a brick) in your toilet tank to reduce the amount of water used per flush.
- ☐ Put a bucket in the shower while you're waiting for the water to warm up, and use the water you catch for watering plants, cleaning, or flushing the toilet.
- ☐ To check for a toilet leak, put dye or food coloring into the tank. If color appears in the bowl without flushing, there's a leak that should be repaired.
- ☐ Turn off the water while brushing your teeth.
- ☐ Turn off the water while shaving, and instead fill the bottom of the sink with a few inches of water to rinse your razor.
- ☐ Install a low-flow shower head. It may cost you some money up front, but your water conservation efforts will save you money down the road.
- ☐ Spend less time in the shower. If you lose track of time in the shower, bring a radio into the bathroom and time yourself by how many songs play while you're in there. Try to get your shower time down to one song (or less).
- ☐ Turn the shower water off while soaping up, shaving, shampooing, using conditioner.
- ☐ If you take a bath, keep the water level low, and consider re-using the water before you let it go down the drain.
- ☐ Fix those leaky faucets. You may think that a constant drip is just annoying, but it's also a huge waste of water (you can lose about 20 gallons of water per day from a single drippy faucet!).
- ☐ Install low-flow faucet aerators in your sinks.
- ☐ When you wash your hands, turn on the water briefly to wet them, turn it off while you lather up, then on again to rinse. You'll save water and soap this way.
- ☐ Buy a low-flow model toilet! They use as little as half as much water as normal toilets.
- ☐ If it's yellow, let it mellow. The saying may be cliche, but it's good advice. If you're grossed out by the "yellow", just put down the toilet lid.
- ☐ Don't flush things down the toilet to dispose of them. Throw away tissues and other bathroom waste in the garbage can, which doesn't require gallons of water.

KITCHEN

- When washing dishes by hand, don't leave the water running the whole time.
- Only run the dishwasher when it's completely full.
- Scrape dishes into the compost (or trash if you don`t compost) rather than rinsing. New dishwashers don't even require pre-rinsed dishes.
- Keep a bottle or pitcher of drinking water in the refrigerator instead of running tap water to cool it each time you want a drink.
- Wash vegetables and fruits in a large bowl of water and scrub them with a vegetable brush your faucet is not a power-washer!
- Eat meat and dairy foods fewer times a day, or just in smaller portions. The amount of water used to produce animal products far exceeds the amount used for growing vegetables and grains.
- When grocery shopping, try to buy more whole foods like vegetables, rice and potatoes. Processed foods and beverages like chips, candies, pre-made meals and sodas take a lot more water to produce than foods that come straight from the farm.

AROUND THE HOUSE

- Only wash clothes when they are dirty, (not after you tried them on once).
  It is okay to wear some articles of clothing twice without washing (like jeans, towels, sweatshirts).
- Wash full loads of clothing.
- Wait for the rain to wash the family car.
- Water plants and pets with water from rain barrels at your drainage spouts instead of tap water.
- Use a broom to clean off patio or driveway instead of spraying it with a hose.

Wastewater Treatment Facility Tour

Grades:

6^{th}-12^{th}

Objective:

- Students gain an understanding of how and why wastewater is treated in designated facilities before discharge.
- Students will be able determine which substances can be removed from wastewater in a treatment facility and which cannot.

Method:

- Students visit a local wastewater treatment facility, are given a tour, and are encouraged to ask questions about wastewater treatment.

Materials:

- Clipboard, paper, and pencil.

Time:

Class Time: Field trip (times will vary).

Vocabulary:

Conservation, Environmental Impact, Graywater, Natural Resources, Wastewater, Watershed.

Procedure:

What is Wastewater?

- Before the field trip give students some background information.
- Define wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
- Why do we treat out wastewater before discharging it into our waterways?
- What kinds of substances are removed from the water in these types of facilities?

  - Human waste, toilet paper, hair, and other biodegradable waste will be removed from the water.
  - *Flotsam*, also called *Floatables*
    - Fun to say, not fun to swim in! These are both terms for floating debris in the water. All the trash that gets sucked down a storm drain and all the rubber duckies that get flushed down the toilet will end up here and caught in a variety of screens.
- What kinds of substances cannot be removed even with treatment at these types of facilities?
  - Some materials like the "micro-scrubbers" in your face & body wash are too small to be removed by these screening systems.
    - These tiny particles are most often made of plastic! They are readily gobbled up by small organisms, but offer no nutrient value, and can clog the digestive tract of tiny creatures.
  - Toxic chemicals and heavy metals, like those left over from industrial practices are not meant to pass through these systems.
    - The wastewater from natural gas drilling (hydraulic fracturing) cannot be treated at these stations.
  - Antibiotics, other drugs, and hormones are not removed either.
    - How do these enter the water in the first place?
    - People on medication release a small amount of the drug when they urinate, some break down quickly, others don't.
    - Any woman on birth control will have hormones in her urine.
    - People often flush old medications.
    - Drugs and hormones can have affects on wildlife in the water! Affects have been seen in fish, frogs, and aquatic invertebrates.

How does it work?

- 1. Large debris is caught in a variety of screens; they get smaller as the water passes through.
- 2. The water that passes through the screen goes into a holding tank where larger particles settle to the bottom.
  - Water is skimmed off the top and goes into the next tank.
  - Solid sludge is collected from the bottom and trucked to the landfill, incinerated or used as fertilizer.
- 3. Water from the settling tank is put in an aeration tank. Here the water is mixed with oxygen from the air. Microorganisms in the water break down the organic waste.
  - The tank is now allowed to settle.
  - Remaining solids sink to the bottom, are collected, and trucked to the landfill, incinerated, or used as fertilizer.

    - Water is skimmed off the top and sent back for another round of aeration or sent to the next tank
- 4. Water from the aeration tank is sent to the clarifying tank to be treated. Here, the water is disinfected to remove any harmful bacteria in the water.
    - Chlorine is widely used to kill bacteria
    - Ultra-violet light is also used to kill bacteria. This process is more effective, but much more expensive!

Combined Sewer Overflows

- Or CSO's as they are also called, occur in older sewer systems.
- "Combined" refers to a system where the sanitary sewer (wastewater from homes and businesses) meets the storm sewer (runoff from streets, parking lots, and rooftops).
- When there is a surge in precipitation within a short period of time, or increased snowmelt, the water treatment facilities get overloaded with too much water!
- In old systems where sanitary sewers meet storm sewers the water level will overflow directly into our waterways, without treatment!
- How can we prevent this from happening?
    - Use less water! Using less water will allow less water to be in the system during times of storm surge, reducing the overflow.
    - Create more Sustainable Storm Water Management (SSWM)
        - This refers to capturing rainwater at the source on rooftops, streets, sidewalks, and open spaces to prevent it from entering the sewer system. This "source control" is often accomplished through green design and water recapture retrofits, like green roofs, rain gardens, disconnected rain gutter downspouts, and porous pavement.

Field Trip to Local Wastewater Treatment Facility

- Arrange a tour with facility personnel so that students can see (and smell) first-hand, where the water they use goes!
- Have students generate questions for the water treatment facility.

Extensions:

- For homework, students can research products that are Wastewater Treatment Facility Friendly.
    - These products are biodegradable soaps & detergents
    - These products do not contain anti-bacterial components
    - These products do not contain plastic micro-scrubbers, check the ingredients of products and choose scrubbers that are made out of nuts instead of polymers.

Assessment:

- Can students explain where wastewater goes once it flows down the drain?
- Can students explain the importance of filtration and treatment of wastewater?

Glossary of Terms:

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Graywater: Greywater is wastewater generated from domestic activities such as laundry, dishwashing, and bathing which can be recycled on-site for uses such as landscape irrigation, and constructed wetlands.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Health, Physical Education, & Family & Consumer Sciences
Standard 2: A Safe and Health Environment
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

Biological Monitoring

Grades:

6th - 12th

Objective:

- Students will draw conclusions about the health of a stream based on the character of its biological components.
- They will be able to determine whether the stream is impacted by pollutants based on the the aquatic organisms found there.
- By looking for aquatic organisms, including macroinvertebrates that thrive at different tolerance levels, students will be able to decide if a stream is "impacted" or "non-impacted".

Method:

- Students will analyze organisms from a theoretical stream sample and classify their stream based on the tolerance levels of its inhabitants.
- They will distinguish between an impacted and non-impacted stream using the presence of biological indicators.
- For the impacted streams students will try to use available data to theorize a possible source of contaminants from a series of possible scenarios.

Materials:

- Stream ID Booklet
- Tolerance ID Sheet
- A plastic container for each group
- Cut-outs of the macroinvertebrates, aquatic vertebrates, and aquatic plants (sheets enclosed)
- "Potential Causes of Pollution" Sheet

Time:

Preparation Time: 20 minutes
Class Time: 40 minutes

Prep:

- Make a copy of each card sheet for each group (Group # 1 - 6).
- Set out a plastic container for each group and label each (#1-6).
- Cut cards out along the dotted lines. Divide up the cards into buckets.
- Make sure that the organisms from each card go into the bucket with the matching number.
- Distribute an identification key to each group.

Vocabulary:

Carrying Capacity, Conservation, Ecosystem Services, Environmental Impact, Fertilizer, Hydraulic Fracturing, Invasive Species, Macroinvertebrate, Non-point Pollutant, Pesticide, .
Point Source Pollutant, Riparian Buffer, Runoff, Stakeholder, Stewardship, Wastewater, Watershed.

Procedure:

When we think of using water wisely we often think of how much we let come out of the faucet. Something just as important is to also consider what we put down our drains.

Point & Nonpoint water pollution

- Water pollution can occur from many sources.
- Some single source or *point source pollutants* can be tracked and controlled.
    - An example would be a small business with piped wastewater.
- Other pollutants can be nearly impossible to track because they come from many different sources, often over a large area.
    - These are called *nonpoint source pollutants*, an example would be pharmaceuticals (medicines) that are flushed down household drains.

Water Conservation

- Conserving water means using it wisely to ensure that its use will be possible for future generations.
    - That includes more than just future generations of humans.
- All living organisms require water for survival.
- Water must remain usable for humans as well as the organisms that make up the base of the food chain, and those in between.
- As part of the watershed we must also consider the streams that feed larger rivers.

Biological Indicators

- We are able to draw conclusions about the health of a stream based on the character of its biological components.
- We can determine how impacted by pollutants the stream is based on the macroinvertebrates found there.
- *Macroinvertebrates* are animals without backbones that are large enough to see with the naked eye.
- Each type of macroinvertebrate can tolerate different levels of water pollution. So by examining who we find in the stream we can decide if a stream is "impacted" or "non-impacted".

STREAM SAMPLE

- Divide the students into groups of no more than 4 students.
- Each group will receive a plastic container with their stream sample.
- Students must remove the aquatic organisms from plastic container.
- Identify each using the Stream Id Sheet
- Place them into the correct tolerance parameter using the Tolerance ID Sheet
- Once the ID is complete, make a determination about whether the stream is impacted or non-impacted.

Impacted & Non Impacted Streams

- Introduce these two terms.
    - IMPACTED means a stream has had some impact from pollution.
    - NON-IMPACTED means that there is no sign of pollution.
- *Non-Impacted* streams contain sensitive species like: mayfly larvae, stonefly larvae, caddisfly larvae, water pennies, and hellgrammites.
- I*mpacted* streams would contain hardy species like aquatic worms, snails, midge larvae, and leeches.

Larvae

- Many of the organisms we are looking at are larvae, or the larval stage of an insect's life cycle.
- Use a simple example of life cycles (the Monarch Butterfly: Egg – Larvae – Pupa – Adult). The larval stage of a monarch butterfly would be the caterpillar stage.
- Dragonflies, mayflies, stoneflies, caddisflies, and craneflies all go through a similar metamorphosis before they become winged adults.

- Unlike Monarch butterflies, these species' larval stage is aquatic.

Potential Causes of Pollution

- Groups will now use the "Potential Causes of Pollution" sheet to determine the possible sources of contamination (if they suspect an impacted stream).

*Present*ation

- Have the students share among the class to see which groups were impacted and which were non-impacted stream samples and the possible scenarios that could have caused contamination.
- After all groups have presented, decide as a class where each sample came from on the Stream Map.

Extensions:

- STREAMWATCH: Students can obtain a stream sample from a nearby stream in order to assess impact. Refer to The Catskills: A Sense of Place Curriculum Module I: Water Resources of the Catskills, Lesson 2: Streamwatch
- MATCHING GAME. Aquatic Insect matching game. Match images of larval aquatic insects with images of the winged adults they will become.
- STREAM MANAGEMENT: Draft a stream management plan to abate the sources of pollution from each site. Identify whether the pollutant is a point or nonpoint source. How can each sample site be remedied? Who should be held liable for point source pollution at each site?

Assessment:

- Use the enclosed quiz as an assessment. Answers are provided on the answer key.

Glossary of Terms:

Carrying Capacity: Refers to the population of an organism that can be sustained in a given environment without degrading the resources available. Once a population increases above the carrying capacity, resources are consumed without replenishment, and the population decreases due to lack of resources. Human populations have risen far above this level by modifying their environment, but human population growth is not unlimited.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth.

These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.
Invasive Species: The term invasive species refers to a subset of introduced species or non-indigenous species that are rapidly expanding outside of their native range. Invasive species can alter ecological relationships among native species and can affect ecosystem function and human health. A species is regarded as invasive if it: (1) has been introduced by human action to a location where it did not previously occur naturally, (2) becomes capable of establishing a breeding population in the new location without further intervention by humans, and (3) spreads widely throughout the new location. In simple terms, an invader has to (1) arrive, (2) survive, and (3) thrive.
Macroinvertebrate: An organism that is large enough to see with the naked eye that does not have a backbone. Usually associated with judging the water quality of streams based on presence / absence and abundance.
Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Point Source Pollutant: A pollutant that has a single traceable source.
Riparian Buffer: A protective strip of land or timber adjacent to a waterway.
Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

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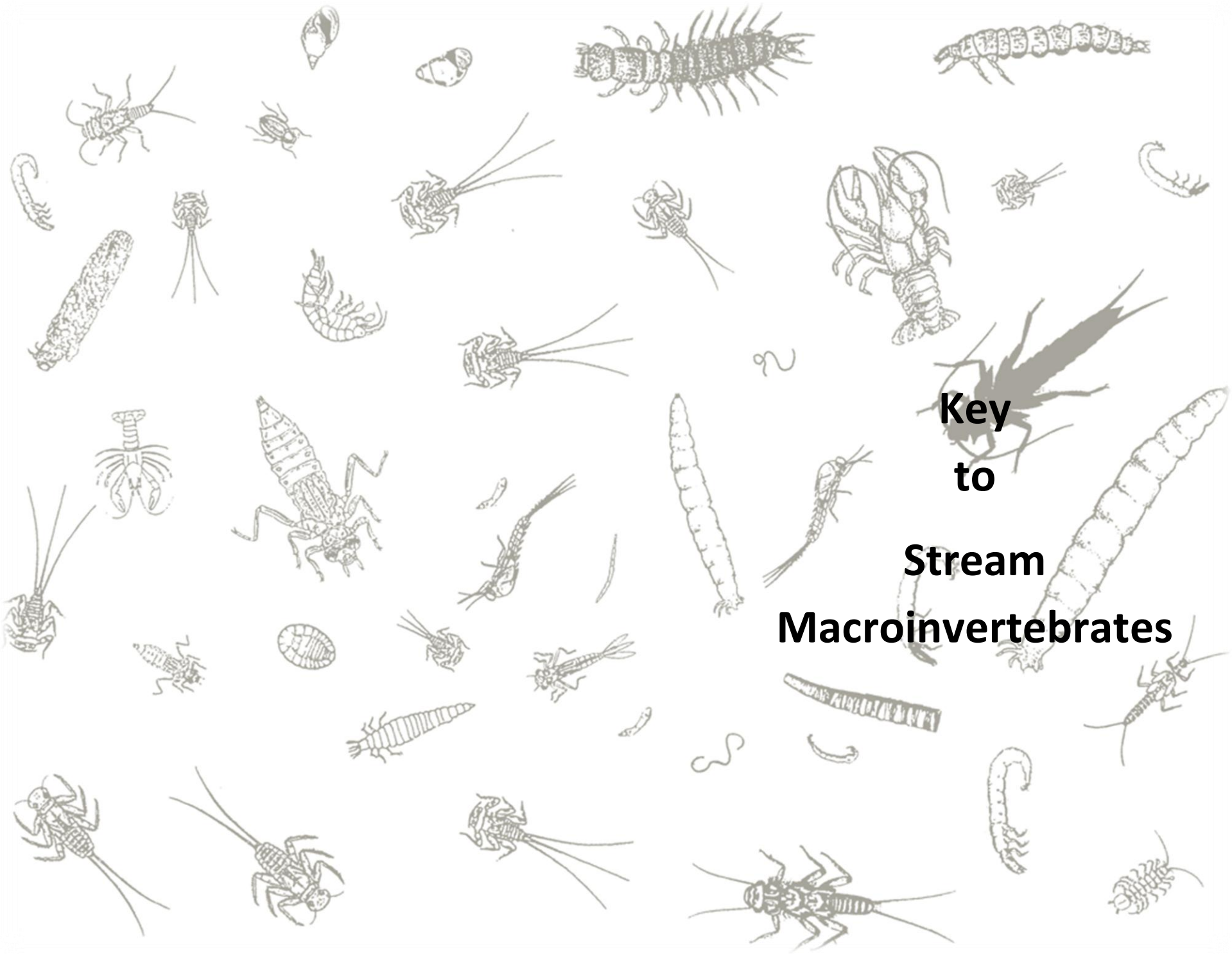
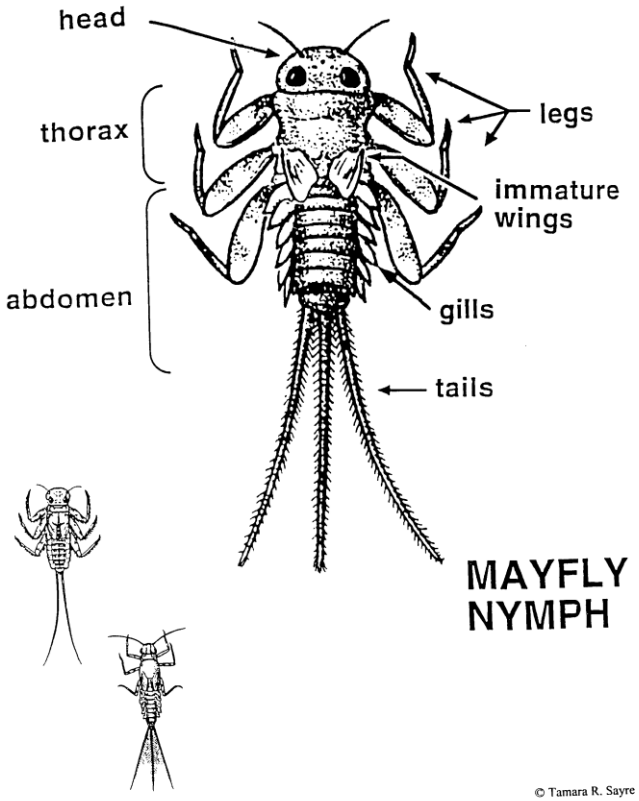
English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation



