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Alternative Energy

What

Alternative energy is energy that comes from sources other than fossil fuels (oil, coal and natural gas). Most alternative energy sources are also renewable sources and are less polluting than conventional sources. Renewable energy comes from sources that are replenished naturally. Renewable energy sources include:

- Solar Energy
- Wind Energy
- Geothermal Energy
- Bioenergy
- Hydropower
- Ocean Energy
- Hydrogen & Fuel Cells

Nuclear energy is an alternative energy source that is not generally considered renewable. In the future, there may be nuclear technologies that can be considered renewable, but, currently, nuclear power is produced from uranium, which is not a renewable.

So What

The use of alternative energy technology has increased in recent years: however, over 80% of the energy used in the United State still comes from fossil fuels. Fossil fuels make up over 80% of the energy used for transportation and over 70% of the energy used to produce electricity. Based on current usage, it is projected that we will exhaust the Earth's supply of fossil fuels by the end of the century. As non-renewable energy sources become scarcer, cost will increase and control of the dwindling supply will become even more important than it is now. Improvements in alternative energy technology and availability will help to counteract these negative economic and social impacts.



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Fossil fuels are also a major source of pollution. The mining, refining, transporting and burning of fossil fuels all produce environmental pollutants. Over the last 40 years, scientists have become increasingly concerned about the climatological effects of fossil fuel usage. When fossil fuels are burned, they produce a number of gases, including carbon dioxide. Over the last 150 years, burning fossil fuels has resulted in more than a 25 percent increase in the amount of carbon dioxide in our atmosphere. Carbon dioxide traps energy in the form of heat in the atmosphere. As the amount of carbon dioxide increases, so does the temperature. Since the late 1800s, the average global surface temperature has risen 0.5-1.1 degrees Fahrenheit (0.3-0.6 degrees Celsius). If this trend continues, the impact of the global climate change will be immense, glaciers will melt causing sea-levels to rise and permanently flood coastal areas, warmer ocean temperatures will cause altered weather patterns, including drought, heat waves, and more powerful storms. Alternative energy sources do not produce greenhouse gases such as carbon dioxide.

Now What

Alternative energy technology can be incorporated in a variety of Service-learning opportunities. Students can assist homeowners by providing information on alternative energy options such as solar, geothermal and bioenergy and help them explore financial assistance programs.

Students can work school administration to incorporate biodiesel and solar technology into the school's energy plan. They can research and develop a plan for using electric, hybrid-electric, and eventually, hydrogen fuel cell vehicles as part of the school systems transportation plan.

Students can participate in challenges, such as the Junior Solar Sprint, to design and build solar-powered devices and share what they have learned with younger students.

For more information about alternative energy, visit:

<http://www.renewableenergyworld.com/rea/tech/home>

<http://www.greenelectricityguide.com/types-of-renewable-energy-a-cost-comparison>

<http://www.epa.gov/cleanenergy/energy-and-you/affect/index.html>

<http://energy.gov/science-innovation/energy-sources/renewable-energy>

<http://www.eia.gov/kids/index.cfm>

<http://greenliving.nationalgeographic.com/green-energy/>

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Spinning Wheels: Hydroelectric Generators

Grade Levels: 6 – 12

Objective: To investigate hydroelectric energy technology by building model hydroelectric generators and exploring the factors influencing the energy output of hydroelectric generators.

Standards:

National Science Education Standards

Unifying Concepts & Processes; Standard A - Science as Inquiry; Standard B - Physical Science; Standard E - Science & Technology; Standard F - Science in Personal and Social Perspectives; Standard G – History and Nature of Science

National Council of Teachers of Mathematics Standards

Numbers & Operations: 6-8; Algebra: 6-8; Measurement: 6-8; Problem Solving: 6-8; Communication: 6-8 National Educational Technology Standards

National Educational Technology Standards

Standard 1 - Creativity and Innovation; Standard 3 - Research and Information Fluency; Standard 4 - Critical Thinking, Problem Solving, and Decision Making