Key to Stream Macroinvertebrates

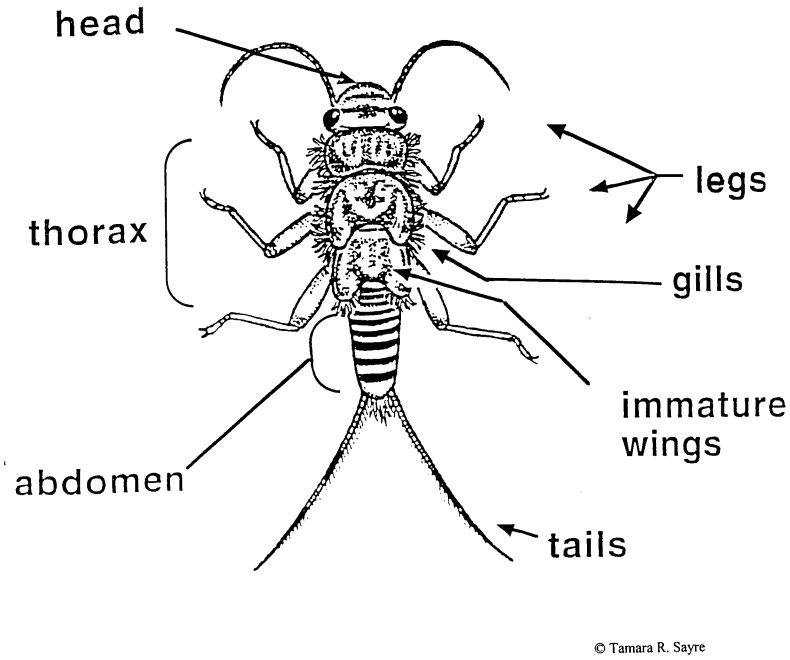
Mayfly



Gills are found on abdomen

2-3 tails

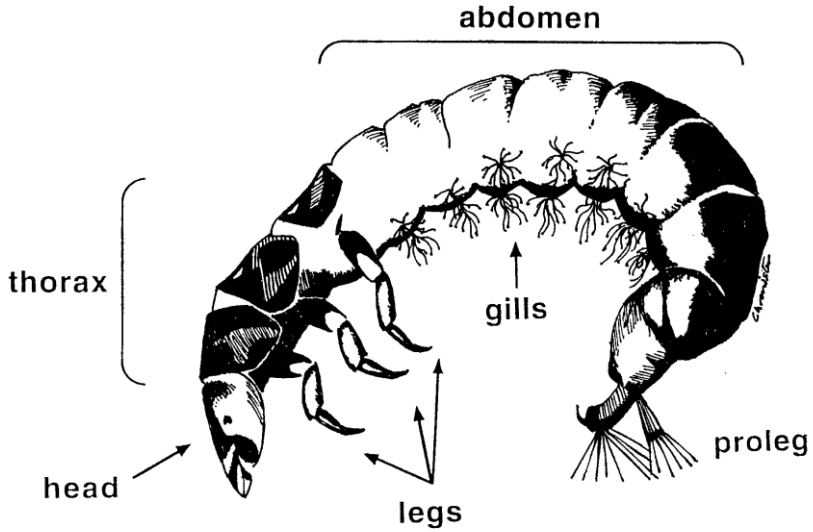
Stonefly

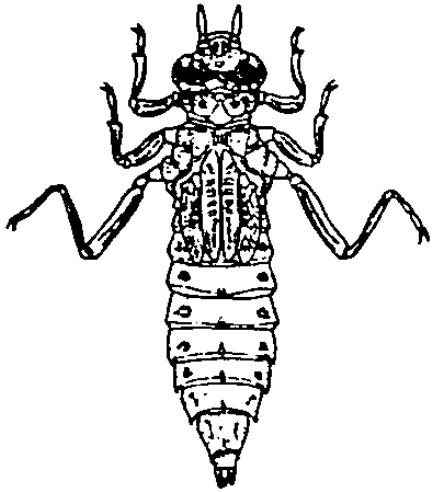


STONEFLY NYMPH

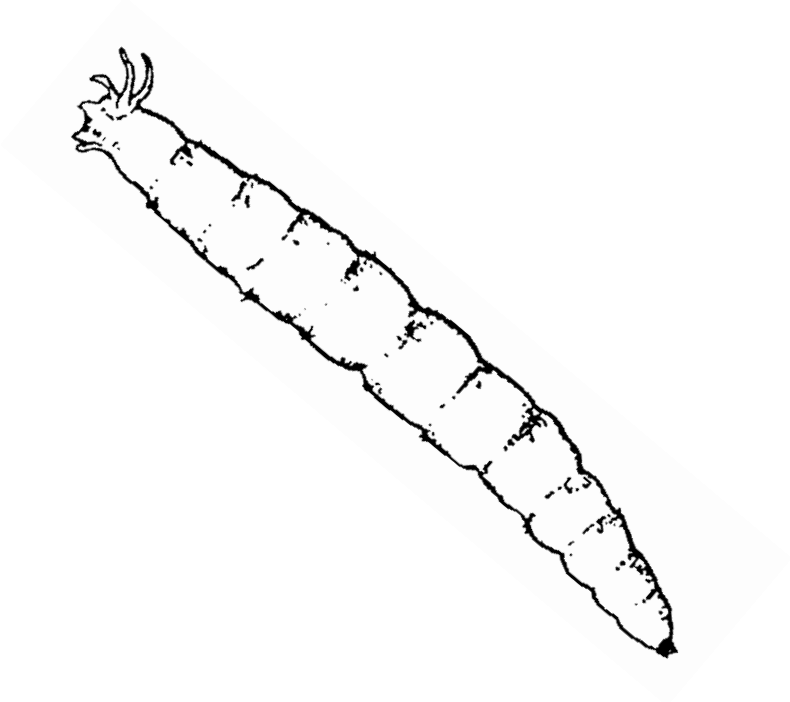
Gills are found on thorax

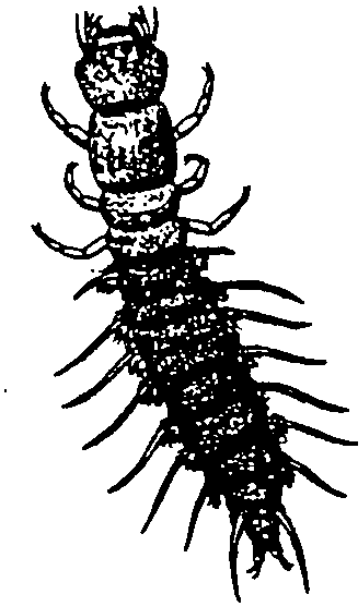
2 tails





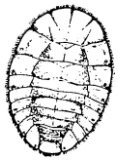
CADDISFLY LARVA

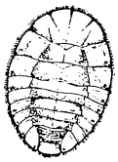


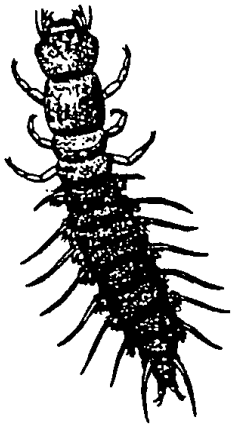


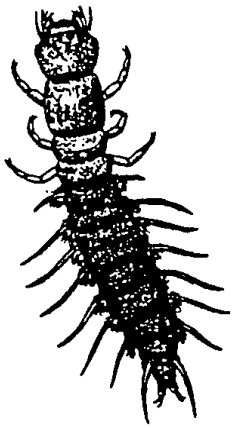
CRANEFLY LARVA

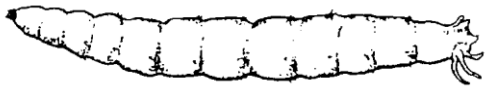
Scenario 1: Cut along Dotted Lines

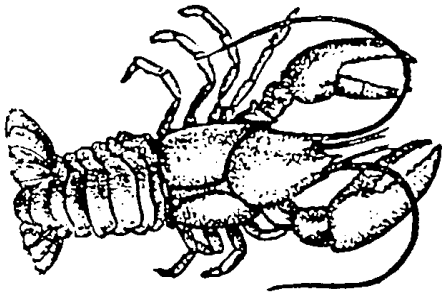












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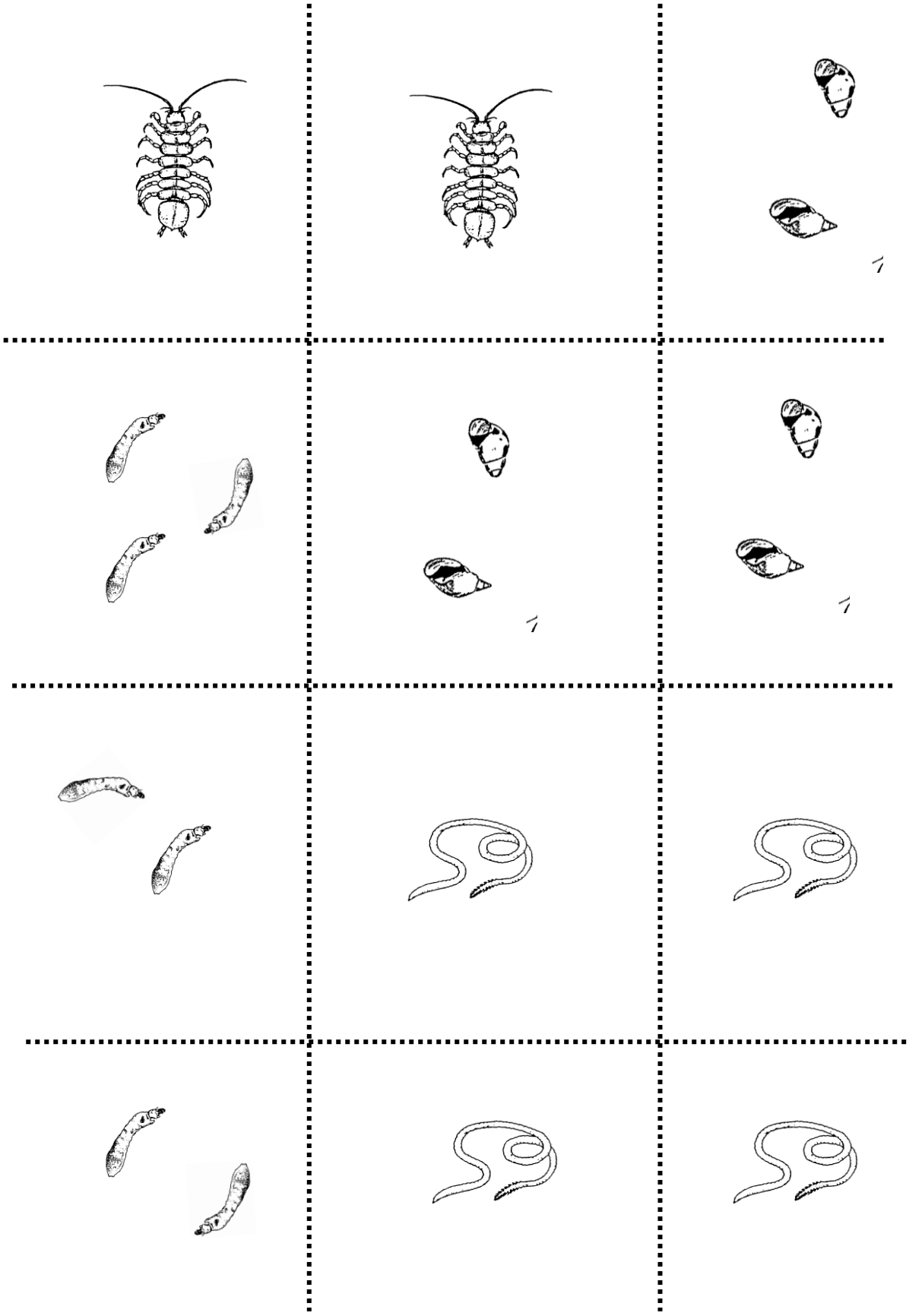

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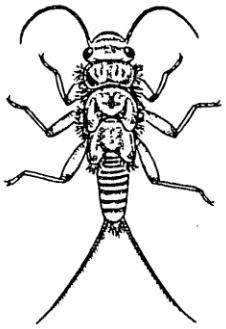
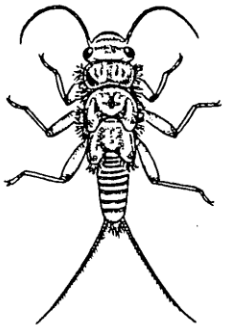
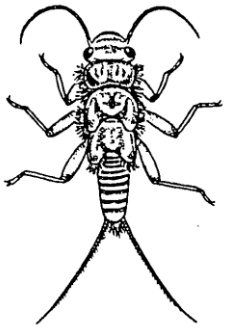
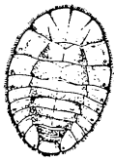
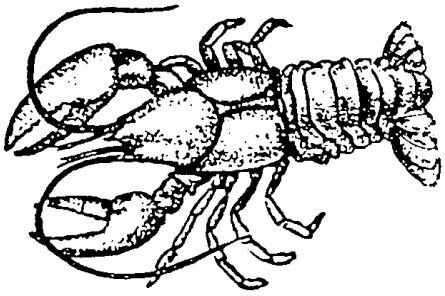
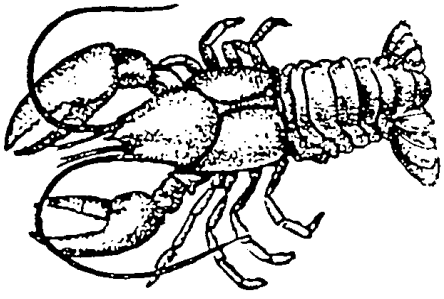
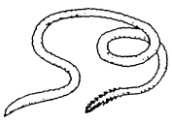
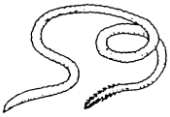
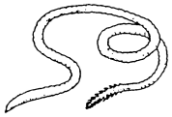
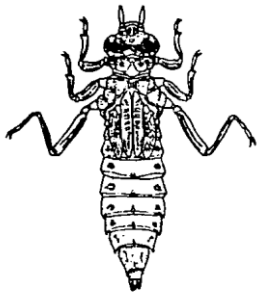




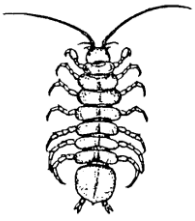
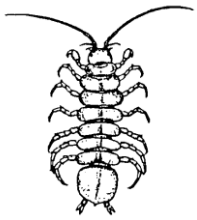
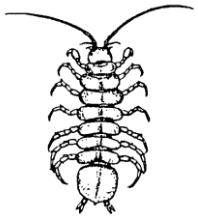
Scenario 4: Cut along Dotted Lines

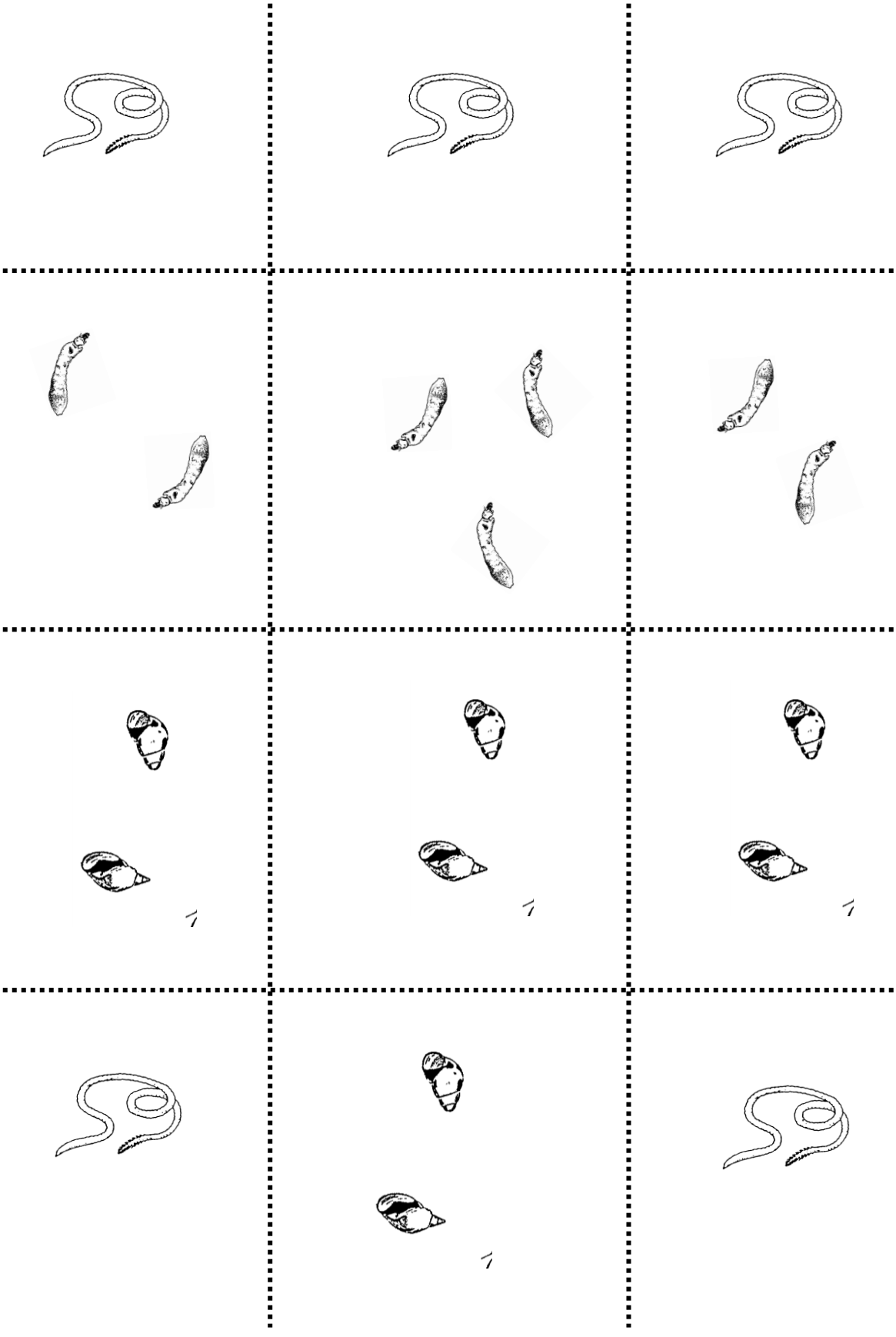







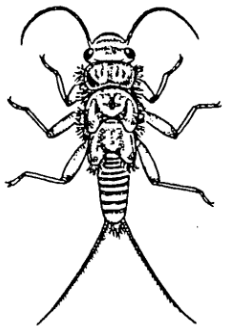





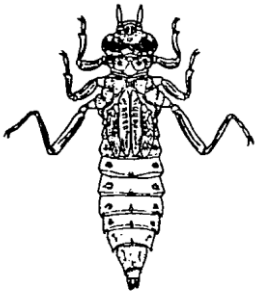
Scenario 5: Cut along Dotted Lines



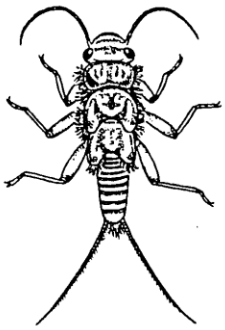
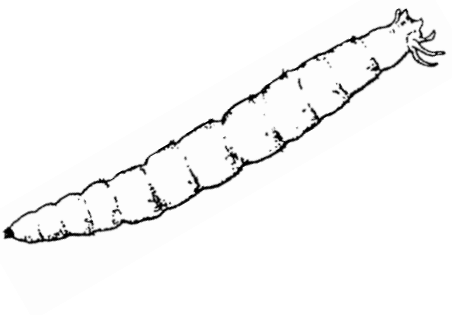
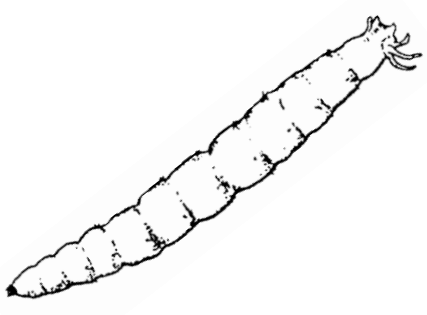
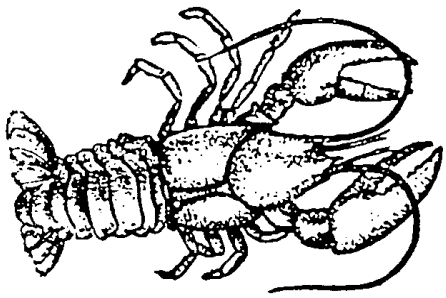
Scenario 6: Cut along Dotted Lines







Waterfront Property

Grades:

6th-8th

Objective:

- Students will discover the *tragedy of the commons* with unrestricted use of property adjacent to a shared waterway.
- Students will determine their effects on shared resources.

Method:

- Students will design their own beachfront property by developing it as they see fit.
- They will then combine their properties to create a connected waterway and determine the effects that each property will have on the other.

Materials:

- 5 x 8 in. notecards, or half sheets of paper for each student
- Pencils
- Blue marker
- Colored Pencils

Time:

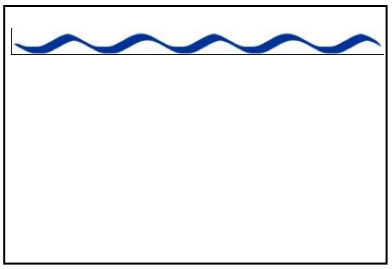
Preparation Time: 2 weeks.
Class Time: 40 minutes.

Vocabulary:

Agriculture, Eco-Friendly, Ecosystem Services, Environmental Impact, Fertilizer, Green Energy, Hydropower, Hydraulic Fracturing, Non-point Pollutant, Oil, Pesticide, Point Source Pollutant, Riparian Buffer, Runoff, Stakeholder, Stewardship, Sustainability, Tragedy of the Commons, Waste Products, Watershed.