Virginia Standards of Learning

Science: 6.1, 6.2, 6.5, 6.9, PS.1, PS.6, PS.11, E.S.1, ES.11

Mathematics: 6.6, 6.7, 6.14, 7.3, 7.12, 8.3, 8.13



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Maryland State Curriculum (Grade 6-8)

Science: 1A, 1B, 1C, 1D, 5.A, 5B, 5C, 6A

Mathematics: 1.B, 4.A, 4.B

Technology Education: The Nature of Technology, The Impacts of Technology, Engineering Design and Development,

Background: Energy from rivers and streams has been used for centuries to power waterwheels and mills. Hydroelectric generators use the energy in the moving water to produce electricity and are an example of a renewable resource. The first hydroelectric in the United States was built in 1882 and continue to be an integral part of our country's energy policies. Hydroelectricity can be produced from water stored in large reservoir that is released to flow through electricity producing turbines or from a run-of-the-river facility that diverts river water through channels into the hydroelectric plant and returns the water to the river after it has past through the turbines. Pumped storage facilities a pumped storage water from a lower reservoir to an upper reservoir during period of low electricity demand. When electrical demand is high, the water is released back to the lower reservoir to generate electricity.

Vocabulary:

Ampere's law: Electric current makes a magnetic field

Faraday's law: Changing magnetic field makes an electric current

Generator: a machine that converts mechanical energy into electrical energy

Hydrogenerator: a machine that converts the mechanical energy of water power into electrical energy

Materials:

For each Group:

1 Plastic Jug (one gallon)

4 High-Temperature Ceramic Disc Magnet (5/8' diameter)

8 Plastic Spoons

1 Cork

20 cm long ¼" Wooden Dowel Rod

50 m Enameled Copper Wire

4 Brass Paper Brads

2 one cm pieces of ¼" diameter clear tubing

Cardboard Rectangle for making wire coils

1 piece of Foamcore (22 cm X 30cm)

Scissors

1 AC Multi-meter

1 Copy of Build Your Own Hydroelectric Generator downloaded from: <http://www.re-energy.ca/docs/hydroelectric-generator-cp.pdf>



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Materials (Continued):

Tools

Glue Gun with Glue Sticks

Wire Cutters

Sand Paper

Electrical Tape

Matches / Candles

Utility Knife

Faucet with Running Water

Drill with .25" Bit

Suggested suppliers

<http://www.mcmaster.com/>

Enameled Copper Wire – Item # 7588K77

Plastic Jug -Item # 46125T7

¼" diameter clear tubing - Item # 5006K57

High-Temperature Ceramic Disc Magnets-
Item # 5857K18

<http://www.mcgillswarehouse.com/>

Cork – Item # 9566K29

AC Digital Multimeter - Item # DT9207A

Procedure:

1. Class discussion:
 - a. What is hydropower? How has hydropower been used throughout history?
 - b. How does hydropower utilize kinetic and potential energy to produce mechanical and electrical energy?
 - c. How is hydroelectricity different from hydropower? How is hydroelectricity produced?
 - d. How are Ampere’s law and Faraday’s law related to generators and electricity production?



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2. Construct the hydroelectric generator as described in “Build Your Own Hydroelectric Generator” downloaded from: <http://www.re-energy.ca/docs/hydroelectric-generator-cp.pdf>
3. Experiments with the hydroelectric generator
 - a. Experiment 1
 - i. Connect the multi-meter to the loose ends of the copper coils and set it to measure 2V AC.
 - ii. Place the finished mechanism under a running water source so that the water is flowing into the bowl of the spoon and turns the turbine
 - iii. Record the voltage that is produced.
 - iv. Repeat experiment using three different flow rates and record the voltages produced.
 - v. Use the data recorded to plot a graph of Voltage vs. Flow Rate.
 - b. Experiment 2
 - i. Pour 1 liter of water through the hydroelectric generator from 3 different heights.
 - ii. Record the voltages produced.
 - iii. Use the data recorded to plot a graph of Voltage (V) vs. height (m).