Procedure:

Waterfront Property



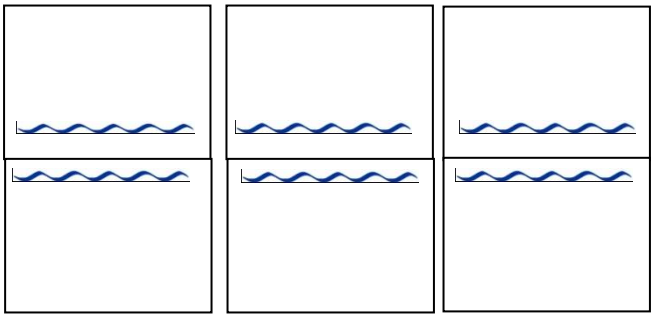
- Each student will receive a sheet of paper with a blue line drawn down one long edge of the paper.
- Students may use their new waterfront property in any way they see fit.
- What will they construct?
- How will they obtain energy?
- How will they use the available resources?

Sketch

- Students will design their new property with a sketch and label important features.
- They must also choose a title for their property to summarize the purpose (i.e. Julia's Horse Farm, or Steve's Fish Shack).

Share & Present

- Students will gather around joined desks, a table, or on the floor.
- Attach all of the sheets of paper together by connecting the blue lines.



Tape the sheets of paper together to form one body of water.

- Label one side upstream, and one side downstream.
- Go down the river and have each student explain what they designed.
- Have each student answer the following questions:

1. What did you design?
2. What is the name of your business?
3. How is your business powered?

4. Does your business rely on water as a resource?
5. Does your business have a parking lot?
6. How does your business dispose of trash?

- Determine which way the water will flow and how each business or development will affect those beside it.
    - Is there any pollution that should be added to the picture?
    - If they didn't draw any trash receptacles, or recycling receptacles into their picture add appropriate amount of trash from businesses, pollution from parking lots, power plant discharge.
    - Were any dams constructed limiting the flow of water further down stream?
    - How are these businesses being powered?
    - Are there any businesses that depend on clean water?
        - Seafood restaurant, fishing boats, canoe or kayak shop?
        - How are they affected by the pollution of other businesses?
- Finally, have students discuss ways that each business could reduce their impact of water use, or pollution.
- Are there greener sources of energy that these businesses could choose to employ?

Extensions:

- Is this a realistic exercise?
    - Research one real-life example of a shared river resource that is causing controversy. (Examples may include but not limited to: the Colorado River, The Nile River, The Hudson River).
    - Write a one-page summary of the geographic location, river facts, and resource issue facing the area.

Assessment:

- Did students design their own waterfront property?
- Were they able to create an energy source and system of waste disposal for their property?
- Were they able to determine the affects of their property on the property of others or vice versa?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Hydropower: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.
Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.
Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.
Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Point Source Pollutant: A pollutant that has a single traceable source.
Riparian Buffer: A protective strip of land or timber adjacent to a waterway.
Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.
Waste Products: An unusable or unwanted material that is produced as the result of a process.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 7: Interdisciplinary Problem Solving

Land Stewardship

Grades:

6^{th}-12^{th}

Objective:

- Students will discover the tragedy of the commons phenomenon on unmanaged lands.
- Students will determine land management strategies to ensure stewardship of their local environment.

Method:

- Students will demonstrate a tragedy of the commons scenario through an exercise with other classmates.
- They will discuss the effects of land use after one round of the exercise and determine how to use land management practices to limit or alleviate the environmental impacts.

Materials:

- Laminated grids
- Dry erase markers of 4 different colors.
- Paper Money

Time:

Preparation Time: 10 minutes
Class Time: 30 minutes

Prep:

- Make copies of grids and laminate one grid for each group.
- Print off sheets of paper money and cut out a sheet for each group.

Vocabulary:

Agriculture, Agritourism, Carbon Footprint,Carrying Capacity, Compost, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Fertilizer, Forestry, Fossil Fuel, Fracing/Fracking, Hydraulic

Fracturing, Natural Resources, Overconsumption, Pesticide, Stakeholder, Stewardship, Sustainability, Timber, Tragedy of the Commons, Watershed.

Procedure:

Tragedy of the Commons.

- Define Tragedy of the Commons
    - What is a common area? Or common space?
    - Have students come up with answers.
    - Settle on an area that is shared among a group of people. In this lesson we are talking about land, but water and ocean resources are also examples of the commons.
- What is a tragedy? Have students come up with answers.
    - Settle on a sad event or situation that is bad for everyone involved.
- A tragedy of the commons can occur when everyone uses the same resource for their own benefit without any concern for how everyone else is using that same resource.
    - Example: This phenomenon is currently happening in the oceans, where many countries fish for the same species. Each country tries to take as many fish as they can without knowledge of how many fish every other country takes.
    - What happens to that fish population if all countries are trying to fish for the same species at the same time?
- In this lesson we are going to be focusing on land issues.

Tragedy of the Commons Activity.

- Divide students into groups of no more than 4.
- Distribute a laminated grid to each group.
- Distribute a dry erase marker to each student making sure that each member of the group has a different colored marker.
- One student will read the rules of the game out loud for the entire group.

RULES OF THE GAME

In front of your group is an area of land used by all. It is known as "the commons" since it is public space.

As time passes each stakeholder will use the commons for different reasons. Begin with the farmer (they wake up earliest!) Go around the group clockwise, and draw cards from the center. Read each card. If you choose to develop write the amount of $ that each square is worth inside the square. If you choose to develop sustainably trace the outside the square and write how much each square is worth inside the square.

- Students will each take the colored card corresponding to their marker.
- Students, beginning with the farmer, draws a card from the center, reads it out loud and responds to the circumstances.
- Continue around the circle until all cards have been drawn.

GREEN You are a LOGGER on The Commons. You: →cut firewood to heat your family's home →cut timber to sell as income →to clear land for other stakeholders and sell the timber	**Black** You are State Parks. →You construct trail systems for outdoor enthusiasts to use →You conserve land for wildlife habitat
Red You are a DEVELOPER on The Commons. →You clear land to build homes, businesses, and roads →Renovate existing structures to make them more eco-friendly	**Blue** You are a FARMER on The Commons. You: →grow crops and graze animals to feed your family & sell →Run agritourism to gain income

- Students begin with the farmer (they get up earliest!) and go clockwise around the group.
    - Once all of the cards have been drawn and completed students discuss the impact on the land. These cards reflect the amount of change a landscape can endure over 10 years.
- What is the effect on The Commons after 10 years?
    - Is there any wild land left intact?
    - What will happen to future generations?
    - If you continue to use spaces at this rate how long will the commons last?
- Who wins?
    - At the end you must see who has made enough to stay in business and provide for their family. The Developer must make $500 in Year 4. The Logger must make $400 in year 4. The Famer must make $300 in Year 4. Parks must make $200 in Year 4.
    - Who made the most money?

Stewardship

- Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
- Why do we manage land? Why is it important?
    - Future generations rely on the same resources that we currently rely on. If we choose to use up limited resources without replacing them it will be harder for future generations to acquire what they need.
    - Think of any landscape on earth. What happens to the quality of life of its inhabitants when the natural resources are diminished?

Extensions:

- Have students research a real-life tragedy of the commons example and present it to the class.
    - Where in the world did it take place?
    - When did it take place? / Is it currently happening?
    - What were the resources involved?
    - How was it managed? Has the ecosystem recovered or collapsed?

Assessment:

- Are students able to define tragedy of the commons and brainstorm examples?
- Did students participate in the land use activity?
    - Were they able to maximize cooperation within their group to minimize land use?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Carrying Capacity: Refers to the population of an organism that can be sustained in a given environment without degrading the resources available. Once a population increases above the carrying capacity, resources are consumed without replenishment, and the population decreases due to lack of resources. Human populations have risen far above this level by modifying their environment, but human population growth is not unlimited.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Forestry: The science of managing forests for the production of timber.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Fracing/Fracking: See hydraulic fracturing
Hydropower: Created by harnessing the natural power of water. It can be harnessed by constructing a dam. As water washes over the dam it turns turbines that create electricity.
Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on

the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Timber: Standing trees that are managed for sale of wood products.
Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Cut out along the dotted lines.

RULES OF THE GAME

In front of your group is an area of land used by all. It is known as "the commons" since it is public space.

As time passes each stakeholder will use the commons for different reasons. Begin with the farmer (they wake up earliest!) Go around the group clockwise, and draw cards from the center. Read each card and have that player decide. To use a space write the amount of $ that it is worth and then cross it out with an X. It will only generate money once. To use it sustainably TRACE the square with your colored marker and write how much $ it is worth. It will generate that much money each year.

RULES OF THE GAME

In front of your group is an area of land used by all. It is known as "the commons" since it is public space.

As time passes each stakeholder will use the commons for different reasons. Begin with the farmer (they wake up earliest!) Go around the group clockwise, and draw cards from the center. Read each card and have that player decide. To use a space write the amount of $ that it is worth and then cross it out with an X. It will only generate money once. To use it sustainably TRACE the square with your colored marker and write how much $ it is worth. It will generate that much money each year.

ECONOMIC RECESSION!

LOGGER

No one is buying lumber in the recession. No major logging operations are scheduled!

You can still sell firewood from any sustainable forest squares that you have.
Will you make enough money to support your family this year?

YEAR 4

ECONOMIC RECESSION!

DEVELOPER

The Housing Market crashes and no one is buying! No new housing projects!

People stay put in their sustainable housing units. Collect income from sustainable squares.

Will you make enough money to support your family this year?

YEAR 4

ECONOMIC RECESSION

FARMER

In this economy you can't compete with the prices at big box stores.

You can still sell your sustainably farmed produce at a high enough price to make a profit.

Will you make enough money to support your family this year?

YEAR 4

A Pristine Wilderness

The commons is a wild land with abundant resources!

LOGGER

Choose to:

Clearcut 6 squares = $200 each now
or
Sustainably harvest 6 squares = $50 each every year.

YEAR 1

ECONOMIC RECESSION

PARKS

People are trying to save money and avoiding expensive theme parks, and are carpooling on tolled roads.

People still pay to visit inexpensive natural areas like trails and lake sites.

Will you make enough $ this year?

YEAR 4

Taming the Land

People need access to the land!

DEVELOPER

Choose to:

Build 1 Mansion of 4 squares = $200 each now.

Or

Build solar powered housing on 4 squares = $50 each every year.

YEAR 1

A New Market

Feed the people!

Farmer

Choose to:

Commerically farm 5 squares = $200 each now.

Or

Sustainably farm 5 squares for $50 each every year.

YEAR 1

Open Space

Increase tourism!

Parks

Choose to:

Create a waterpark on 4 squares = $200 each now

Or

Build a bird sanctuary on 4 squares = $50 each every year

YEAR 1

A Cold Winter

Demand for Firewood!

Logger

Choose to:

Clearcut 6 squares = $400 each now

Or

Sustainably harvest 6 squares = $200 each every year

YEAR 2

A Growing Economy

Business is booming!

Developer

Choose to:

Create a housing development on 6 squares = $400 each now

Or

Build apartments on 6 squares = $200 each every year

YEAR 2

Drought!

Why wont the grass grow?

Farmer

Apply chemical fertilizer on 4 squares = $400 each now

Or

Graze sustainably on 4 squares = $200 each every year.

YEAR 2

Recreation!

Time to play!

Parks

Build a community pool on 2 squares = $400 now

Or

Conserve 2 squares of natural lake = $200 every year.

YEAR 2

Forest Fire!

Manage the forest.

Logger

Clearcut 4 squares before the fire gets here = $400 each now.

Or

Cut the dead trees and weak trees in 4 squares to weaken the blaze = $100 each every year

YEAR 3

Town Roads

Developer

Clear & Pave a new 4 square highway & charge tolls
= $400 each now.

Or

Sustainably build on 4 squares of bumpy logging roads & charge tolls
= $200 each every year.

Year 3

Buggy Year!

Farmer

Increase crop yields with pesticides on 2 squares = $400 each now

Or

Grow organic crops on 2 squares, (the bugs eat some) = $200 each every year.

Year 3

Hunting Pressure

Parks

Release farm bred deer on 4 squares = $400 each now.

Or

Set aside 4 squares of preserve for wildlife habitat for deer = $100 each every year.

Year 3

Local Seasonal Agriculture:

Grades:

6th-12th, Adult

Objective:

- Students will discover how to access and utilize local food supplies and why it is important for personal health, environmental health, and the vitality of the local economy.

Method:

- Students will discover the "100-mile diet" and create a map that plots their local food sources by seasonal availability.

Materials:

- *Pure Catskills 2010-2011 Guide to Farm Fresh Products*
- Regional map print out
- Internet Access

Time:

Preparation Time: 20 minutes
Class Time: 80 minutes (2 to 3 class periods)

Prep:

- Create a google map of the greater region surrounding the school address. Navigate to www.google.com, click "maps", and type in the school address. Zoom out on map picture 3 to 4 times to create a map that is 25-30 miles across. Print this map in a LARGE black and white version for each student.

Vocabulary:

Agriculture, Agritourism, Biomass, Carbon Footprint, Compost, Conservation, Eco-Friendly, Environmental Impact, Fertilizer, Fossil Fuel, Greenhouse Gases, Natural Resources, Pesticide, Stakeholder, Stewardship, Sustainability.

Procedure:

- Ask students: **Where does your food come from?**
    - **Did you know that the average food travels over 1,500 miles to reach your plate?**
    - Ask students to generate a short list on the board of groceries that come from other countries or distant states.
        - Answers may include, but are not limited to: apples, bananas, potatoes, tomatoes, coffee, milk, pears, peaches, etc.
    - Now ask students to take a look at that list and determine how many of them are also grown right here in New York State, or better yet, right here in the Catskills.
        - Tomatoes, apples, potatoes, milk, pears, peaches, etc.

Introduce the 100 Mile Diet.

- The 100 Mile Diet is a lifestyle where people choose to eat food grown or raised within 100 miles of their home.
- Ask students to come up with some benefits of choosing the 100-mile diet. Answers may include, but are not limited to:
    - *Better taste* – Freshly picked food tastes better and often more varieties are grown locally, known as "heirloom" varieties.
    - *Know where your food comes from!* – Food safety is important. With this method you can meet the people who grow your food and talk to them about the products they offer.
    - *Conserve energy!* - Locally grown food uses less fossil fuel to transport food to makets. Local organic food means less oil and natural gas is used to make fertilizer, pesticides and herbicides.
    - *Support your local economy*! - Buying from local farms keeps money in your area and can revitalize the local economy.
    - *Preserve open space!* – Farmers pay a lot in taxes every year. In order to afford the taxes to preserve their land they must be supported by a local consumer base. The open space farms provide allows for scenic views and prevents development.
    - *Keep your food decisions local!* – Consumer's don't have a whole lot of say in company procedure on a farm – that they have never seen – thousands of miles away.
- 100 Mile HOW TO:
    - Resources for finding locally grown food:
        - Pure Catskills – food guides

- www.100milechallenge.com (Capital District 100 mile diet)
- Where to buy:
  - Local Orchards "U-Pick
  - Farmers Markets – These may gather once a month, or once a week during growing season to offer local goods.
  - Community Supported Agriculture (CSA's) are based on memberships to local farms.

Activity 1: *Local Food Map*

- Students can create a FOOD MAP to plan and schedule their grocery shopping.
  - Distribute google region maps, Map Making Directions, and Pure Catskills 2010-2011 guide.
    - Students now research their area by: Navigate to www.buypurecatskills.com and look for the Pure Castkills Local Food Map Icon and click it. 

      Direct link: http://www.buypurecatskills.com/purecatskillsmap/
    - Use the zoom in/ zoom out arrows to navigate to your location.
  - Use the key provided to map locations of farmers markets, farm stands, U-PICK orchards, restaurants and retailers.
  - Double-click on any icon from the map to reveal the name, location, and website information.
    - Students may personalize their maps by choosing to include the veggies, fruits and other items that they like most (i.e. they don't have to list brussel sprouts when in season if they are not actually likely to eat them, instead list what they might buy).
    - Teachers may want to create some structure here with mapping by instructing students to list at least 3 fruits, 3 veggies, 2 meats, 2 other items, etc.
  - Schedule months when each item is available – use growing chart on pg 32 in *Pure Catskills* food guide to research availability.
  - Create a seasonal icon or label each with the correct month to visit.
  - Plan a schedule for preserving items for winter.
- Debrief: Discuss with students how this mode of eating requires much more planning than a weekly (or daily) trip to the grocery store. With that in mind have students try to imagine how much planning it took our ancestors to schedule growing, harvesting wild foods, and hunting what they needed to survive!
  - The planning time we save can now go to things that bring us more happiness like leisure time and strengthening our social interactions. Instead of just taking our available food sources for granted we might have a sense of

reverence for the time and energy it took into preparing, growing, and transporting that item.

Extensions:

- More info on Community Supported Agriculture (CSA's)
    - Each member or family pays a flat rate for the year for a share of what is produced from the farm during the growing season.
    - Whatever is produced is split among the members.
    - Research your local CSA and find out yearly costs and locations.
        - http://pure-catskills.blogspot.com/2011/03/nows-time-to-join-csa.html
        - http://www.chronogram.com/issue/2011/5/Locally+Grown/Community-Supported-Agriculture-Farms
    - Many CSA's also hold workshops. These workshops can teach the local community how to preserve food during the growing season by canning or freezing for the rest of the year.
- *CSA versus Grocery Store Price Comparison:* How does membership cost of your local CSA compare to the cost of produce from the grocery store each year?
    - Save a receipt from your grocery store visit.
    - Total the sum of produce that could be replaced with local options.
    - Extrapolate that price out over the growing season?
    - Which is the cheaper option, the grocery store, or the CSA?
    - Which is better for your local economy?

- Do any students know of a local farm? Ask for information about the farm and distribute it to the rest of the class to help support the local economy.

Assessment:

- Can students use information systems to find a local a farmer's market or orchard close to their home?
- Have students created a useful map featuring local food availability?
- Can students explain the benefits of a 100-mile diet?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Biomass:
Board Feet: Is the measurement of a single board 1 foot long, 1 foot wide, and 1 inch thick.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement

of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

Compost: The decomposition of organic matter.

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.

Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.

Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 1: Personal Health and Fitness
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 2: Information Systems
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes

Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Farmland Debate

Grades:

6^{th}-12^{th}, Adult

Objective:

- Students will use a theoretical farmland issue and stakeholder viewpoints to generate solutions for the state of local farms.

Method:

- Students will act as stakeholders in a community that will present proposals for a land use at a struggling local farm.

Materials:

- Stakeholder Cards
- Farming Issue Card

Time:

Preparation Time: 10 minutes
Class Time: 40 minutes

Prep:

- Cut out Stakeholder Cards and "Farming Issue" Card. Laminate each (optional).

Vocabulary:

Agriculture, Agritourism, Biomass, Carbon Footprint, Compost, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Fertilizer, Forest Products, Forestry, Fossil Fuel, Green Energy, Hydraulic Fracturing, Natural Gas, Natural Resources, Non-renewable Resource, Pesticide, Renewable Resource, Solar Power, Stakeholder, Stewardship, Sustainability, Timber, Tragedy of the Commons, Waste Products, Wastewater, Watershed, Wind Power.

Procedure:

Introduce the Issue

- It is getting harder and harder for our local small farms to survive. Each year the taxes of farmland increase, competition with big box stores increase, and the cost of food production increases. Local farms need a boost in order to stay in business.
- You are all stakeholders in a business discussion about a local farm called the "Catskill Farm".
- What will happen to the Catskill Farm?
- Divide students into groups of 3 or 4 and give each group a stakeholder card.
- The teacher or another staff member may act as the "farm owner" and ask questions to each group.
- Stakeholders will each present proposals for this small local farm.
- At the end of the each presentation the farm owners will have the chance to ask 2 questions to each stakeholder group.
- Once all stakeholders have presented the Catskill Farm owners (teacher or staff member) will consider the options and pick a solution.

Who are the Stakeholders?

- Monsanto
    - Monsanto will give the farm a loan. With this loan the farm will buy the genetically engineered seeds that Monsanto produces. These seeds will grow plants like potatoes that are genetically engineered to grow larger without fertilizers, tomatoes that will grow without excessive watering, and corn that produces its own pesticides so it will resist pest predation.
- New York State Department of Agriculture & Markets
    - Will provide training to help develop educational farming programs. Agritourism can help bring in extra income for the farm. It can also help create a local fan base and increase farm sales.
        - Sell at local farmers markets
        - Sell at local farm stand
        - Open farm to U-Pick customers
        - Become a CSA and charge membership fee for produce.
        - Offer workshops on preserving food (charge money)
        - Allow local schools, 4-H groups, scout groups to come to the farm and learn / volunteer. (Take a donation)
- Chesapeake Oil

    - Chesapeake Oil will pay $10,000 an acre for the mineral rights to the land. The mineral rights will allow the company to drill for Natural Gas on the land using a process called Hydraulic Fracturing. Roads will have to be constructed, concrete slabs poured, and 5 million gallons of water and chemicals trucked in for each drill site.
- Catskill Mountain Wind Inc.
    - Catskill Mountain Wind will install wind turbines on the farm land. Incentives exist, which means the government provides some of the money to reduce the cost of installing the turbines. Wind power will power the farm and the extra energy is sold back to the grid, generating income.
- Mark Project
    - The Mark project will pay for the land to construct low-income housing. They will construct technologically advanced, green buildings that are low energy use. Their residents will compost, recycle, and have backyard gardens.
- New York State Department of Environmental Conservation
    - The NYSDEC will put a conservation easement on the property. It means that the state will pay the farm for the rights to the land. In return the farmer must never develop the land. If the farmer sells the land the conservation easement stays and no future owner of the land call develop the land.

Debate Format

- Remind students that they will be taking part in an in-class debate that functions as a mock-town meeting to discuss energy options.
- During this debate their group is to represent the viewpoint of their stakeholder group (and not their personal opinion).
- Remind students that a "debate" doesn't mean an argument. These groups must present their opinions with respect to the other groups.
- Divide students into groups of 4-5.
- Distribute a stakeholder card to each group.
- Distribute "The Issue" card to each group.

Poster Preparation

- Students have 15 minutes to generate a poster for their group stating their option for use of the farmland.
- They must all include bullet points of their opinions, supporting facts, and incentives.

Stakeholder Group Name
Main Option
* Reasoning

← Poster Template

*Supporting Facts
*Incentives

Poster Presentation

- Each group will have approximately 5 minutes to read their posters to the rest of the class, and take 2 questions from the farm owners.

Farmer Vote

- Have the teacher, (or staff member), make a decision based on the proposals.

Class Vote

- Once all of the groups have presented take a few moments to regroup.
- Now give your personal opinion.
- Raising hands, how many of the students were part of a group that they personally agreed with?
- How many were part of a group that held opinions they didn't personally agree with?
- Take a real vote. Which proposal are students most in favor of?

Is this debate realistic?

- Do communities ever come together to deal with conflicts?
- What other environmental issues could bring up conflict between stakeholders?
- Why is it important to be able to face an issue with someone else's viewpoint or opinion?

The Future of Farming

- It is important to stress to students that the Catskills are currently facing and will continue to face decisions about farmland.

Extensions:

- Do any students know of a local farm? Ask for information about the farm and distribute it to the rest of the class to help support the local economy.

Assessment:

- Can students use information systems to find a local a farmer's market or orchard close to their home?
    - What type of products are offered?

- What months of year are they open?
- Is membership required? CSA?
- How is it managed? Small family farm? Company?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Biomass: a renewable energy source composed of biological material (from living or recently living organisms), such as wood, waste, hydrogen gas, and alcohol fuels. Biomass is commonly plant matter grown to generate electricity or produce heat.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Forest Products: A material that is derived from a forest for commercial use, such as lumber, nuts, paper.
Forestry: The science of managing forests for the production of timber.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Hydraulic Fracturing: Also called fracing (pronounced frack-ing) is the process of creating fractures in the underground formations of shale to allow natural gas to flow out. Water, sand, and chemicals are squirted under high pressure into the earth through a drilled hole. Once the shale fractures open the natural gas leaks into the well hole where it can be sucked out to the surface.

Natural Gas: Natural gas is a combustible mixture of hydrocarbon gases. While natural gas is formed primarily of methane, it can also include ethane, propane, butane and pentane. It is used commonly to heat homes, as cooking fuel, and to generate electricity.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Timber: Standing trees that are managed for sale of wood products.
Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.
Waste Products: An unusable or unwanted material that is produced as the result of a process.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.
Wind Power: Harnessing energy that wind creates with the use of large windmills. It is a clean, green way to create electricity without burning fossil fuels.

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Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Stakeholder Cards – Cut, laminate, and distribute one to each group.

The Mark Project

The Mark project will buy the land from the farmer for a fair price. They will use the land to construct low-income housing. This type of housing is needed for residents in the area that are struggling to get by in this tough economic time. They will construct technologically advanced, green buildings that are low energy-use. Their residents will compost, recycle, and have backyard gardens.

Monsanto

Monsanto will give the farm a loan. With this loan the farm will buy the genetically engineered seeds that Monsanto produces. These seeds will grow plants like potatoes that are genetically engineered to grow larger without fertilizers, tomatoes that will grow without excessive watering, and corn that produces its own pesticides so it will resist pest predation.

Growing these new crops will allow the farm to produce more with less money and resources going into production. The farm will increase profits and will be able to pay off the loan within 10 years.

New York State Department of Agriculture & Markets

Will provide training to help develop educational farming programs. Agritourism can help bring in extra income for the farm. It can also help create a local fan base and increase farm sales. We will also help the farm to slightly increase their income by:

- Selling at local farmers markets
- Selling at local farm stand
- Opening farm to U-Pick customers
- Becoming a CSA and charging membership fee for produce.
- Offering workshops on preserving food (charge money)
- Allowing local schools, 4-H groups, scout groups to come to the farm and learn / volunteer. (Take a donation)

Stakeholder Cards – Cut, laminate, and distribute one to each group.

Chesapeake Oil

Chesapeake Oil will pay $10,000 an acre for the mineral rights to the land. The mineral rights will allow the company to drill for Natural Gas on the land using a process called Hydraulic Fracturing. Roads will have to be constructed, concrete slabs poured, and 5 million gallons of water and chemicals trucked in for each drill site. Local jobs will be created on construction crews.

New York State Department of Environmental Conservation

The NYSDEC will put a conservation easement on the property. It means that the state will pay the farm for the rights to the land. In return the farmer must never develop the land. This may generate enough money for the farm to stay in production.

If the farmer sells the land the conservation easement stays and no future owner of the land call develop the land.

Catskill Mountain Wind

Catskill Mountain Wind will install wind turbines on the farm land. Incentives exist, which means the government provides some of the money to reduce the cost of installing the turbines. Wind power will power the farm and the extra energy is sold back to the grid, generating income.

This is a sustainable form of energy that will never run out. The windmills will generate enough power to pay for themselves within 5 years. Installing wind power may make the farm eligible for tax breaks (they won't have to pay as much each year in taxes on the land).

Issue Cards. Cut, laminate, and distribute one for each group.

Catskill Farm Issue

It is getting harder and harder for our small local farms to survive. Each year the taxes on farmland increase, competition with big box stores increases, and the cost of food production increases. Local farms need a boost in order to stay in business.

You are all stakeholders in a business discussion about a local farm called the "Catskill Farm". You each have a solution for the struggling farmer that will benefit your business.

Catskill Farm Issue

It is getting harder and harder for our small local farms to survive. Each year the taxes on farmland increase, competition with big box stores increases, and the cost of food production increases. Local farms need a boost in order to stay in business.

You are all stakeholders in a business discussion about a local farm called the "Catskill Farm". You each have a solution for the struggling farmer that will benefit your business.

Agritourism Field Trip

Grades:

6th-12th, Adult

Objective:

- Students will discover agritourism as a way for local farms to supplement their income in a sustainable way.

Method:

- Students will spend a day of service at a local farm involved in agritourism.
- Students will get a farm tour and discover how a local farm is using sustainable production to produce goods.
- Students will volunteer their time to assist the farm in needed services such as compositing, picking produce, or feeding livestock.

Materials:

- Boots
- rain gear
- water bottle
- bagged lunch
- clip board & booklet
- pencil

Time:

Prep Time: Researching & Scheduling with local farm (Times will vary)
Class Time: Field Trip (Times will vary)

Prep:

- Research a field trip to a local farm that offers agritourism.

  Schedule a tour of their facilities and find out how the tourism they incorporate into their farm production represents a sustainable avenue to help the farm stay in business.

Catskill Region Farm Tours & Education

Search farms using the Pure Catskills website map.
http://www.buypurecatskills.com/purecatskillsmap/
Or use the list below sorted by county.

Broome County
Miller Farms - 178 Main St. Windsor NY. (607)-655-1152 millerfarms.net

Delaware County
Catskill Revitalization Corporation - 21 Railroad Avenue, Stamford, NY. (607)-652-2821. gilboahome.com
Greenane Farms - 5637 Turnpike Road, Delhi NY. (607)-746-8878. greenanefarms.com
Lazy Crazy Acres – Arkville, NY. Karen Fairbairn. karenfarmgirl@yahoo.com
Maple Shade Farm – Delhi, NY. Abby Wilson mapleshade@hotmail.com
Stony Creek Farm – Walton, NY. Kate Marsiglio. kate@stonycreekfarm.org

Greene County
Armstrong's Elk Farm - 936 Hervey Sunside Road, Cornwallville, NY. (518)-622-8452.
http://www.greenetourism.com/listings/armstrongs-elk-farm
Catskill Mountain Foundation -7950 Main St, Hunter, NY. (518)-263-4908. catskillmtn.org
Lazy S Ranch - 637 Hervey St. Cornwallville, NY 12418. (518)-239-8995.

Schoharie County
Cooper's Ark Farm - 145 Ark Lane, Schoharie, NY. (518)-295-7662. coopersarkfarm.com

Sullivan County
Apple Pond Farm – Farm Tour & Renewable Energy – Kids hands on farming. Calicoon Center, NY
http://www.applepondfarm.com/
Little Farm Show – Educational show for young children featuring environmental/land issues as well as food and health. http://www.nacl.org/performances/farm_show.html

Procedure:

1. *Agritourism.*

- Have students define.
  - What is agriculture?
  - What is tourism?
  - What is agritourism?
- Review farming practices. Have students look over Agritourism Booklet and fill in back page with questions to ask during the farm field trip.
- Visit the farm, and fill in the Agritourism Booklet
- Choose one of the 4 segments from the Agritourism Booklet to focus on and write a 1-2 page report in more detail. Include photos from your farm day or from the farms web page (if available).

Extensions:

- Have students design a flyer highlighting ways that the community can support their local farms
    - Purchase items grown / made at the farm
    - Attend a farm tour with friends or family
    - Volunteer one day each year at the farm with friends or family.
    - Raise funds to "adopt-an-animal" at the farm. Send a small monthly contribution in exchange for a monthly farmer's letter to update you one the goings-on at the farm.
- Have students draft a contract that they will make with family and friends. Have this agreement allow a group of students (along with appropriate custodian) to volunteer at the farm one day per year.

Assessment:

- Are students able to define agritourism?
- Did students attend the farm field trip?
- Did students complete their packets and reports?

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English Language Arts
Standard 1: Language for Information and Understanding
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Questions to Ask

Q. 1._____

_____

A.1._____

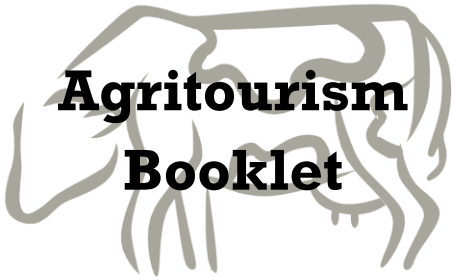
_____

Q.2._____

_____

A.2._____

_____



Agritourism Booklet

Farm Name: _____

_____

Location:_____

Student Name:_____

Date: _____

1.) Farm Production (Type of Farm)

_____

_____

_____

_____

2.) Farm Labor (Man vs. Machine)

_____

_____

_____

_____

3.) Farm Sales – Products sold on-site? Local markets? Shipped?

_____

_____

_____

_____

4.) Types of agritourism?

_____

_____

_____

_____

Sustainable Forestry Practices

Grades:

6th-12th, Adult

Objective:

- Students will discover how sustainable forestry practices can ensure the longevity of a vital resource.
- Students will learn to assess market value of timber on school property and why it is important to manage forest resources for more than short-term economic goals.

Method:

- Students will learn about forest resources and why it is important to manage forests in the Catskills.
- Students will complete a worksheet to assess market value of timber species on school property.

Materials:

- Biltmore Stick
- Saw Timber Price Guide
- Market Value Worksheet
- Tree ID Guide (dichotomous key).
- Calculator

Time:

Prep Time: 10 minutes
Class Time: 40 mins

Prep:

- Make 1 copy per pair of students:
    - Saw Timber Price Guide
    - Market Value Worksheet
    - Tree ID Dichotomous Key (or use tree field guides)

- Obtain 1 for each pair of students:
  - Biltmore Sticks
  - Tree ID Guides (or photocopy dichotomous keys)

Vocabulary:

Biltmore Stick, Biomass, Board Feet, Clear Cutting, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Forest Products, Forestry, Green Collar Jobs, Green Energy, Greenhouse Gases, High Grading, Invasive Species, Natural Resources, Renewable Resource, Riparian Buffer, Stakeholder, Stewardship, Sustainability, Timber, Watershed, Wood Power.

Procedure:

1. *Forestry*: What do our forests provide? – Ask students what forests provide?

- Forest products (like paper, and wood products) fuel a $243 billion dollar industry annually. The forest products industry is the third largest industrial use of energy in the United States.
- Generate a list of products and services on the board.
  - Answers may include, but are not limited to:
    - wood products
    - paper products
    - lumber
    - wildlife habitat
    - food products
    - food for wildlife
    - ecosystem services (wind shelter, prevent erosion, shade, carbon sequestration)
    - recreation
    - aesthetics.

2. *Forestry*: Why do we manage forests?

- Have students brainstorm a list on the board, and explain each example.
  - If reasons cannot be readily generated by students divide the class into small groups. Give each group one of the following reasons and have them provide a definition each bullet.
    - Forest Health
    - Wildlife Management
    - Wood Products
    - Watershed Protection
    - Invasive Species Management
    - Overcrowding
    - Recreation & Aesthetics
    - Ecosystem Services
    - Fire Prevention & Control
  - Review the following reasoning.

- There are many reasons to manage forests, and cut particular trees.
    - *Forest Health: Manage against forest insect pests and diseases* – weaker trees are more susceptible to forest pest infestation and disease. Choosing to harvest weaker trees can leave stronger trees with the remaining resources to rejuvenate forest stocks.
    - *Wildlife Management* – Many landowners can choose to cut trees, plant trees, or plant other woodland vegetation in order to provide habitat for certain wildlife.
        - Landowners that wish to hunt wildlife such as wild turkey, or white-tailed deer may choose to favor large mast trees (like oak and beech) growing on their property.
        - Trees that compete with large mast tree species for light or water may be removed in order to favor the selected tree species.
    - *Wood Products* – Many landowners manage their forest resource to produce firewood to heat their homes or provide income. Others manage their lands for optimal timber production.
        - Trees that are managed for firewood are usually selected for species, but may be trees that are chosen for removal for many other reasons.
            - These include trees that are dying, trees growing in unwanted areas, trees with knots or deformed limbs.
        - Trees that are managed for timber production are not only chosen for species, but also health, and size.
            - These trees must be relatively straight, without branching of the main stem.
    - *Watershed Protection* – Forest ecosystems along waterways are known as riparian areas, or riparian buffers. Here, the forests:
        - Provide bank stability to prevent erosion
        - shade the water improving wildlife habitat
        - promote species diversity through energy flow in the ecosystem.
        - All of these factors combine to benefit water quality as these waterways flow and join at lower elevations in the watershed.
    - *Invasive Species management*- Our forests may become overrun with invasi**ve** plant species from disturbed areas or garden escapes.
        - Choosing to remove invasive species will favor our native species that naturally provide habitat for wildlife.
    - *Overcrowding* – A forest with many trees of the same species and age is more like a plantation than a naturally occurring forest.
        - As the young trees compete for light the population may have to be thinned in order to let a few trees thrive, instead of many trees surviving in stressful conditions.

        - It is best to maintain a forest with a diverse age class as well as species class.
    - *Recreation & Aesthetic Value* – Landowners can cut trees in order to build trails or view sheds from their property.
    - *Ecosystem Services*- Selecting for certain individual trees, tree species, or age classes can help you to maximize the ecosystem services that your forest provides.
        - Certain species like willow can be planted along stream banks to prevent erosion, while fast growing conifers can be planted as carbon sinks.
    - *Fire Prevention & Control* – In the hardwood forests of the Northeast accidental fires from careless campers, smokers, or people burning debris pose the biggest threat to forest health, especially during drought seasons.
        - Cutting vegetation –free fire lanes can stop the spread of forest fires.

3. Forestry: How do we manage a forest sustainably?

- Harvest Systems: How we cut. Have students write definitions of each term and draw a forest sketch to correspond with each term.

    - Clearcutting: The entire stand is removed at one time regardless of value, or ecosystem service.
        - Clearcutting is used in many places to clear land for farming. It allows natural regeneration through sucession, or artificial regeneration through plantings.

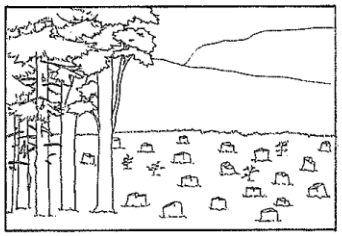


Figure 19. Clear-cut system.

    - Seed-tree system: Clear cut where some large or mature trees are left to provide seed stock for establishing a new timber stand. This method also provides some level of wildlife habitat.
        - Birds of prey can now use these trees to nest and perch in to catch prey in the new field habitat.

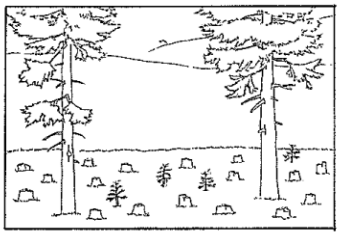


Figure 18. Seed tree system.

    - High Grading: the practice of removing most of the largest and fastest growing trees of the most valuable commercial species in order to meet short-term economic goals. This results in total disregard for the long-term viability of the forest

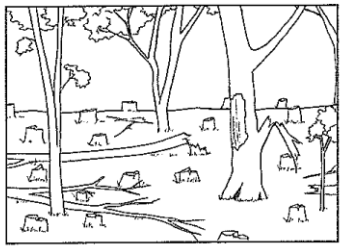


Figure 15. High-grading removes all but the poorest quality trees, thereby greatly reducing the future timber value of a woodland.

stand or providing for future income and regeneration.

- Selection System: Individual or groups of trees are removed to make space for natural regeneration.
  - This is a sustainable way to remove trees for firewood from a forest.

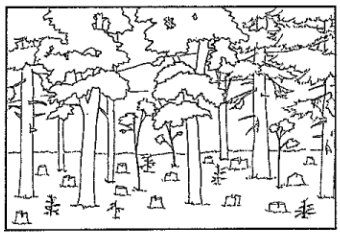


Figure 16. Selection system.

- Shelterwood: Harvesting of some trees that allows for new stems to grow up under an overstory of maturing trees. The shelterwood may be removed approximately 5 or 10 years later, once new trees have replaced their function within the ecosystem.
  - When some trees are selected and removed space in the canopy let's light to the forest flow where it can reach young trees and allow them to grow.

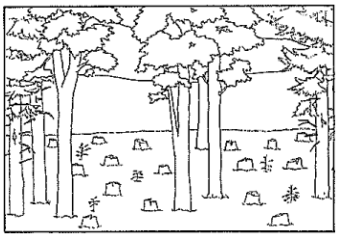
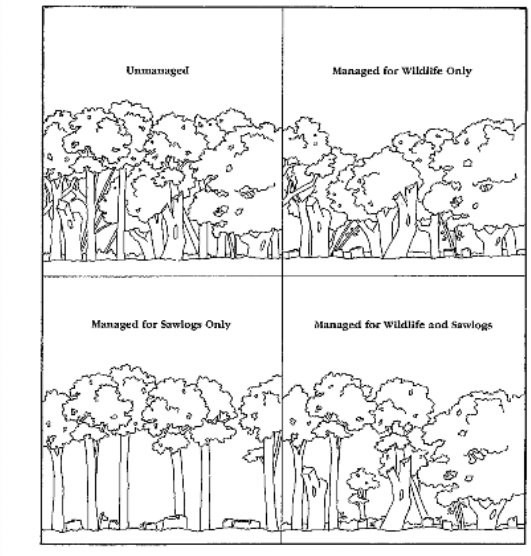


Figure 17. Shelterwood system.

Managing for Wildlife - Trees are selected by species, age, or function.

- Wildlife Habitat – An area where wildlife have access to enough food, water, shelter, and cover to survive.
  - Old, dead, or decaying trees may provide nesting sites for woodpeckers, owls, ducks, squirrels, and raccoons.
  - Food Sources – Oak – Acorns, Beech – Beech Nuts, Dying trees – Insects, Pine & Spruce – cones feed a variety of wildlife.



4. Basic Forestry Skills: Determining market value of a tree.

- Students can learn to use a Biltmore Stick. A Biltmore stick is a common tool for foresters to assess the amount of board feet that a standing tree contains.