Observations & Conclusions:

1. How did the flow rate affect the voltage produced?
2. How did the height from which the water was poured affect the voltage produced?
3. How does your hydroelectric generator utilize kinetic and potential energy to produce mechanical and electrical energy?
4. Based on these results, how would you increase the voltage output of your hydroelectric generator?

Extensions:

1. Visit the website, <http://renewableteacher.wordpress.com/2009/12/10/model-hydroelectric-generator/> and redesign your hydroelectric generator to use CDs in the place of the foamcore disks. Repeat the experiments. Does this modification affect the experiment results? Why?
2. Use the Internet to research the differences between the various types of hydroelectric generation plants. What are the benefits and disadvantages of each?

Resources

http://www.need.org/needpdf/infobook_activities/SecInfo/HydroS.pdf

http://education.nationalgeographic.com/education/encyclopedia/hydroelectric-energy/?ar_a=1

<http://ga.water.usgs.gov/edu/hyhowworks.html>

<http://www.visionofearth.org/industry/renewable-energy/renewable-energy-review/types-of-hydroelectric-power-how-do-the-dam-things-work/>

<https://www.dom.com/about/stations/renewable/hydro-power.jsp>

<https://www.dom.com/about/stations/hydro/bath-county-pumped-storage-station.jsp>

Green Jobs and Careers:

The Bureau of Labor Statistics (<http://www.bls.gov/green/>) defines green jobs as:

“Jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources.” And “Jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources.”

1. Have students investigate the types of jobs are suited to their personality, skills and interests by using these online resources. The personality test center helps identify career options based on personality indicators and the O*NET tool uses interests and skills to suggest potential careers. Students can choose to use both tools and compare the results or use each tool individually.

- a. Personality Career Tool Activity: Complete your Meyers Briggs type indicator at the online site.
 - i. Go to www.personalitytest.net/cgi-bin/q.pl
 - ii. Answer the 68 quick “either/or” questions. Choose your best answer to each question.
 - iii. When you click “RESULTS” your personality type will be listed.
 - iv. With your four letter reference type, choose an occupation from the list that might help suit your type and is a job that you might be interested in exploring.
 - v. The listing can be found by clicking “Green Jobs List” at <http://www.ctenergyeducation.com/greenjobs.htm>
 - vi. Do a web search of the listed resource sites and other sites to find out more about the job you chose.
 - What training/background is required?

- What is the entry-level pay or average pay for this occupation?
- Do there seem to be any jobs available in this occupation? If so where are they?
- After completing your research are you more or less interested in this occupation that when you started? Explain why.

b. O*NET Interest Profiler Activity: Complete the O*NET Interest Profiler

- Go to <http://www.mynextmove.org/explore/ip> and complete the interest profiler
- Answer the quick 60 questions with your best answers for each question.
- When you have finished your interests will be shown in a graph, click Next to see the jobs suited to your interests.

- Where any of the jobs you chose green jobs? If not you can go to www.onetonline.org/find/green to search the green economy jobs sector.

iv. For the jobs listed, choose ones you are interested in.

- What training/background is required?
- What is the entry-level pay or average pay for this occupation?
- Do there seem to be any jobs available in this occupation? If so where are they?
- After completing your research are you more or less interested in this occupation that when you started? Explain why.

2. Have the students investigate green jobs related to solar energy and green building. Suggested resources:

<http://www.bls.gov/green/greencareers.htm>

Service-learning Projects:

Have students design a service-learning project implementing a green solution at your school or in your community.

1. Create a brochure or display explaining alternative energy technology and highlighting the pro and cons for use in your area. Share this information at community or PTA meeting or Earth Day celebration.
2. Develop a fun lesson for K-2 students at the school that explains hydropower and hydroelectricity. Have upper-grade student present this lesson to the young students in the school.
3. Work with your school administration to install alternative energy technologies to supplement the school's traditional energy sources.

To learn more about service-learning visit www.servicelearning.vcu.edu and <http://www.servicelearning.org/what-service-learning>.