- What is a board foot? A board foot is a piece of wood that measures 1 inch by 12 inches by 12 inches.
- Have students determine the amount of board feet in trees on the school property.
- First hold the stick level, 25 inches from your eye, against the tree at a height of 4.5 feet. Read the average tree volume in board feet.
  - Now stand 66 feet from the same tree and hold stick 25 inches from your eye. Line up the end of the stick with stump height and read the number of 16 foot logs within the tree.
  - Using the table on the stick match the diameter of the tree in inches to the number of 16 foot logs to determine board feet.
  - Identify the specie of tree that you measured using a dichotomous key.
  - What is that species worth per board foot?(http://www.dec.ny.gov/lands/5259.html)
  - Multiply the number of board feet by the current cost per board feet of that species.
  - What is the approximate value of that tree?

4. Basic Forestry Skills: Which trees to take?

- In order to decide which trees to cut from a forest you must consider
  - Approximate market value
  - Value to wildlife
  - Ecosystem services
  - Age, health, species, location.
- Ask Students: It can be appealing to spend time cutting only the largest and more valuable trees…but what does that leave your forest with?
  - *Highgrading* - the practice of removing most of the largest and fastest growing trees of the most valuable commercial species in order to meet short-term economic goals. This results in total disregard for the long-term viability of the forest stand or providing for future income and regeneration.
  - Leaving the healthiest trees will ensure that those seeds colonize the new space in the forest.
  - How will you make a compromise between high grading and making money?
  - Generate management ideas among the students.

Extensions:

- Magazine Forestry
  - Have students each cut a picture of a forest from a nature magazine and create a management plan for that forest.
  - Students should use details from the image to estimate market value, assess the value for wildlife, and the possible ecosystem function.

    - Students can attach the photo to a poster and present the poster of their management plan in front of the class.
- Create forestry cakes – have students decorate their own small cake with the forestry method they choose
    - Mini peanut butter cups = tree stumps
    - Dried coconut & green food coloring = low growing vegetation
    - Twizzlers / stick pretzels = trees
    - Brown frosting / green frosting (or pudding) shows ground cover.
- Create Forestry Flashcards to quiz students on the type of harvest system that was used in the picture.
- http://www.forestsforall.com/ A k-12 children's book on the importance of forests, also coloring & activity book.
- Visit a Maple Syrup Farm to discover the process behind this delicious forest product, threats to the industry, and how you can get involved.

Assessment:

- Are students able to define forestry?
- Are students able to name and describe reasons why we manage forests?
- Are students able to use the Biltmore stick to determine the approximate board feet per tree?
- Are students able to use the board feet to estimate the approximate market value of a tree?

Glossary of Terms:

Biltmore Stick: A tool of foresters and loggers that measures dimensions of a tree such as diameter at breast height (dbh) and height (h). It enables the user to estimate the number of board feet that a tree contains.
Biomass:
Board Feet: Is the measurement of a single board 1 foot long, 1 foot wide, and 1 inch thick.
Clear Cutting: All trees in a stand are removed at one time regardless of value or ecosystem function.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Forest Products: A material that is derived from a forest for commercial use, such as lumber, nuts, paper.

Forestry: The science of managing forests for the production of timber.
Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
High Grading: the practice of removing most of the largest and fastest growing trees of the most valuable commercial species in order to meet short-term economic goals. This results in total disregard for the long-term viability of the forest stand or providing for future income and regeneration.
Invasive Species: The term invasive species refers to a subset of introduced species or non-indigenous species that are rapidly expanding outside of their native range. Invasive species can alter ecological relationships among native species and can affect ecosystem function and human health. A species is regarded as invasive if it: (1) has been introduced by human action to a location where it did not previously occur naturally, (2) becomes capable of establishing a breeding population in the new location without further intervention by humans, and (3) spreads widely throughout the new location. In simple terms, an invader has to (1) arrive, (2) survive, and (3) thrive.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Riparian Buffer: A protective strip of land or timber adjacent to a waterway.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Timber: Standing trees that are managed for sale of wood products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.
Wood Power: Used a fuel source, harvested from tress and burned for heat energy which can heat homes or heat water.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 2: A Safe and Healthy Environment
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 4: Science

Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Assessing Market Value
Worksheet

1. Find a partner, a tree guide, and a Biltmore Stick.
2. Choose a tree.
3. Hold the stick level an arm's length from your eye (~25inches) against the tree. Make sure the stick is about 4.5 feet above the ground while you hold it against the tree. The *TREE SCALE STICK* side should be facing you.
4. What is the **average tree volume** in **board feet**? _____.
   (Read the number on the top of the stick 10-40)
5. Now flip the stick and look at the skinny side that reads *MERRIT HYPSOMETER*.
6. Stand 66 feet from the tree (One partner holds a measuring tape and the other walks 66 feet away).
7. Hold the stick an arm's length away from your eye. Line up the bottom of the stick with the stump height.
8. What is the **number of 16 foot logs**? _____.
   (It is a number 1-5)
9. Now flip the stick and together hold the *TREE SCALE STICK* side facing you.
10. Use the chart to match the diameter (on top) with the number of 16 foot logs (left).
11. Approximately how many **board feet** are in this tree? _____.
    (Match the row with the column)
12. Identify what species you are looking at using your tree guide.
13. What **species** of tree is it? _____.
14. Use your saw timber price guide to determine the approximate value per board foot for that species.
15. What is the **value per board foot**? _____.
16. Now multiply the **number of board feet** in your tree by the **value per board foot**.
17. What is the **approximate value of your tree**? _____?

Saw Timber Price Guide

NYS Delaware / Catskill
(Listed in alphabetical order)

Species Name	Average Price Per Board Foot
Ash, White	$0.15
Aspen, Quaking	$0.035
Beech, American	$0.04
Birch, White	$0.125
Birch, Yellow	$0.15
Basswood	$0.12
Cherry, Black	$0.70
Hemlock	$0.04
Hickory	$0.10
Maple, Red	$0.125
Maple, Sugar	$0.45
Oak, Red	$0.35
Oak, White	$0.20
Pine	$0.10
Tulip Poplar	$0.10

(Species that are not listed had no report. Use a closely related species to estimate).

Adapted from the: NYSDEC - Stumpage Price Report - Winter 2011 / #78
Prices used reflect median values for the average price range.

Compost

Grades:

6^{th}-12^{th}, Adult

Objective:

- Students will discover how to reduce their household organic waste by turning it into soil and nutrients!

Method:

- Students will discover the benefits of composting and learn how they can construct and feed a compost bin in the classroom or at home.

Materials:

- Shovel, thermometer, pitchfork, wooden pallets, chicken wire (outdoor bin)
- Organic waste (egg shells, coffee grounds, fruit peels, nut shells, vegetable matter, leaves, grass clippings).
- Plastic storage bin (for indoor bin)
- Red Wiggler Worms (indoor bin)

Time:

Preparation Time: 10 minutes
Class Time: 40 minutes

Prep:

- Obtain materials for and get permission for construction of classroom vermi-compost bin (worm bin).
- Obtain materials for and get permission for construction of outdoor compost pile.

Vocabulary:

Agriculture, Compost, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Fertilizer, Natural Resources, Stewardship, Sustainability, Vermicompost, Waste Products.

Procedure:

What is compost?

- Have students generate a definition of compost.
    - Compost is simply decomposed organic matter.
- What are it's components?
    - Food – organic matter
        - Carbon (also called browns) newspaper, dead leaves, sticks, straw, sawdust, shredded corn stalks, dried grasses.
        - Nitrogen (also called greens) – household veggies, green grass clippings, green leaves, manure from vegetarian animals.
        - You want to keep a 30:1 ratio of Carbon to Nitrogen, so for every 30 handfuls of browns that you put in, put 1 handful of greens!
    - Moisture- water
    - Oxygen
- Generate a list of items that you could put into a compost pile.
    - Vegetable matter (uncooked)
    - Egg shells
    - Fruit & vegetable peels
    - Coffee grounds
    - Grass clippings
    - Dead leaves & sticks
    - Straw & Hay
    - Nut shells
    - Tea Bags
    - Vegetarian animal manure
- Generate a list of items that you would not put into a compost pile.
    - Meat products
    - Dairy products
    - Cooked or processed foods
    - Chemicals (soap, cleaning agents)

What is vermin-compost?

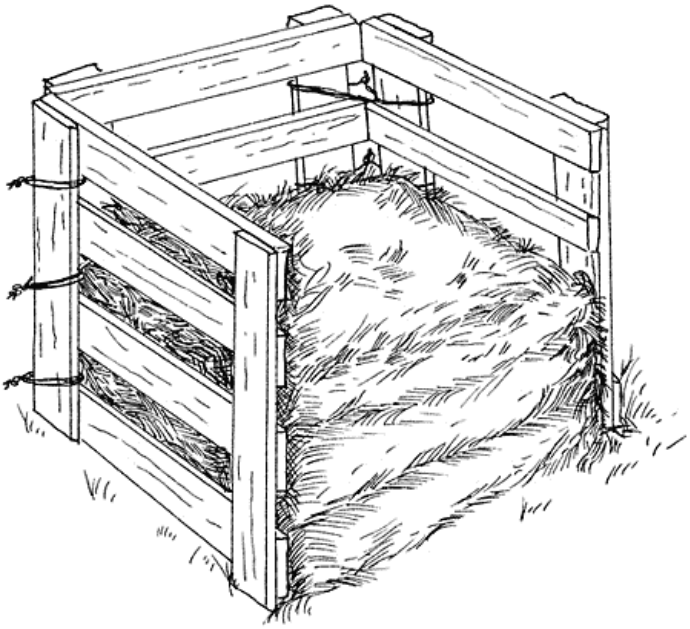
- Have students generate a definition of a vermi-compost bin.
    - What is the difference between vermin-compost and traditional composting?
        - Vermi-compost contains worms that break down organic matter, a closed container that is protected from freezing in cold climates is used.
        - A traditional compost pile will attract worms from the surrounding soil to help the decomposition process.

- Traditional compost relies more on microorganisms at high temperatures to break down organic material.

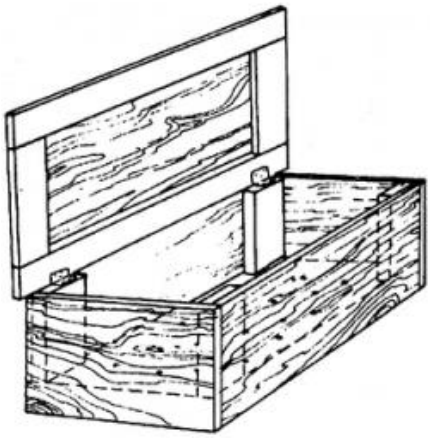
Why Compost?

- Compost makes excellent fertilizer!
  - Use as is, or mix with soil to grow a garden or indoor plants
- Compost is environmentally responsible
  - Compost is made from materials that you would otherwise throw in the garbage and would take up space in landfills.
  - It is a super efficient way to reduce household waste.

How to construct an outdoor compost pile.



- In order to construct an outdoor compost pile in the Catskill Mountain Region Climate you will need.
  - A shovel – dig down about 2 feet in a large square in the soil.
  - Wooden posts – bury posts in the corners of the square.
  - Lumber – Old wooden pallets will work just file to create walls for your compost pile.
    - Remember you want a functioning compost, not a pile of food to feed wildlife!
  - Chicken wire – to wrap around the lumber and create a barrier to wildlife.
  - Large zip ties to hold the wooden pallets together, or to corner posts.
  - A thermometer – a properly working compost should reach 160° F in the center of the pile.
- You will need to stir your compost in order to aerate the soil. Use the pitchfork and take a temperature reading first. Stir weekly in warm weather.
- Feed your compost pile from one side and cover with a layer of browns.



How to construct an indoor vermi-compost pile.

- You will need a large plastic storage container or wooden bin.

- Hammer and a nail (or electric drill) – drill several TINY holes on the sides and lid of the plastic bin in order for oxygen to read the worms.
- Greens & Browns – shred these first.
    - You will have to moisten the browns by dunking handfuls into a bucket and ringing it out sufficiently.
    - 30 hand fulls of browns and 1 hand full of greens
- Worms – red wigglers work the best – you can get these from local fish & tackle shops or on the internet.
- You will need to feed and occasionally water your worm bin.
    - If the bin becomes too wet, add plenty of browns
    - If the bin becomes too dry, add more greens, and spray slightly with water
    - Adding the food consistently to one side will draw the worms to that side, leaving the other side with completely decomposed soil.
    - Remove small amounts of soil when ready.

Extensions:

- Create a compost pile in your classroom or at your school.
    - Obtain approval from principal and BOE, identify approved location.
    - Use the internet to identify a local business that scraps wooden pallets
    - Advertise the project and solicit donations for needed tools
        - Shovel
        - Pitchfork
        - Thermometer
        - Work gloves
        - Chicken wire

Assessment:

- Can students explain the benefits of having a compost bin?
- Can students distinguish differences between a traditional outdoor compost pile and an indoor vermi-compost bin?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain

energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Vermicompost: A system of managing decomposition of organic matter using a worm bin.
Waste Products: An unusable or unwanted material that is produced as the result of a process.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
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LESSON 4: Shopping & Living Locally

Living Locally

Being an active member of your community can give you more say in issues that are important to you. It is important to educate yourself on local issues in order to be a more informed citizen. There are many issues in your local community that affect you as an individual, your livelihood, your family and friends, and the environment around you.

As our global population grows, so does our insatiable appetite for natural resources. These resources however, are not evenly distributed across the global environment. People must work at a local level to protect resources that they wish to conserve, or use wisely now and ensure for future generations. As we use natural resources we also create waste. Remote landscapes to harbor our waste are becoming more scarce as the population grows. Where do we put our waste? Once again it is action at a local level that can be the difference between your backyard becoming a wildlife preserve, or a toxic waste dump.

Introduction to Local Shopping

Shopping locally is an important way to contribute to the sustainability of your community. Consumers have purchasing power. The money that we all spend on food, clothing, and other goods can help to revitalize our local economy by keeping it within local businesses. Thriving businesses in the community help to absorb some of the tax burden that we face as citizens.

Understanding where our products come from is an important tool to buying locally. It is much better for the local economy to purchase apples and milk from the ample supply in Delaware County than it is to have apples shipped from Washington State, or milk from California.

Main Street Game

Grades:

6th-12th, Adult

Objective:

- Students will discover how a community can work to support a self-sustaining local economy.

Method:

- Students will construct a balanced local economy in order to provide for the needs of its inhabitants while promoting the preservation of its natural resources.
- Students will act as town planners and choose among different businesses and housing options in order to create the most sustainable community possible.

Materials:

- Choice Cards (attached)
- Pencils
- Poster Paper
- Box of crayons (or assorted highlighters)
- Main Street Maps (attached google maps)

Time:

Preparation Time: 30 minutes
Class Time: 60 minutes

Prep:

- Make copies of the Main Street Maps (attached google maps) 1 for each student.
- Make copies of Choice Cards for each group. (Attached).

Procedure:

Students will work in groups of 2-3 as city planners.

Background Info& Setup

- Generate short discussion with students.
    - Ask students to define the term "Blueprint". How would you create a blueprint for a community that hasn't been developed yet?
    - When developing a community from scratch is it better to have many houses close together, or fewer houses spread out over the land? Why?
    - It is better to have many stores owned by local residents that offer specific products or a single large store that offers all of those services in one place? Why?
- Have students each take a *Main Street Map*
    - Students complete the worksheet and give their opinions.
        - Does this community have development that makes money?
        - Does it use space wisely?
        - Does it support local residents?
    - What if we changed the term "Blueprint" to "Greenprint"?
        - What if the goal wasn't just to create a thriving community, but to create a thriving and environmentally sustainable community?
        - What other factors about businesses would have to come into play?
- Have students take a sheet of poster paper for each group. This will now be their "Community Greenprint." As students choose how to build their community they will sketch in on the poster paper.
    - The entire paper starts out as natural open space. It has not yet been developed. Students may draw roads, buildings, and farms on as they develop.
    - Begin by drawing 2 lines down the middle of the poster paper. This is now your main street and you will set up the community around it.

Building a Community

- Students determine what to develop in order to:
    - Meet the communities basic needs
        - Food, Water, & Shelter
    - Create an appropriate standard of living.
        - School, post office, hospital, fire department, pharmacy, open space.

Setting up Residence: Homes

- How will you choose to build homes for your residents?
    - Look at "Housing Options" cards as examples.
    - Building Community Housing complexes would mean less space has to be developed from the natural environment, and fewer access roads would need to be created between homes and main street businesses.

- Building homes with private space, and private yards are more desirable to many homeowners. The town can charge slightly higher taxes on these properties but more land will have to be cleared for large homes and roads.
- Students can sketch in their choices for residents into their *community greenprint*.

Setting Up Main Street : *Pick your businesses*

- Choose from the set of business cards. (*Teachers may make a required number of businesses to choose in order to limit time on this activity*).
  - Cards are sorted with icons
    - Food 
    - Shopping 
    - Pharmacy 
    - Local business 
    - Automotive 
    - Arts & culture 
    - Medical Service 
    - Salon 
    - Florist 
  - There are 2 “Other” business cards included that can be filled out by students. You may suggest a recycling facility or a wastewater treatment facility.
  - Choose the companies and businesses that you will allow in your community.
  - Each team member will vote.
  - Companies and businesses that are approved should be sketched into your *community greenprint*.
- Students work together to determine the best options for their community.
  - Which companies will help to create a network with other companies?
  - Which companies would out-compete other companies?
  - Which companies will employ local residents?

Community Proposals

- Take turns drawing the center “Proposal” cards and read one at a time.
  - Each member of the community will take a vote to pass or reject each proposal.
  - If a proposal is approved sketch it into your *community greenprint*.

Resisting consumer culture

- How will this town resist the incentives to over-develop?
- How can you generate local alternatives for products you wish to buy?

Extensions:

- Divide the class in half.
    - Have half of the students come up with a community blueprint that aims to have the most economically successful community.
        - How will those businesses make the most money?
    - The other half of the class will work on a community greenprint.
        - How will that community work to be economically successful but also limit it's impacts on the environment?

Assessment:

- Are students able to brainstorm a definition for "community greenprint"?
- Have students created a community sketch?
- Can students defend their choices for community businesses?
- Can students generate ideas for community sustainability that were not mentioned in the game?

Glossary of Terms:

Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth

by causing solar radiation to become trapped within the atmosphere.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
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Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

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Business Card

Hospital

This area needs a local hospital. It will employ residents for many different positions. It will feature emergency room services, a birthing center, intensive care unit, and space for regular doctors visits.

Business Card

Catskills Central School District

This area will need a school in order to attract families to the area. This school will have sports fields, a small garden greenhouse, and fleet of buses for students. This school will employ residents as teachers, aides, administration, and workers.

Business Card

Whale-Mart

This big box store is interested in coming to town! The store can offer the lowest prices around and sells a variety of goods including food, clothing, home décor, bed & bath, pharmacy, auto care, electronics, cleaning supplies, flowers and gifts. It offers a salon and restaurant.






Business Card

Burger Prince

A fast food chain wishes to put up a restaurant in town. This chain offers quick meals for eat-in dining, or pick-up. They also provide a space to throw children's parties.

Business Card

Horizon Wireless

A chain store for electronics wishes to open in town. It will offer electronic devices including cell phones and smart phones. It will also provide technical support for these devices. There is currently no cell-phone service in this area.

Business Card

Fire Department

A local group wants to join together to start a local fire department. This will employ residents, paying them an annual salary to be on call for fires in the immediate area. They will also provide training, and support to other local organizations.

Business Card

Pizza Place

A local family wants to open a pizza place. This restaurant will offer eat-in dining, take out, or delivery. They will serve pizza and other Italian Specialties. This company will contract with local farms for produce (when in season).

Business Card

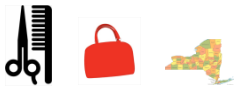
Auto Parts

A local family wants to open an Auto Parts store. They will service vehicles; do body work, and state inspections. They will train and hire locals, creating jobs.

Business Card

Catskills Salon

A local beauty-school graduate wants to open up a salon in town. The salon will offer all types of hair styling, nails, and tanning. It will also sell hair, nail, and tanning products.



Business Card

Movie Theater

A local arts group wants to manage a movie theater in town. This theater will screen new movies, as well as feature classic movie nights, live performances, and concerts. The theater can hold benefits for town causes.

Business Card

FLORIST

A local couple wants to open a florist business. The florist will contract with local farms and greenhouses in order to provide native plants year round. All of the scraps from the florist shop will be sent back to the farms to be used as compost.

Business Card

Drug Store

A local family wants to open up a drug store. Customers will be able to purchase health related items, cards, and pick up their prescriptions.

Business Card

Natural Food Store

A local group wants to open up a natural food store. Customers will be able to purchase food grown at local farms. They will also sell frozen food, and canned items like jam and honey from local farms.


Business Card

Specialty Store

A local artisan's guild wants to open up a specialty store. Customers will be able to purchase local gifts, many hand-made items, paintings, wood-workings, and knit items. Buying gifts here will support local artists in your community.



Business Card

Other _____

_____

_____

_____

_____

_____

Business Card

Other _____

_____

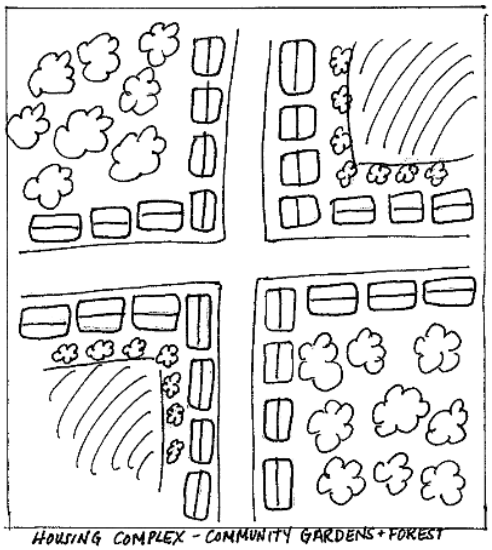
_____

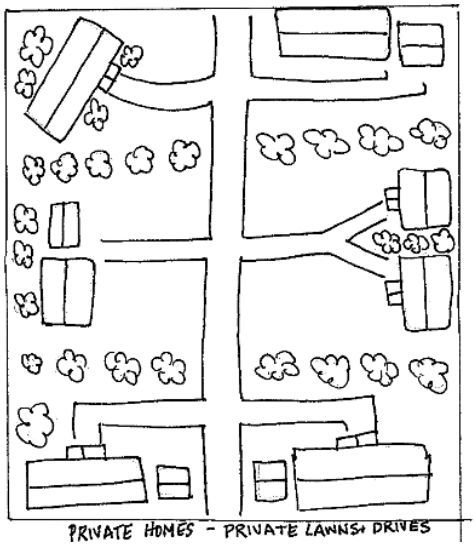
_____

_____

_____

Housing Proposal Cards: Copy, Cut, Laminate.





Proposal 1

Cell Phone Towers

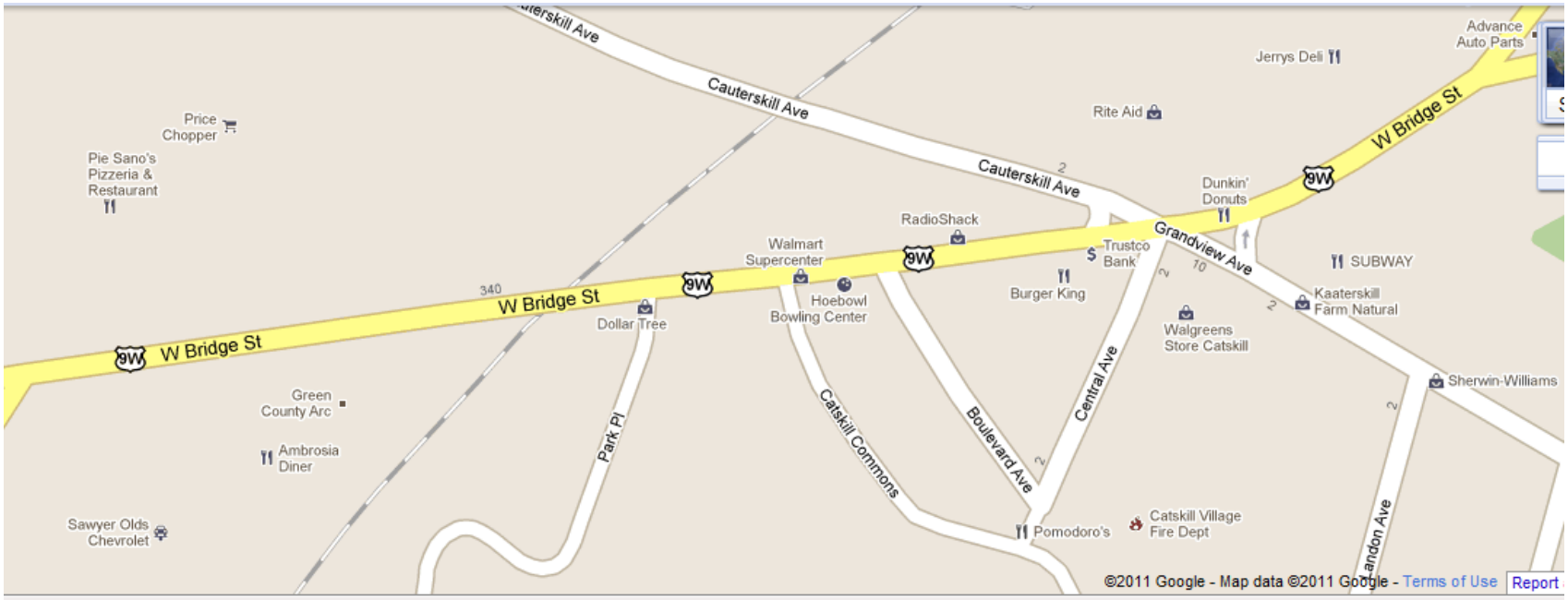
Installing cell phone towers will allow Catskill residents to communicate from nearly anywhere.

VOTE
Approve or Reject?

Proposal 2	Big Box Store A Big Box Store has offered to buy up some land to open a store with very low prices! They will hire people from the local community. VOTE Approve or Reject?

Proposal 3	Public Transit System Run a bus loop from the residential section to the center of town and charge a fare. Run the bus on biodiesel from local restaurant waste. VOTE Approve or Reject?

Main Street Map



Highlight in YELLOW all of the places where you could buy something to eat.

Highlight in GREEN all of the places where you could buy local farm produce.

Highlight in RED all of the places you could get your prescription filled.

Highlight in BLUE all of places you could purchase a clothing item.

Highlight in PINK all of the places where you could purchase electronics.

CIRCLE all of the locally owned businesses (not chain-stores).

<u>Does this community have businesses that make money?</u>

<u>Is this community sustainable?</u>

Food Miles

Grades:

6th-12th, Adult

Objective:

- Students will discover the journey that our food must first travel before ending up on our table.

Method:

- Students will document the travel of different examples of our food products and determine how much energy goes into each step of production of a food item.
- Students will then calculate the food miles that common food items have traveled and choose the most sustainable food options for their community.

Materials:

- Food Charts
- Pencils
- Clipboards
- Catskill Mountain Region Map
- World Map/ Globe
- Raw Materials Map (attached)
- Rulers
- Internet Access (optional)

Time:

Preparation Time: 10 minutes
Class Time: 30 minutes

Prep:

- Identify common food items to use as class examples.

Vocabulary:

Agriculture, Carbon Footprint, Conservation, Eco-Friendly, Environmental Impact, Fertilizer, Fossil Fuel, Greenhouse Gases, Natural Resources, Pesticide, Sustainability.

Procedure:

Food Miles Example

- Hold up a can of soda.
- Ask students: What did it take for this item to be ready to consume?
- Have students start at the beginning and brainstorm each step.
- Write this example down by writing each step first, and then the resources that were consumed at each step.
- Begin by looking up the ingredients.
- How many miles went into that soda?

can of soda				
	ingredient	**source**	**resources consumed**	**transportation**
can	metal	mined	water, fossil fuels	transported to soda factory
	ink	blended	water, chemicals	transported to soda factory
soda	carbonated water		water	
	high fructose corn syrup	corn	water, soil, fertilizer	transported to soda factory
	carmel color	blended	water, chemicals	transported to soda factory
	sugar	cane	water, soil	transported to soda factory
	phosphoric acid	mined	water, fossil fuels	transported to soda factory
	caffeine	plants	water, soil	transported to soda factory
	citric acid	fruit	water, soil	transported to soda factory
	natural flavor	plants	water, soil	transported to soda factory
Shipping	From distributor	to store	Address:	Somers, New York 10589

Complicated Products

- For products with many ingredients it may be nearly impossible to track down the location of where each ingredient was grown.
- In that case, you may only be able to identify the factory, distributor, or state where a product was grown.
- For those you can track the distance of the final shipping from that factory, distributor, or farm state.

- Use the internet to investigate the source of the ingredients companies use by going to different company websites. You may also be able to find the nearest distributor information listed here.

Group Work: *Investigate*

- Students work in groups of 2-3.
- Each group will choose a food item to use.
- Students work together to determine the journey of production that the item went through before it was ready to consume.
- How many miles did that food item travel?

Local Alternatives

- Are there local alternatives to products that travel far to reach us?
- Why don't people always purchase local foods?
    - New Yorkers have many choices for local foods.
    - We are especially successful growers of apples, milk, creams, cheese, honey, corn, pumpkins, tomatoes, and many other fruits and veggies in season.
    - The *in-season* part is what many consumers struggle with.
    - Technology has allowed us to ship food all over the earth while keeping it fresh.
    - So we are now able to eat strawberries and pineapples in February. Historically, people in our part of the world relied on preserving food during the abundant growing months.

Resisting food miles.

- Focusing on locally produced foods can boost our local economy while being a fresh and healthy base to our diets.
- Foods that are shipped great distances usually contain preservatives to keep them fresh.
- These highly processed foods are often much less healthy than raw foods.
- Brainstorm ways to eat locally year round! Try out these methods!
    - Buy local when it is fresh! Know your seasons!! Local food is fresher than the food at the grocery store, and it is often cheaper since it's price doesn't contain a shipping cost.
        - Waiting for local/seasonal food makes the experience rare, special, worth waiting for, something to look forward to all year long!
    - Canning: Preserving food can be fun and rewarding. Try canning tomatoes over the summer, for delicious sauce in the winter! Canning methods are pretty simple, although they take some practice.
    - Freezing: Many fruits are easily stored for the winter in the freezer. Picking many fruits while they are ripe (and often cheap) , thoroughly washing them, and

freezing them for winter is an excellent way to cut down on the food miles it would normally take to eat fruit in February.

Extensions:

- Food Mile Charades. Divide the class into 2 groups. Each half of the class receives an item that the other half of the class doesn't know the identity of. Each member of the team will act out their contribution to the production of that item. The other team will try to guess what each person on the other team is acting out. At the end the guessing team will get 1 final guess to see what the product was.
  Then the teams switch and the team that was first to act is now the guessing team.
  Example: Carton of Milk
  1. Cow Eating
  2. Farmer Milking the Cow
  3. Factory worker processing the Milk
  4. Truck driver transporting the milk to the store
  5. Store Clerk stocking milk on the shelf
  6. Person purchasing the milk
  7. Child at home drinking the milk and feeling healthy and strong.

- See Lesson 4: *Sustainable Agriculture & Forestry* Activity 2: *Community Supported Agriculture,* for the 100 Mile Challenge.

Assessment:

- Are students able to define products by what materials they are made from?
- Can students describe how food production uses resources?
- Can students think of ways to cut down on food miles?
- What are their local alternatives?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 1: Personal Health and Fitness
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 3: Mathematics
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding

Packaging: Grocery Store Field Trip

Grades:

6th-12th, Adult

Objective:

- Students will analyze characteristics about food product packaging in their local grocery store and form opinions based on the data they collect.

Method:

- Students take part in an organized scavenger hunt to analyze shipping and packaging attributes of common products at their local grocery store.

Materials:

- Question handout
- Pencil
- Clipboard

Field trip Alternative: "In-class Store Experience"

If the ability to coordinate a store field trip is not available you can recreate the store field trip in class.

- *Begin a week or two in advance by assigning "homework". Have each student bring the packaging from two food items to class.*
  - *Note: Students do not need to bring the actual item, only the packaging, but should be sure that items still have labels attached.*
  - *Bring extra items to ensure that there are enough well labeled items to complete the scavenger hunt.)*
  - *Include items that do not contain packaging, like fruit. Having students share these items at the end can make a fun addition to the debrief discussion.*

Potential List of items to create 'in-class' store experience:
Q.1.)Package of cookies/ 6 pack of plastic soda bottles,
Q.2.)Watermelon / 2 liter bottled soda,
Q.3.)Bag of chips /candy,
Q.4.)can of soup
Q.5.) box of cereal/ paper napkins.

Time:

Preparation Time: 30 minutes
Class Time: Field trip travel times will vary.

Scavenger Hunt: 20 minutes
Debrief & Sharing: 40 minutes

Prep:

- Contact the local grocery store to inform them of the class trip.
- Stores are usually accommodating to such requests.
- Ensure that your group of students can be trusted to represent your school in public.
- Extra chaperones may need to be contacted in order to gain trip approval by administrators.

Vocabulary:

Carbon Footprint, Compost, Conservation, Eco-Friendly, Ecosystem Services, Environmental Impact, Fossil Fuel, Greenhouse Gases, Natural Resources, Non-renewable Resource, Overconsumption, Renewable Resource, Recycle, Stewardship, Sustainability, Waste Products.

Procedure:

Prepare

- Divide students into pairs in which they can be trusted to act responsibly in public.
- Each pair of students will receive a clipboard, scavenger hunt handout, and a pencil.
- Review instructions to filling in the handouts before students get off the bus.

Scavenger Hunt

- Students will navigate through grocery store locating and listing items for each question.
- Students should use caution handling items and be sure to place items back where they were found when done obtaining data from their packaging.
    - Many items may not have to be handled to obtain data from their packaging.

Stop Time & Meeting Place

- Once students have filled out the front page of questions they may gather in the front of the store to wait for the rest.
- A 20 minute time limit should be sufficient for each group and they should meet at the front of the store after 20 minutes whether or not they have finished all of the questions on their sheets.

Debrief

- Students may complete the back page of their handout on the bus on the way back to school.
- Once back at school debrief the answer to each question.
- How did their answers differ?
- How were they similar?
- Students may present their new-and-improved packaging design in front of the class.
- How does the new product reduce the use of energy?

Extensions:

- Students may each re-draw / improve their sketch of a product with improved packaging for homework. Students may create a product poster with before and after sketches of the product. Students may come up with a 30 second commercial advertisement to read in front of the class to display the new-and-improved product.
- Students can create a "Wanted" and "Not-Wanted" style poster to display products that the class found to be efficiently packaged. This way 'model citizens' can reap the benefits of increased publicity in reward for their environmental ethics while, companies that poorly package their products can be encouraged to change using the purchasing power of consumers.
- Students can write a letter to a company that poorly packages an item. They can encourage them to change the product packaging to be less overall, more eco-friendly, made from recycled materials, or reusable. Be sure to include your ideas about the product with your letter.

Assessment:

- Are students able to define products by what materials they are made from?
- Can students describe how packaging uses resources?
- Can students think of ways to make packaging on food items more environmental friendly and efficient?

Glossary of Terms:

Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it

does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.
Waste Products: An unusable or unwanted material that is produced as the result of a process.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 3: Mathematics
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes

English Language Arts
Standard 1: Language for Information and Understanding

The Arts
Standard 1: Creating, Performing, and Participating in the Arts

Packaging

Store Trip Scavenger Hunt Worksheet

Brand……..Item Name……..Details

1.) Find an item with poor packaging.

_____

2.) Find an item with good packaging.

_____

3.) Find an item with non-recyclable packaging.

_____

4.) Find an item with recyclable packaging.

_____

5.) Find an item that contains at least 30% post-consumer material.

_____

6.) Find an item with reusable packaging.

_____

7.) Does this store sell reusable bags?

_____

8.) Find your favorite food or drink item. Does it have poor packaging or good packaging?

_____

Is it recyclable or non-recyclable?

_____

Does this new knowledge change your choice about buying this product?

_____

Brand……..Item Name……..Details

1.) Find another poorly packaged item.

_____

Sketch the item:

Give it an eco-friendly makeover!

Sketch the new design:

What did you change about the item? _____

_____

The Waste Stream

Grades:

6th-12th, Adult

Objective:

- Students will discover how much waste can actually be eliminated from its landfill destination with simple lifestyle changes.

Method:

- Students analyze their waste stream and determine how they can cut down on their contributions to the landfill.

Materials:

- Question handout
- Pencil
- Clipboard
- Internet Access
- Hanging Scale

Potential List of household items for decomposition activity:

Aluminum Can
Glass Bottle
Paper
Cotton Rag
Plastic Bottle
Newspaper
Apple Core
Banana Peel
Plastic bag
Styrofoam
Milk Carton
Cell Phone
CD

Time:

Preparation Time: 15 minutes
Class Time: 40 minutes

Prep:

- Cut out the labels for items and corresponding decomposition times.

- Laminate each label and place a piece of Velcro on each.
- Place 2 pieces of Velcro onto each household object from your sample waste stream.
- Download "The Story of Stuff: Electronics" from the following website to be played for the class. http://storyofstuff.org/electronics/

Vocabulary:

Carbon Footprint, Compost, Conservation, Eco-Friendly, Environmental Impact, Fossil Fuel, Greenhouse Gases, Natural Resources, Non-point Pollutant, Non-renewable Resource, Oil, Overconsumption, Pesticide, Point Source Pollutant, Renewable Resource, Recycle, Stakeholder, Stewardship, Sustainability, Vermicompost, Waste Products, Wastewater.

Procedure:

Designed for the Dump

- Write "Designed for the dump" on the board and ask students if they know what that could mean when talking about consumer products.
    - Explanation: Many of today's products are not designed to last. Instead they are "designed for the dump" meaning that they are easy to break, hard to upgrade, and impractical to repair. It is cheaper to replace the majority of goods we buy. It also allows companies to make more profit.
- Only 1% of the goods we buy are still in use 6 months after the purchase date in North America. We have become a disposable society.
- Have students watch this 10 minute video: "The Story of Stuff: Electronics" from the following website http://storyofstuff.org/electronics/
- It isn't just electronics, but they are a good example. Consider the following example with the following household materials.
    - *Activity*: Have students brainstorm 10 items that are "designed for the dump".
        - List may include: Mop, broom, paper towels, plastic bag, DVD player, coffee cup, toaster, etc.
    - Make a list of items. Next, list the reason they are usually replaced:
        - Cannot be upgraded
        - Cheaper to replace than to upgrade
        - Easy to break
        - Cannot be repaired
        - Goes out of style
        - Technology has made it unusable
    - Finally, list a probable lifespan for each either one-time-use, one day, one week, one month, 6 months, a year, 1-2 years, etc.
        - Plastic Bag – one time use
        - Coffee Cup – one time use
        - Mop – a year

- Toaster – not more than 5 years
- Coffee Maker – not more than 5 years
- Cell Phone – 2 years
- CDs & DVDs – 1-2 years
- Disposable Camera – one time use
- Plastic Bottle – One time use
- DVD player – not more than 5 years
- Inflatable pool – Not more than 5 years
- Squirt Gun – 1 year
- Computer – Not more than 5 years
- Plastic utensil – one time use

Optional Resources:
EPA poster for "Life Span of a CD or DVD: http://www.epa.gov/waste/education/pdfs/finalposter.pdf
EPA poster for "Life Span of a Cell Phone: http://www.epa.gov/waste/education/pdfs/life-cell.pdf

Sample Waste Stream

- Introduce the sample waste stream.
- Have students take the initial weight of the bag of waste using a hanging scale.
- Students identify common materials in the waste stream.
- Once identified we will try to break them down into groups in an effort to reduce the amount of waste that we create.

How Long Does It Take?

- Students match household items to laminated labels with Velcro to guess long each item takes to naturally break down in the environment.

Potential List of items:

Aluminum Can: 80-200 years
Glass Bottle: 1 million years
Paper: 2 – 4 weeks
Cotton Rag: 5 months
Plastic Bottle: 450 years
Newspaper: 6 weeks
Apple Core: 2 months
Banana Peel:2-5 weeks
Plastic bag: 10-20 years
Styrofoam cup: Unknown. Forever.
Milk Carton: 3 months
Cell Phone: Forever
CD: Forever

Additional Optional Materials:

Monofilament fishing line: 600 years
Disposable diapers: 450 years
Boot sole: 50-80 years
Tin can: 50 years
Leather: 50 years
Nylon fabric: 30-40 years
Plastic film canister: 20-30 years
Wool sock: 1-5 years
Plywood: 1-3 years

Waste Stream Break Down

- Now break the waste stream down into groups.

Group 1 – Recyclable materials. These are items that should never go into your waste stream! New York State recycles plastic of number 1 & 2. However, certain towns may be able to recycle many more varieties than that. You can contact your towns recycling company in order to find out what items may be recycled. Look for a tiny recycling symbol and a number on the bottom of plastic containers. You can also recycle glass, aluminum cans, cardboard, newspaper, and junk mail.

Group 2 – Compostable materials. These are items that do not have to go into your waste stream! Composting is easy and beneficial for the environment. Raw food scraps, peels, newspaper, coffee grounds, nut shells, egg shells, can be put into your compost. Composting allows waste to be naturally broken down, creating nutritious soil that can be used in the garden.

Group 3 – If you can't recycle it or compost it, it will probably end up in this group. This group includes things like plastic silverware, food wrapping, Styrofoam. There are simple ways to reduce the amount of waste that you produce by eliminating use of these products. Many of them are one time use.