Green Jobs and Careers Extension based on an activity developed by

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GreenSTEM@VCU Unit Plan

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Reduce, Reuse, Recycle and/or Renew

Unit Description

Unit Overview

This unit focuses on natural resources as they relate to sustainable development. Students will learn about the connections between natural resources and the products they use. They will investigate and trace raw materials to landfill trash of everyday products. They will learn about some of the problems that arise from not conserving raw materials and introduced to ideas on how to make that process more sustainable. Students' final project will be to develop their own recycling program at school in order to recycle both renewable and nonrenewable resources. Students will then work together collecting scientific data in order to design a recycling program for their school. In doing so, they will learn about what materials are recyclable, how they are recycled and how this benefits the environment by contributing materials to the local recycling center.

Unit Context

The unit will begin by presenting the curriculum objectives for the year, the goals of service-learning, and what students will be doing in the coming weeks and months. Discussions will be made regarding the basic mathematics and scientific concepts that students will be learning. The lessons will enable students to investigate the concept of protecting their environment and the importance of recycling. Each lesson will focus on aspects of the environment and how it produces the raw materials people use to make products. Wood, metals, sand, and oil are called raw materials. Raw materials are the building blocks of products. Many raw materials, such as oil and metals, are nonrenewable resources.



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Earth's oil was formed millions of years ago. There's a limited amount of it. When it's gone, it's gone forever. Metals mined from the ground are used to make cars, ships, pots and pans, appliances, and many other things. Glass is made from sand. Plastics are made from chemicals in oil found deep underground. Certain other resources, such as wood, are renewable resources. If trees are cut down for lumber and paper, more can be planted to replace them. Even so, trees take years to grow. Recycling paper and other wood products can help keep forests from being destroyed. Renewable energy sources at the earth's surface: solar, wind and water will be included. Further investigation of green careers will be included.

Service-Learning Standards

Duration & Intensity

The lessons will take place over the course of the school year and address the processes of investigation of community needs, preparation for service, action, demonstration of learning and impacts, and celebration.

Meaningful Service

The lessons are found to be age-appropriate to students' developmental abilities. Students and school staff will demonstrate high interest in a school-wide recycling campaign and the effects the project will have on the school and community at large. Throughout the school year, students, school staff, and family members will learn about how recycling impacts their community and the environment and the role they can play in making the school and their homes more environmental friendly.

Links to Curriculum

The learning goals in this unit are articulated in the Standards of Learning Objectives and are aligned with the school district's passing guides. Students transfer knowledge and skills from the classroom to the school at-large and community and vice versa. Students will enhance their Science, Technology, Engineering and Mathematics (STEM) skills as they organize, collect, design, and present their recycling program to the school and community.

Youth Voice

Students are involved in planning, implementing and evaluating the school-wide recycling campaign and the effectiveness of their experience. They are actively engaged in an open dialogue with the teacher throughout the process, especially during reflective activities. They develop leadership and decision making skills through their work in teams and when communicating the goals of their project to administrators, other students, and school staff.

Partnerships

External partners for the recycling project include: Alcoa, the Virginia Department of Environmental Quality (DEQ), the Southeast Recycling Development Council (SERDC), Russell County Environmental

Control and Recycling Center, along with parents and the local media. Internal partners include: students, school administrators, teachers and staff. Students work with both external and internal partners to develop the school- wide recycling program through weekly meetings and classroom visits. External partners donate free recycling bins to the school, which students decorate and place around the school for the collection of waste commodities. Students provide written reports on a monthly basis to report to SERDC. Students form a small media group within their advisory team to provide future interviews with the media.

Diversity

Students work in teams throughout the project during which they develop skills in conflict resolution and group decision-making. It will also provide them with an educational cultural experience that takes seriously the importance of school and community and provide them with the intellectual, civic, and moral tools to work with each other and their community.

Reflection

Reflection activities are woven throughout the lessons and activities throughout the entire school year. They include classroom discussions and exercises, discussions with community partners and family members, peer discussions, dialogue between middle and high school students, oral presentations, field trips to recycling center, school scrapbook, data charts and graphs and student surveys.

Assessing Impacts

Evidence of progress is collected from student reflection activities, the Timeline/Task/Activity Chart. During the school year the teacher will check with students, school staff, and partners to see if any aspects of the project need to be improved. Student and teacher assessment of the project at the end of the school year will help to develop ideas and suggestions in sustaining the recycling program.

Sharing & Celebrating

There are a variety of ways that students will demonstrate what they have learned throughout the school year. Publicity of the project's success will be communicated within the school, throughout the community, and with the media regarding the vision accomplished and school goals met. Students will dedicate funds generated by the school aluminum can recycling to the local Children's Advocacy Center, a non-profit organization.

Civic Goals

The unit will actively engage students in a hands-on, interdisciplinary service-learning approach that will educate students regarding human impact on their school environment and their personal responsibility in solid waste management as it directly relates to the needs of their school. Participation in the unit will

further enable students to maintain their interest, voice, and awareness in sustaining a service-learning project within their home and community.

Character & Social Skills

Students' participation in this unit will promote good citizenship through environmental stewardship. Students will develop interpersonal skills in conflict resolution and group decision-making skills while participating in the recycling project.

Career Skills

Students will become equipped with the knowledge of a "Green Career." Lessons will incorporate information and guest speakers to encourage and influence students in the types of "Green Jobs" available in the places in which they choose to settle, whether in Southwest Virginia or not. The lessons in these activities, along with the experiences and partnered relationships they establish along the way, will empower them to become agents of change in Southwest Virginia and beyond, while they are students and as they begin to think about a future path of career.

Environmental Problems, Their Causes, and Sustainability

Methods and Activities:

A) Lecture and Discussion (PowerPoint):

- Human population
 - 2007 ~ 6.7 billion people
- Projections
 - 225,000 people per day
 - Add population of U.S. < 4 years
 - 2050 ~ 9.2 billion people
- Resource consumption, degradation, depletion
 - Possible results
 - Huge amount of pollution and wastes
 - Disrupt economies
 - Loss of species, farm land, water supplies
 - Climate change
 - Political fallout
 - Solutions
 - Understand our environment
 - Practice sustainability
- What Is an Environmentally Sustainable Society?
 - Concept 1-1A Our lives and economies depend on energy from the sun (solar capital) and natural resources and natural services (natural capital) provided by the earth.
 - Concept 1-1B Living sustainably means living off earth's natural income without depleting or degrading the natural capital that supplies it.

- Sustainability – central theme
 - Natural capital
 - Natural resources
 - Natural services
 - What are the Natural Resources we need to manage?
 - Materials
 - Renewable
 - Nonrenewable
 - Energy
 - Solar capital
 - 99% of earth’s energy input
 - Drives most other systems/cycles
 - Photosynthesis
 - Basis for food and energy needs
- On what Natural Services do we depend?
 - Functions of nature
 - Purification of air, water
 - Nutrient cycling
 - What does it take to manage capital and resources sustainably?
 - Trade-offs (compromises)
 - Sound science
 - Individuals matter
 - Ideas
 - Technology
 - Political pressure
 - Economic pressure
- GOAL: Sustainable Living from Natural Capital
 - Environmentally sustainable society
 - Financial capital and financial income
 - Natural capital and natural income
 - Bad news: signs of natural capital depletion at exponential rates
- Let’s look at an example: Principles of Water Sustainability
 MANAGING WATER AS NATURAL CAPITAL – parameters to consider
 1. The value & limits of water
 People need to understand the value and appreciate the limits of water resources and the risks to people and ecosystems of unbounded water and land use
 2. Principles of Water Sustainability
 - Shared responsibility
 Because water does not respect political boundaries, its management requires shared consideration of the needs of people and ecosystems up- and downstream and throughout the hydrologic cycle
 - Equitable access
 Sustainability suggests fair and equitable access to water, water dependent resources and related infrastructure
 - Stewardship
 Managing water to achieve sustainability challenges us while meeting today’s needs to address the implications of our decisions on future generations and the ecosystems upon which they will rely

Natural Processes:

- Disturbance & Response
- Hydrologic Cycle & Flow Regime
- Materials Cycling
 - Two views of economics
 - Economics – how does it affect the environment?
 - Economic growth – increase of goods/services
 - Measured in Gross Domestic Product (GDP) – annual market value of goods/services, national and international
 - Per capita GDP – total GDP/population midyear
 - Per capita GDP – PPP (purchasing power parity) - how much a citizen could purchase in the US
 - Economic development – use of economic growth to improve living standards
 - Developed countries – 1.2 billion people (US, NZ, AU, CA, JP, & most of Europe. High per capita GDP-PPP
 - Developing countries – 5.5 billion people, middle- or low-income. Per capita GDP-PPP is either steady or declining.
- How Are Our Ecological Footprints Affecting the Earth?
 - Concept 1-3 As our ecological footprints grow, we are depleting and degrading more of the earth's natural capital.
 - Natural Resources
 - Perpetual – renewed continuously
 - Solar energy
 - Renewable – hours to decades
 - Water, air
 - Forest, grasslands
 - Natural Resources
 - Nonrenewable – fixed quantities
 - Energy (fossil fuels)
 - Metallic minerals
 - Nonmetallic minerals
 - Recycling
 - Reducing
 - Reusing
 - Repurposing
 - Natural Resources
 - Sustainable yield
 - Highest use while maintaining supply
 - Living off income, not capital
 - Environmental degradation
 - Exceed natural replacement rate
 - Living off of the capital
 - Natural Capital Degradation
 - Measuring Environmental Impact
 - Ecological footprint
 - Biological capacity to replenish resources and adsorb waste and pollution
 - Per capita ecological footprint
 - Includes: renewable resource use per individual
- Pollution

- What is pollution?
- Point sources
- Nonpoint sources
- Why bother? - Unwanted effects of pollution
- Solutions to Pollution
 - Pollution prevention (input control) - Front-of-the-pipe
 - Pollution cleanup (output control) - End-of-the-pipe
 - Disadvantages of Output Control
 - Temporary
 - Growth in consumption may offset technology
 - Moves pollutant from one place to another
 - Burial
 - Incineration
 - Dispersed pollutants costly to clean up
- Why Do We Have Environmental Problems?
 - Concept 1-5A Major causes of environmental problems are population growth, wasteful and unsustainable resource use, poverty, excluding the environmental costs of resource use from the market prices of goods and services, and trying to manage nature with insufficient knowledge.
 - Concept 1-5B People with different environmental worldviews often disagree about the seriousness of environmental problems and what we should do about them.
 - Resources depletion and degradation
 - Global Connections – the effect of affluence
 - Environmental Effects of Affluence
 - Harmful effects
 - High consumption and waste of resources
 - Advertising – more makes you happy
 - Beneficial effects
 - Concern for environmental quality
 - Provide money for environmental causes
 - Reduced population growth
- Evaluating Full Cost of Resources Use
 - Examples
 - Clear-cutting + habitat loss
 - Commercial fishing + depletion of fish stocks
 - Tax breaks
 - Subsidies
 - Environmental Viewpoints
 - Environmental worldview
 - Your own assumptions and values
- Environmental ethics
 - Beliefs about what is right and wrong
- Planetary management worldview
 - We are separate, nature here to meet our needs, we use our technology to use the earth for our benefit, indefinitely
- Stewardship worldview
 - Manage earth for our benefit as stewards. Pro = environmentally sustaining economic growth, anti = environmentally degrading economic growth
- Environmental wisdom worldview

- We are part of and dependent on nature. It's there for all species. Our success depends on understanding and promoting environmentally friendly actions.
 - Social capital – a necessary component
 - Everyone communicating about and solving environmental issues
 - For instance: Chattanooga, Tennessee
 - 1960s
 - Dirtiest air in the United States
 - Toxic waste in Tennessee River
 - High unemployment, crime
 - 1984
 - Vision 2000 – grassroots consensus
 - Chattanooga, Tennessee 1995
 - Zero emission industries, buses
 - Low-income renovations, downtown renewal
- B) Reflection: What does sustainability mean to you? How can we make our community more sustainable?