Plastic silverware – use metal, wash, and reuse.
Plastic wrap / baggies – use Tupperware, wash, and reuse.
Styrofoam cup – use a travel mug, or water bottle, wash, and reuse.
Plastic bag – carry reusable bags instead

Have students eliminate all recyclable items, compostable items, and items that could have been reduced or reused. Weigh whatever is left and compare that to the initial weight taken. Do students note a large difference? How much weight was reduced from this sample?

REDUCE, REUSE, RECYCLE

- The 3 R's work wonders, in that order.
- The first way to trim your waste stream is to *REDUCE* the amount of waste you produce. It takes some thought and effort at first but it is easy to eliminate those pesky one-time-use items from your waste stream. Use reusable items! After a short time you won't even have to think about it, it will just be second nature to bring your mug or grocery bag! Reduce the amount of junk mail you throw away by unsubscribing to mailing lists that you don't use and opt to pay bills online.
- The second R is *REUSE*. It can be easy to find ways to reuse materials, instead of sending them to the landfill. In order to be green you should not have to worry about purchasing another water bottle, plastic utensil, paper napkin, or garbage bag. Find creative ways to use other materials, even before you recycle them. It is more efficient than buying something new, even if you recycled the first item.

- The third R is *RECYCLE*. In many places it is a requirement to recycle certain materials. There is a minimal effort required to locate recycling containers, clean container, and sort items. Recycling products reduces the need for the new raw materials it takes to make products from scratch.
- There are more than just these 3 R's to live by.
    - RESIST, or REJECT products that cannot be reused, recycled or that are produced by companies that do not actively try to lessen their environmental impacts.
- Provide students with a few simple tools to reducing their waste.
    - Reusable cloth bag, reusable water bottle, reusable coffee mug, Tupperware, hobo-tool (reusable fork & spoon), handkerchief, cloth kitchen towel.
    - Have them identify from the waste items which could be eliminated: plastic grocery bag, water bottle, paper cups, plastic baggies, plastic utensils, tissues, paper towels.

Extensions:

- *Consumer Throw Back*: Consumer products have changed drastically within the last 50 years. For homework have students interview a senior citizen in order to investigate what consumer products were like 50 -70 years ago. Were products reusable*?* Repairable? Recyclable?
    - Use the following list of products or generate your own:
        - Milk carton – were made of glass, cleaned and reused!
        - Mop – wood and cloth, longer lifespan than plastic and sponge.
        - Shopping Bag – Cloth: reusable indefinitely, paper – biodegradable.
        - Radio – repairable: probably by someone in your neighborhood.
        - Pair of socks: made of natural fiber (not synthetic) could be "darned" to fix.
        - Telephone – was repaired: probably by someone in your neighborhood.
        - Pair of shoes – how many did they have?
    - What are the lessons that we can learn from our ancestors? How can we apply these lessons to the products of today?
    - Have students share their responses during the next class.

- *Trashy Art Fashion Show*. Divide the class into 2 groups. Each group receives a mystery box of supplies, all of which are materials that could enter the waste stream. They also receive tools to use: scissors, and tape. Each team has 15 minutes to unpack their supply box and design an outfit with accessories and outfit a volunteer from the team to "model" the outfit while the designers explain their rationale for reusing the materials instead of

throwing them away.

Sample List of Materials:

Shoe strings	Milk carton
Plastic bags	Wrapping paper
Cloth pieces	Cereal box
Pool noodle	Etc.

NIMBY

- Write NIMBY on the board and inform students that the letter stand for something. Anyone know what it stands for?
    - Not In My Back Yard
- Meaning: This debate goes back in history to the very first manufactured item. Technology has allowed us to have any item we can imagine. But what to do with the waste? Not In My Back Yard says it all.
- Does anyone volunteer to make their back yard a landfill or toxic waste dump? But it must go somewhere. What are our solutions?
- How do citizens decide where our waste should be stored?
- Many of our landfills are reaching their storage limits. Where to go when those are full?
- Often states pay other states or other countries to take their waste. It can be trucked out of populated areas to the rural countryside or to the ocean.
- Many landfills produce a greenhouse gas called Methane. How can that affect our daily life?
    - *Activity:* Use your list of items that were "designed for the dump". Choose one to redesign in order to increase its lifespan or keep it out of the waste stream completely.
        - *Example:* Plastic bag, coffee cup, and plastic bottle: construct from biodegradable or from materials that can be used forever.

Assessment:

- Are students able to distinguish between different types of materials in the waste stream?
- Can students identify recyclable materials?
- Compostable materials?
- Can students brainstorm ways to reduce the amount they throw away?
- Can students think of ways to reuse materials that they would otherwise throw away?

Glossary of Terms:

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climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.

Compost: The decomposition of organic matter.

Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.

Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.

Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.

Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.

Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.

Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.

Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.

Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.

Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.

Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.

Point Source Pollutant: A pollutant that has a single traceable source.

Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

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Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

Vermicompost: A system of managing decomposition of organic matter using a worm bin.

Waste Products: An unusable or unwanted material that is produced as the result of a process.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.

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Standard 6: Interconnectedness: Common Themes

The Arts
Standard 1: Creating, Performing, and Participating in the Arts

Apple Core	Banana Peel
Milk Carton	Plastic Bag
Glass Bottle	Styrofoam Cup
Cotton Rag	Paper
Plastic Bottle	Newspaper

2-5 weeks	**3 months**
1 million years	**Forever**
2 months	**80-200 years**
2-4 weeks	**5 months**
10-20 years	**450 years**

Overconsumption

Grades:

6^{th}-8^{th}

Objective:

- Students will determine ways to serve human needs and maintain / improve the standard of living while creating a smaller footprint on earth's resources.

Method:

- Students will distinguish between different types of manufactured products: practical, pleasure premium, and display premium.
- Students will use their own consumption as a case study to identify ways they can cut their footprint.

Materials:

- Notebook Paper
- Pencil
- Consumer Item Cards (attached)

Time:

Preparation Time: 15 minutes
Class Time: 45 minutes

Prep:

- Make copies of consumer items for each student.
- Cut out items from sheet or have students cut them out.

Vocabulary:

Carbon Footprint, Compost, Conservation, Eco-Friendly, Environmental Impact, Fossil Fuel, Greenhouse Gases, Natural Resources, Non-point Pollutant, Non-renewable Resource, Oil, Overconsumption, Pesticide, Point Source Pollutant, Renewable Resource, Recycle, Stakeholder, Stewardship, Sustainability, Vermicompost, Waste Products, Wastewater.

Procedure:

Introduce Overconsumption

In the past 50 years humans have consumed more resources than in all previous human history.

The challenges for our future are:

- How to serve human needs and maintain / improve the standard of living while creating a smaller footprint on earth's resources.
- How to help consumers have a better array of choices and better information for making choices about what we buy.

Consumption: What we buy.

- The items we consume can be separated into 3 different categories.
- Have students organize the example items from their sheets into these categories.
  - Begin with a piece of paper.
  - Have students turn the page to landscape view and draw 3 columns.
  - In the first column write "practical items" and come up with a definition.
  - In the second column write "Pleasure Items" and come up with a definition.
  - In the third column write "display items" and come up with a definition.
  - Now organize the cut-outs into the correct columns.

Survival Items - _____	Pleasure Items - _____	Display Items - _____

- *Survival Items*: Survival Commodities that contribute to your basic quality of life.
  - Food, water, heating oil/firewood, basic clothing.
- *Pleasure Items*: Things you consume for your personal enjoyment. Often consumed privately.
  - Chocolate, magazines, bubble bath, extra soft toilet paper.

- *Display Items*: These are luxury items that are often used to signify wealth or status to others. They are often bought for how they look, because they are popular at the time or "in style", and are heavily advertised. These days, this category makes up the majority of what we buy.
    - Ipods, cell phones, elaborate clothing, numerous pairs of shoes, electronics, jewelry, perfume, fancy cars.
- Have students sort the cards and list each one into a column of their chart.
- Now have students draft a list of items from their daily lives and add them into these categories.
    - What items do they consume that fit into the Practical Items category?
        - These are items that they need for survival and probably use on a daily basis.
    - What items do they consume for pleasure?
        - These items are slightly more expensive versions of basic needs and are probably purchased occasionally.
        - Review examples: We require food but we don't require expensive chocolates. Bringing an energy drink instead of brining a reusable bottle of water from the tap. We all use toilet paper but we don't need the more expensive "extra soft" option.
    - What items do they consume for display?
        - These are those items that show wealth, status, your taste, or personality. (Review examples: high-tech cell phone, ipods, jewelry, trendy clothing & accessories).
            - When thinking about these items note that this category most quickly goes out of style and requires replacement.
            - Consumers generally upgrade their cell phone after 2 years for a newer model even if theirs is still functional.
            - Consumers get rid of clothing that has gone out of style within the past couple of years, even if it is still functional.
            - New trends emerge all the time. Keeping up with current styles uses a lot of resources!

Breaking the Consumer Cycle

- What we want.
    - Sustainable Products
    - Sustainable food supply chains
- How we do it?
    - Consumer info, education, and raising awareness
    - Resource efficiency and eco-innovation
    - Sustainability into planning and development

  - Integrated waste management

- Identify 1 item from the "pleasure items" category that can be eliminated from your footprint.
  - (Example: Instead of purchasing a personal magazine subscription, join a local library and share the subscription with others).
  - (Example: instead of buying new clothing at the mall, shop vintage clothing stores or do clothing swaps with friends).
- Identify 2 items from the "display items" category that can be eliminated from your footprint.
  - (Example: New video game release! – Instead of buying it, check it out from a local library, rent it from a movie store, or make a contract with friends to split the cost and share video games.)

Extensions:

- Take the *purchase pledge*! Student's can take a pledge and sign a contract not to buy pleasure items for 1 week and not to buy display items for 1 month. Instead of buying new items they can find ways to obtain personal enjoyment without consuming resources.
  - Take your dog for a walk and play fetch.
  - Hand-make gifts for holidays or special occasions by reusing materials that would normally end up in the waste stream. (Example: plastic bottle birdfeeder).
- *Trade Blanket:* If you and your friends find the urge to buy, instead host a trade blanket.
  - Each person brings an item that they wish to trade.
  - One person starts by placing their item in the center of the blanket.
  - Now, go around the circle clockwise.
  - Each person may choose to pass on the item or offer their item onto the blanket to bargain the trade.
  - The first person then can choose to trade with them or pass to the next person.
  - If the item is not tradable it can wait to try again after everyone has gone.
  - Each round everyone can choose to pass or to trade the item they have in their hands.

Assessment:

- Are students able to distinguish items that they really need from items that they want?
- Are students able to compare products to determine the most sustainable option?
- For those students who feel they need to consume resources, can they establish local options?

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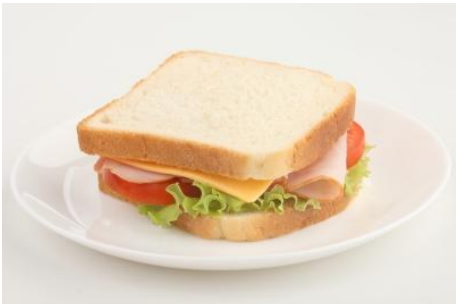

COURTESY: PROCTER & GAMBLE

Marketplace Ethics

Grades:

6th-12th, Adult

Objective:

- Students will discover "The Materials Economy" and how their consumption of goods is just one link in a global chain of events.
- Students will be become smarter consumers by discerning between products to find the most sustainable options available.

Method:

- Students will create a plan to manage their consumption to lead a more sustainable lifestyle.
- Students will make a list of criteria to look for when purchasing everyday products.

Materials:

- World Map
- Greenwashing Game
- Supermarket Label Cheat Sheet

Time:

Preparation Time: 10 minutes
Class Time: 45 minutes

Prep:

Create and print signs with images depicting the following terms: Extraction, Production, Distribution, Consumption, and Disposal of consumer products. Print an image of a radio for "Materials Economy" example.

Vocabulary:

Carbon Footprint, Compost, Conservation, Consumption, Disposal, Distribution, Eco-Friendly, Environmental Impact, Extraction, Fossil Fuel, Greenhouse Gases, Natural Resources, Non-point

Pollutant, Non-renewable Resource, Oil, Overconsumption, Pesticide, Point Source Pollutant, Production, Renewable Resource, Recycle, Stakeholder, Stewardship, Sustainability, Waste Products.

Procedure:

Introduction: Ask students what the definition of a consumer is?

- Students may define a predators ecological role in the environment. Have students think about how human beings consume (instructor may show them clues with images of dollar bills and shopping bags)
- Ask students how consuming resources differs between humans and the rest of the animal kingdom
    - Answers may include that most animals do not waste resources, they take what they need to survive, what is left is recycled back into the earth.
    - Inform students that Humans use of natural resources is much more complex, in fact it is an entire system.

The Materials Economy:

The *Materials Economy* refers to the system we currently use to produce consumer goods. It is composed of five different processes that are linked in a chain. (show terms and images on the board and have students come up with a definition for each term).

- Extraction
- Production
- Distribution
- Consumption
- Disposal

Extraction: The use of natural resources. All of the goods we buy are made of natural resources (wood, metals, plants, animal products, plastics, etc.) and they all required natural resources for their production and shipping (fossil fuels, water, etc). The natural resources that are ingredients for more complex products are often called "raw materials". Raw materials are harvested from the earth in order to be used (metals mined, wood cut, water collected).

For example, to create a radio; metals might be mined in South Africa, petroleum (oil) in the Middle East, and plastics produced in China.

Production: Once the raw materials are extracted they are joined together in factories to become finished goods. This can be a simple process done completely by human hands, or can involve toxic chemicals, and complex industrial factories.

Remember our radio? Once the raw materials were all extracted they may have sailed across the ocean to a factory for assembly in Mexico.

Distribution: Once finished goods are completed at the factories they must be sent to the store shelves.

Our radio travels from the factory in Mexico in tractor trailers to the shelves of a big box store.

Consumption: This is the ENGINE of the whole system. As we purchase items we create a demand, and production of that product continues.

We find the radio on the store shelf and purchase it for a great low price!

Disposal: Once we consume an item we discard the packaging that it came in, use the product until it serves its purpose, breaks, or goes out of style, then we discard it and get a new one.

Our radio may still be functional a year later, but we buy an ipod to take our music with us everywhere we go! The radio is taken to the dump where it is shipped somewhere else.

The Problem with our Materials Economy chain:

There are problems with this system at every link in the chain. At each stage of the link we hit LIMITS. (Ask students to identify limits at each stage of the chain).

Extraction: We cannot continue to extract raw materials at our current rate because our planet is running out of resources. Americans are using more than their share of natural resources. Currently the United States has 5% of global population, but we use 30% of the natural resources.

- We are able to use more resources than other countries because we have great wealth and prosperity, which is good. But, our wealth as a nation can allow us to forget how precious our natural resources are and take them for granted.

Production: Much of production uses toxic chemicals, creates waste, or relies on cheap labor. It often occurs overseas in undeveloped countries where people might not be fairly compensated for their labor or protected from the risks of using toxic chemicals. The nations might not be fairly compensated for the natural resources that were extracted, or the pollution that occurred to the remaining natural resources.

Consumption: The majority of goods that we currently buy are “destined for the dump”. The faster our goods have to be replaced the more goods we will ultimately consume over our lifetime.

- Planned obsolescence: Designing items that are hard to upgrade, easy to break, and impractical to repair. They require replacement…or buying more goods.
    - Examples include: Toaster, coffee maker, mop, plastic bag, coffee cup, camera, cds & dvds, cell phones, and computers.
    - 50 years ago items were saved by the "repair man". These days it is probably cheaper to replace items, while some can't be repaired at all.
- Perceived obsolescence: This is driven by media and advertisements. It convinces us to throw away stuff that is still useful…because it has gone "out of style".
    - Americans are targeted with over 3,000 ads per day. That is more than people 50 years ago saw in their lifetime!
    - We are convinced to "upgrade" to newer models or to buy new products based on fashion (ex. free cell phone upgrades).
- Why do we like to shop?
    - Humans have evolved to be choosy! Our ancestors evolved to distinguish between beneficial and harmful plants, flavorful and poisonous mushrooms, and judge the fittest mate.
    - These same traits may make us choosy when it comes to products as well.
    - The average American consumes twice as much as Americans did 50 years ago.

Disposal: **Only 1% of the total materials flowing through the entire chain are still in use 6 months after their purchase date in North America.** The other 99% has been discarded into the waste stream after use and was replaced by new stuff!

- Does recycling really help reduce waste?
    - YES! Recycling reduces the trash that is sent to landfills, AND it reduces the amount of raw materials that need to be extracted for new products.
    - BUT there is 70 times more waste created during production of a many goods, than there are left at the end of it's life. So recycling isn't enough to solve this problem.

Your local grocery store probably offers

- ~200 types of cereal
- ~50 types of toothpaste
- ~150 types of shampoo
- ~20 types of deodorant

Before you even pick an item up off the shelf, do you first think:

- What resources were used to create that item?

- How far was it shipped?
- Does it contain wasteful packaging?
- Can the item be reused?
- Can the item be recycled once its use has expired
- *How much time would it take to go shopping if we asked these questions for every product until we found the most sustainable item? No one has time to do this. Instead of setting up camp in the store while you take time to decide, learn to look for* ***consumer clues.***

3. *Breaking the Consumer Cycle*: ***Consumer Clues***

- Does consuming natural resources make us bad?
    - Take a class vote.
    - The ability to consume natural resources and live comfortably with items that we enjoy means that we are lucky enough to be prosperous. That is a good thing. We should however, keep a reverence for the items that we purchase by keeping in mind where the resources come from, and the process that items undergo before and after they reach us (along the materials economy).
- How do we know which items are produced with the impacts on the environment and people in mind?
    - Use the following chart of logos to translate what each means.

Extensions:

- Show 20 minute video clip. "The Story of Stuff". http://www.storyofstuff.com/
- Have students use the *"Translating Logos & Labels"* sheet next time they go to the grocery store.
    - For a homework assignment (or for bonus points), have students list any items they find with the featured labels. How many items can they tally?

Assessment

- Are students able to brainstorm 3 realistic ways that they can make their everyday consumption more sustainable?
- Can students distinguish items that they really need from items that they want?
- Are students able to compare products to determine the most sustainable option?

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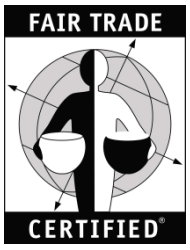
Translating Logos & Labels

- ☑ **USDA Organic** – The US Department of Agriculture has been around since 2002. To earn the label foods must be produced without the use of manmade pesticides (insect killer), herbicides (weed killer), fertilizers, or genetically modified seeds. Cows must have access to a pasture a minimum of 120 days per year. There are 4 tiers.

  - When 100 percent of the ingredients and methods are organic the product can be classified as 100% organic.
  - When at least 95 percent of the ingredients were organic it can be labeled "organic" but does not have the official seal.
  - When at least 70 percent of the ingredients were organic it can be labeled "made with organic" but cannot have the official seal.



- ☑ **Fair Trade** – This certification looks at economic, social, and environmental criteria: farmers are paid living wages and have safe working conditions; child labor is prohibited. Environmentally sustainable farming methods protect both habitat and farmer's health. Foods most well known for this label are coffee, tea, herbs, fruit, sugar, rice, vanilla, and chocolate.

☑ **Rainforest Alliance** – This certification aims to reduce water pollution and soil erosion, protect human health, conserve wildlife habitat, improve livelihoods, and reduce waste. More than 84,500 farms in South America, Southeast Asia, and Africa have been certified. The chief products include coffee, cocoa, tea, nuts, and fruits.

☑ **Food Alliance** - This logo requires that certifiers assess a farm or ranch in five areas: soil and water conservation; safe and fair working conditions for employees; limiting pesticide use and toxicity with integrated pest management; animal welfare; and habitat conservation.

☑ **Demeter Biodynamic –** This label also takes a whole farm approach. Not only does it require that foods be organically produced, without the use of man-made pesticides (insect killer), fertilizer, or animal by-products, it also prohibits the use of genetic engineering. It requires that 10% of a farms total land be set aside for fostering biodiversity and the humane treatment of animals. The focus is on whole-farm certification instead of one particular crop of area.

☑ **Salmon-Safe –** This certification goes to farms that protect salmon streams in the Pacific Northwest from farm runoff, chemicals, and erosion. To date is has accredited more than 60,000 farms and more than 200 vineyards.

☑ **Bird Friendly –** Developed by the Smithsonian Migratory Bird Center, this label certifies shade-grown coffee. Tree canopy height, plant diversity, shade coverage, and streamside plant borders must all meet specific criteria. Certified shade-grown coffee farms provide important sanctuaries for migrating birds.