Materials/Resources:

PowerPoint Presentation slideshow

The Benefits of Recycling

Methods and Activities:

A) Lecture and Discussion (PowerPoint):

University of Georgia Recycling (<http://sustainability.uga.edu/what-were-doing/campus-operations/recycle/>)

- For year 2007, the total waste generated by the University was 8,258 tons, of which 2,294 tons were recycled.
- This represents a 28% recycling rate for all generated waste.
- Recycling = Impact Reduction
 - Recycling is as much as 95% more energy efficient than new production
 - Landfills are rapidly becoming full – Recycling reduces the amount of material in landfills
 - Less Energy Use = Lower Carbon
 - Emissions, Reducing UGA's contribution to global warming
- One easy Solution - Recycling is the way!
 - What do is recycle?
 - Paper – if it rips, we can recycle it!
 - Bottles and Cans – plastics 1 & 2, glass, aluminum, steel
 - What are plastics #1 and #2?
 - #1 PETE – Commonly used in soft drinks, juice and cough syrup containers
 - #2 HDPE – Commonly used in milk jugs, detergent and shampoo bottles
- What happens to the recyclables?
 - Upon arrival at the recycling facility, papers are cleaned, baled and sold to pulping mills
 - Upon arrival at the recycling facility, plastics are sorted, cleaned, baled and sold to mills
- Why recycle?
 - Saves Money: Lowered garbage collection
 - Payment for recyclable materials
 - Creates New Jobs - Creates jobs in recycling and remanufacturing

- Gives new life to materials otherwise destined for landfill
- For Example, recycling paper
 - Conserves natural resources: Every ton of recycled paper saves 17 trees and 7,000 gallons of water!
 - Saves energy
 - Recycling 1 ton of paper saves 4,200 kilowatt hour - that's enough to power an average-sized home for two years!
 - Saves and Makes money
 - At UGA: Every ton of recycled paper saves \$42/ton tip fees and produces approximately \$100/ton income.

B) Guest Speaker

Russell County Environmental Control and Litter Officer

C) Reflection: Does our community recycle? How can we improve community participation in recycling?

Materials/Resources:

PowerPoint Presentation slideshow

Global Warming, Climate Change, and Carbon Footprint

Methods and Activities:

A) Movie: No Impact Man (<http://noimpactproject.org/movie/>)

B) Lecture and Discussion (PowerPoint):

- Climate Change and Global Warming
 - Climate Change & Global Warming are the names given by scientists for the gradual increase in temperature of the Earth's surface that has worsened since the industrial revolution.
 - According to the National Academy of Sciences, "the phrase 'climate change' is growing in preferred use to 'global warming' because it helps convey that there are [other] changes in addition to rising temperatures."
 - Climate change refers to any distinct change in measures of climate lasting for a long period of time. In other words, "climate change" means major changes in temperature, rainfall, snow, or wind patterns lasting for decades or longer
 - Global warming is an average increase in temperatures near the Earth's surface and in the lowest layer of the atmosphere.
 - Increases in temperatures in our Earth's atmosphere can contribute to changes in global climate patterns.
 - Global warming is probably the most talked about climate change we are experiencing, but is just one of many changes along with precipitation levels, storm intensity, etc.
 - Global warming can be considered part of climate change along with changes in precipitation, sea level, etc.
 - Global change is a broad term that refers to changes in the global environment, including climate change, ozone depletion, and land-use change.
- Climate change may result from:
 - natural factors, such as changes in the Sun's energy or slow changes in the Earth's orbit around the Sun;
 - natural processes within the climate system (e.g., changes in ocean circulation);
 - Human activities that change the atmosphere's makeup (e.g., burning fossil fuels) and the land surface (e.g., cutting down forests, planting trees, building developments in cities and suburbs, etc.).

- Climate Change and Global Warming
 - Over the past two decades the effect has become more marked. Considerable evidence exists that most of this warming has been caused by human activities... that's to say we have altered the chemical composition of the atmosphere through a buildup of greenhouse gases – primarily carbon dioxide, methane, and nitrous oxide.
 - What if we