☑ **Certified Human Raised and Handled –** This certification is supported by several animal welfare and food safety organizations including the ASPCA. It focuses on humane animal care standards, from birth through slaughter. For example, animals must be free to move about and "engage in natural behavior". This means chicken have room to flap their wings and pigs have space to move around and root. Cages, crates, and tie stalls are prohibited, as is the use of growth hormones.

☑ **Fish Wise –** This is a three tier system of color-coded labels that ranks seafood products according to sustainability criteria. The catch location and the fishing method – longline or hook and line – are also included on the label. FishWise is a program from Sustainable Fishery Advocates. Its researchers work with Monterey Bay Aquarium to evaluate sustainability. Each report is externally reviewed for scientific content and accuracy.

☑ **Non-GMO Project Verified –** This seal, one of the newer labels on food shelves, grew out of the public's frustration that GMO foods to not require labeling in the United States. Food carrying the label are made following "best practices of GMO avoidance" because of cross-contamination and pollen drift, it can't guarantee that a food is entirely free of genetically modified ingredients. Certification also requires genetic testing, to guarantee that product contains no more than 0.9% biotech material.

☑ **Healthy Grown Potatoes –** Working with the University of Wisconsin, the World Wildlife Fund, the International Crane Foundation, and Defenders of Wildlife, potato growers adopted a plan to reduce their overall use of chemicals and eliminate the highly toxic ones. To earn this certification, farmers must also restore some of their farmland to prairie or wetlands.

⇨BUYER BEWARE

⚠ **Raised without Antibiotics –** There is no verification system in place by the USDA to find out if antibiotics were used at any stage of production. Antibiotics could still be injected into chicken eggs before they are hatched and "raised" and they could still be labeled with this claim.

⚠ **Natural -** This label doesn't actually have to mean anything. In the supermarket these products are often kept near those that are USDA organic certified. The USDA has defined the term only for use on fresh meat. In this case, it is defined as nothing added to the cut of meat itself. As a result, you could have a cloned animal eating genetically modified food and being fed antibiotics every day and the product could still be called "natural".

⚠ **Free Range –** According to the USDA all a farmer has to do to claim "free range", or "free roaming" is show that the poultry has been allowed access to the outside. The animals may get only short periods outside in a cramped area, even 5 minutes is adequate to approve use of this claim. There are no restrictions on what poultry can be fed. When it comes to beef and egg-laying hens the term is completely unregulated.

⚠ **United Egg Producers Certified –** The logo, devised by the United Egg Producers, falsely implies that the chickens have been treated humanely. In fact, they have cramped cages, starvation-based molting (to increase egg laying), dehydrated birds, denial of veterinary care.

⚠ **American Humane Certified –** A program of the American Humane Association, this label permits both caged and cage-free options for egg-laying hens. A caged hen can live in a space the size of a sheet of paper. Forced molting through starvation is prohibited, but beak cutting is allowed.

⚠ **Dolphin Safe -** This is a partially certified claim because the National marine Fisheries Service verifies only tuna caught from a specific region – the eastern tropical Pacific Ocean – and not all tuna. Tuna from this designated area might bear a label that includes the additional phrase "US Department of Commerce". Tuna caught outside this area have no universal standards for verification.

⚠ **Grass Fed –** This label would seem to mean that a cow ate only grass. But all cows eat grass when they are young. So greenwashers can legally put this label on beef from a conventional feed lot. Make sure the label states "100% grass fed". Also look for the USDA Process Verified Shield.

⚠ **Nutri Clean Residue Free Certification –** Doesn't actually mean that pesticides were used to grow the food. It sets standards for how much trace of pesticide can be found on certain foods, which isn't usually less than the EPA grants. So really it isn't very different from the conventional brand.

⚠ **Marine Stewardship Council –** Scientists argue that many of the fisheries carrying this label have gone through drastic decline in recent years. Also some destructive methods of fishing such as bottom trawling still receive this label.

FALSE ADVERTISING?

- The following labels have no standards, definitions, or method of verification. Therefore, they can be put onto any product without repercussions. The use of these vague labels doesn't mean that a company isn't looking to be ecologically responsible. It does mean however, that further regulation needs to be done on labeling our nation's food.

- **X** Cruelty Free
- **X** Cage Free
- **X** Environmentally Friendly
- **X** Nature's Friend
- **X** No chemicals
- **X** Vegetarian Fed

Supermarket Smarts - Cheat Sheet

✔ WHAT LOGOS MEAN

USDA Organic

- ☒ **NO** manmade pesticides
- ☒ **NO** herbicides
- ☒ **NO** fertilizers
- ☒ **NO** genetically modified seeds
- ☑ Cows must have access to a pasture a minimum of 120 days per year.

Fair Trade

- ☑ Socially responsible
- ☑ Environmentally sustainable farming methods
- ☑ Protect both habitat and farmer's health.
- ☑ Products include coffee, tea, herbs, fruit, sugar, rice, vanilla, and chocolate.

Rainforest Alliance

- ☑ Conserves wildlife habitat
- ☑ products include coffee, cocoa, tea, nuts, and fruits.

Food Alliance -

- ☑ soil and water conservation
- ☑ safe and fair working conditions
- ☑ animal welfare
- ☑ habitat conservation.

Demeter Biodynamic

- ☑ Whole farm biodiversity
- ☑ Organic
- ☑ No genetic engineering

Salmon-Safe

- ☑ Farms protect salmon streams from farm runoff, chemicals, and erosion.

Bird Friendly

- ☑ Certified shade-grown coffee
- ☑ Habitat for migrating birds.

Certified Human Raised and Handled

- ☑ animal care standards, from birth through slaughter.

Fish Wise

- ☑ Sustainable fish population
- ☑ Non-destructive fishing methods

Non-GMO Project Verified

- ☑ GMO avoidance

Healthy Grown Potatoes

- ☑ Eliminate toxic chemicals to support wildlife
- ☑ Restoration of habitat

Human Population

Grades:

6^{th}-12^{th}

Objective:

- Students will discover the challenges faced with an ever-growing global population and the choices that they have to maintain quality of life as resources become more limited.

Method:

- Students will use information systems to analyze facts about current global human populations.
- Students will brainstorm options for using technology to use existing resources wisely.

Materials:

- Internet Access
- National Geographic Insert: *The Face of Seven Billion*

Time:

Prep Time: 10 minutes
Class time: 40 minutes

Prep:

- Research National Geographic Issue: The Face of Seven Billion.

Vocabulary:

Agriculture, Carbon Footprint, Carrying Capacity, Compost, Developed Countries, Developing Countries, Eco-Friendly, Ecosystem Services, Environmental Impact, Fossil Fuel, Green Energy, Greenhouse Gases, Natural Resources, Non-renewable Resource, Oil, Overconsumption, Renewable Resource, Recycle, Stakeholder, Stewardship, Sustainability, Tragedy of the Commons, Waste Products.

Procedure:

1. *Human Population*.

- Using reliable internet sources, have students determine.
  - What is global population currently?
    - Use a population clock (made available by the census bureau) http://www.census.gov/main/www/popclock.html
    - By 2011 we will have a global population of 7 billion. It is nearly impossible to imagine how large of a number 7 billion is. Read students facts from the handout "How Big is 7 Billion?"
  - How quickly is the global population growing?
    - http://www.ibiblio.org/lunarbin/worldpop
    - http://www.worldometers.info/population/
    - http://www.worldometers.info/
  - In what countries are populations growing most rapidly?
    - http://www.geohive.com/earth/population1.aspx
    - http://www.nationsonline.org/oneworld/world_population.htm
  - In what countries are populations growing more slowly?
  - Are there any countries where the population is decreasing?
    - If the world is broken up into 4 income levels:

The World of Seven Billion				
Income Level	Low Income	Lower Middle	Upper Middle	High
$	$995 or less a year	$996 to $3,945	$3,946-$12,129	$12,196 or more
Population	1 billion	4 billion	1 billion	1 billion
Pop. Increase This Year	22,700,000 (That's like Australia!)	50,800,000 (That's like everyone in the world that died in WWII!)	9,600,000 (That's like Sweden!)	3,900,000 (That's like Puerto Rico!)

  - What are developed countries? What are developing countries?
- Why are population rates in developed countries different from those in developing countries?
  - Have students brainstorm answers and explain. Also, include and review the following examples.
  - *Current Population* – Developing countries have higher overall populations currently, having more women of reproductive age creates a larger base to grow from.
  - *Education* – Increases in education affect not only economic development but population: The more education a woman receives, the fewer children she is likely to bear. This is because with education comes more opportunity to become employed.

- *Infant Mortality* – More children under 5 die in developing countries due to poor sanitation, lack of health care, and lack of resources. Women in these countries are likely have more children expecting that not all may survive to adulthood.
- *Family Planning* – Developing countries have less access to birth control methods than developed countries. Religious and social obligations also prevent the use of birth control in many countries. Women that use birth control methods have fewer children than those who do not.

- What can be done in countries where birth rates are high and the current population is already struggling to use limited resources?
  - Have students brainstorm ideas and explain. Also, include and review the following examples.
  - Education and distribution of birth control are most effective methods. Developed nations must be careful to respect cultural and religious tradition when offering this type of assistance to developing countries.
  - *"JUST ONE"* An ideology where parents, or sometimes governments (China) decide that there are only enough resources to adequately provide for one child per couple.
    - In a population of 1 billion people, (without immigration) the population would be cut in half with one generation if each couple chose to only have one child.
    - Class Poll: Do you think it is a responsible personal choice to have only one child, in an effort to reduce the pressure on limited resources?
    - Class Poll: Do you think the government should be able to limit the number of children that a woman can produce in an effort to reduce the pressure on limited resources?
    - Class Poll: What if you lived in a nation where the majority of the population was malnourished, lacked basic medical care, lacked proper sanitation, and was struggling over limited resources?
- National Geographic: The Face of Seven Billion
  - National Geographic. March 2011 Issue. Cover story: *Designing the perfect pet.* Contained a poster insert: "*The Face of Seven Billion*".
  - Obtain the insert and determine which nations are contributing most to the global population, and which nations are consuming the most resources per person.

2. *Environmental Consequences of Unlimited Growth.*

- Why should we be concerned about population growth?
- What are the environmental impacts of each woman on earth having 10 children that survive in excellent health?
- What is a carrying capacity?

- Refers to the population of an organism that can be sustained in a given environment without degrading the resources available.
- Once a population increases above the carrying capacity, resources are consumed without replenishment, and the population decreases due to lack of resources.
- Human populations have risen far above this level by modifying their environment, but human population growth is not unlimited.

3. Environmental Solutions

- What can we do to help our environment handle the demand for resources from an ever growing population?
  - Have students brainstorm solutions to meet our:
    - Energy needs
    - Need for food
    - Need for clean drinking water
    - Need for open space & natural areas for wildlife.

Extensions:

- Have students use trusted internet sources to look up demographics for the town that they live in.
  - What is the current population?
  - How much has the current population increased or decreased in the past 10 years?
  - What is the average size of the household in their town?
  - What was the average size of the household 10 years ago?
- Have students use trusted internet sources to compare their towns demographics to a city in a developing country.
  - What is the current population?
  - How much has the current population increased or decreased in the past 10 years?
  - What is the average size of the household?
  - What was the average size of the household 10 years ago?
  - How do these demographics differ from their town?
  - Why? Brainstorm reasons.

Assessment:

- Are students able to define developing, and developed countries?
- Are students able to determine the environmental consequences for unlimited population growth?
- Are students able to offer socially responsible and culturally sensitive solutions to global overpopulation?

Glossary of Terms

Agriculture: the production of food and goods through farming
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Carrying Capacity: Refers to the population of an organism that can be sustained in a given environment without degrading the resources available. Once a population increases above the carrying capacity, resources are consumed without replenishment, and the population decreases due to lack of resources. Human populations have risen far above this level by modifying their environment, but human population growth is not unlimited.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Developed Countries: Highly industrialized countries with a high average income.
Developing Countries: A nation with a relatively low level of industrialization and often characterized by a reduced standard of living.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.
Ecosystem Services: Processes supplied by natural ecosystems such as carbon sequestration and erosion control.
Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy

source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.

Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.

Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.

Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.

Sustainability: The idea of obtaining energy from resources that will not run out (either because they are unlimited or renewable) that do not damage to the environment to obtain or use.

Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.

Waste Products: An unusable or unwanted material that is produced as the result of a process.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 1: Personal Health and Fitness
Standard 2: A safe and Healthy Environment
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 2: Information Systems
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Don't even try counting to seven billion!

Even if each number took only 1 second, and you didn't lose your place, it would take more than 2 centuries to count that high!

7 Billion text messages

Number send in the U.S. every 30 seconds. That's about 65,000 every second. No wonder our thumbs are tired!

How Big is Seven Billion?

7 Billion Steps

Would take you around the earth 133 times. You could also walk the entire Appalachian Trail 1,500 times.

Wait, How many pairs of boots is that?

7 Billion Years

Half the age of the universe.

7 Billion Seconds

Guess what, the U.S. was ratifying the Bill of Rights 7 billion seconds ago.

Mozart died 7 billion seconds ago.

Vermont became a state. 7 billion seconds ago.

Think Globally, Act Locally

Grades:

6th-12th, Adult

Objective:

- Students will determine how to use information that they have gathered from the previous lessons in this curriculum to create a sustainability plan and come up with a new blueprint for everyday action entitled: "Sustainable YOU".

Method:

- Students will use information from previous lessons and their available resources to draft a sustainability blueprint for everyday action in their life.

Materials:

- Handouts / Notes from previous sustainability lessons
- Blueprint Paper
- Internet Access (optional)

Time:

Prep Time: 10 minutes
Class time: 40 minutes

Prep:

- Make copies of blueprint paper, one (or more) for each student.
- Provide supplemental handouts from previous lessons if students do not have notes to refer back to.

Vocabulary:

Agriculture, Agritourism, Carbon Footprint, Compost, Conservation, Eco-Friendly, Environmental Impact, Fertilizer, Fossil Fuel, Green Collar Jobs, Green Energy, Greenhouse Gases, Natural Resources, Non-point Pollutant, Non-renewable Resource, Oil, Overconsumption, Pesticide, Point Source Pollutant, Renewable Resource, Recycle, Riparian Buffer, Runoff, Solar Power, Stakeholder, Stewardship, Sustainability, Tragedy of the Commons, Waste Products, Wastewater, Watershed.

Procedure:

Big Changes Start with Small Steps!

- Have students reflect on the sustainability lessons that they have received.
- How can students make changes in their lifestyle that will help them to live sustainably and reduce their environmental footprint in each of the following areas:
    - Energy Usage
    - Water Usage
    - Agriculture & Forestry
    - Living & Shopping
- The following are just some examples. Students answer may include, but are not limited to:
    - Energy Usage
        - Remember it takes energy to heat water!
            - Take shorter showers!
            - Wash clothing in cold water.
            - Hand-wash dishes (instead of using the dishwasher).
        - Research alternative energy incentives, like tax credits for wood stoves, or geothermal heat installation.
        - Remember it takes energy to ship products that we buy.
            - Buy local products whenever possible
            - Carpool
            - Run all errands in one trip from home.
        - Reduce your junk mail by unsubscribing to mailing lists online (c3.newdream.org) or on the phone. → The annual U.S. production of junk mail consumes more than 100 million trees, enough to deforest four Rocky Mountain National Parks.
    - Water Usage
        - Remember it takes water to produce & ship every product you buy!
            - Buy local products when available.
        - Tighten your tap
            - Repair leaky faucets!
        - Do you need to use drinking water?
            - Setup rain barrels to collect rainwater for household chores, watering the garden, and washing the car, even flushing the toilet.
    - Agriculture & Forestry
        - Eat local foods → the average food travels 1,200 to 2,500 miles from pasture to plate!

        - Take advantage of local CSA's, farmer's markets, farm stands, and U-pick orchards.
        - Manage forests for timber as well as wildlife requirements!
        - Start a compost pit to recycle organic waste!
    - Living & Shopping
        - Bring your own bag → Worldwide, over one million plastic bags are used per minute!
        - Buy things because you NEED them, not because they are on sale!
        - Choose to buy products with efficient packaging!

Everyday Action Blueprint

- Have students fill out a sustainability plan on the blueprint paper provided.

Extensions:

- Have students use their blueprint as models for other students to use.
    - Modify their personal blueprint into informative flyers to hang around the school and neighborhood. Bonus points for using scrap paper to make the flyers!
- Have students work in groups to create a blueprint of everyday action for their entire school.

Assessment:

- Are students able to draft a sustainability plan?
- Are students able to set realistic goals that will generate significant outcomes?
- Are students motivated to take responsibility over environmental issues in their world?

Glossary of Terms:

Agriculture: the production of food and goods through farming
Agritourism: Agricultural based activity of operation that brings visitors to the farm or ranch.
Carbon Footprint: A measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc. The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of tonnes (or kg) of carbon dioxide equivalent.
Compost: The decomposition of organic matter.
Conservation: A wise use of limited natural resources, to ensure that some are preserved for future generations. The conservation of a non-renewable resource simply slows the rate at which it runs out, it does not prevent it from running out.
Eco-Friendly: Also called environmentally friendly, this can describe a product or way to obtain energy that has a lower impact on the earth than conventional methods.

Environmental Impact: This is the effect that occurs when natural resources are used and the natural ecosystem is modified in some way.
Fertilizer: A chemical nutrient that is added to agricultural crops of sports fields to promote plant growth. These nutrients can also cause huge aquatic plant blooms if the chemical seeps into water ways.
Fossil Fuel: Fuels like oil, natural gas, and coal that were formed over millions of years in the earth. Fossil fuels were formed from the carbon in ancient organisms that did not properly break down after death. The carbon was trapped in the earth and is now mined and burned for energy. Fossil fuels are a non-renewable resource, meaning that there is a fixed amount of them available in the earth and once that supply is used up it is gone forever.
Green Collar Jobs: These are jobs in the workforce that promote environmentally friendly business such as wind power, solar power, or hydro power.
Green Energy: Often associated with renewable resources, these are environmentally friendly methods of obtaining energy, that do not involve burning fossil fuels, or creating hazardous waste products. Examples include solar energy and wind energy.
Greenhouse Gases: Gases that occur naturally on earth, but in large amounts cause warming of the earth by causing solar radiation to become trapped within the atmosphere.
Natural Resources: A general name for the things we use from the earth to obtain energy. Can be fossil fuels, wood, water, air, animals, plants, etc.
Non-point Pollutant: A pollutant that does not have a single traceable source, usually it originates from more than ones source.
Non-renewable Resource: A resource (such as fossil fuels) that occur in fixed amounts on earth. Once they have been used up they are gone forever.
Oil: Also called petroleum. Oil can be as thick and black as tar or as thin as water. See Petroleum.
Overconsumption: The rapid decline of global resources due to factors including overpopulation, over production of goods, and waste of reusable materials.
Pesticide: A chemical that is applied to agricultural crops and sports fields to kill pest insects feeding on the plants. This chemical can be hazardous to beneficial insects, invertebrates, and fish if it seeps into a water supply.
Point Source Pollutant: A pollutant that has a single traceable source.
Renewable Resource: An energy source that does not occur in a fixed amount on earth. This energy source can be regenerated, or will not run out. Examples are solar energy, wind energy, and geothermal energy.
Recycle: The ability to melt down products into their raw materials and make something new. It requires less energy than to mine for raw materials and produce products for the first time.
Riparian Buffer: A protective strip of land or timber adjacent to a waterway.
Runoff: Water that falls from precipitation and washes into a body of water, washing anything in its path into the water.
Solar Power: A renewable resource that is harnessed from the sun's rays. This energy from the sun is used to create electricity, heat homes, and heat water.
Stakeholder: A person or group of people that have a stake in the outcome of a decision. They will be affected by what happens to their environment.
Stewardship: Is the idea of carefully and responsibly managing a resource to ensure it's existence for future generations.
Sustainability: The idea of obtaining energy from resources that will not run out (either because they are

unlimited or renewable) that do not damage to the environment to obtain or use.
Tragedy of the Commons: A debate that confronts the degradation of shared resources without regulation.
Waste Products: An unusable or unwanted material that is produced as the result of a process.
Wastewater: water that is used domestically and industrially, as well as runoff from roads, parking lots and rooftops that has come in contact with human products.
Watershed: The entire area of land that collects and transports precipitation into a water supply.

NYS Learning Standards:

Health, Physical Education, and Family and Consumer Sciences
Standard 3: Resource Management

Mathematics, Science, and Technology:
Standard 1: Analysis, Inquiry, and Design
Standard 2: Information Systems
Standard 4: Science
Standard 5: Technology
Standard 6: Interconnectedness: Common Themes
Standard 7: Interdisciplinary Problem Solving

English Language Arts
Standard 1: Language for Information and Understanding
Standard 3: Language for Critical Analysis and Evaluation

Sustainability Plan
Everyday Action Blueprint

Energy Usage:

Water Usage:

Agriculture & Forestry:

Living & Shopping: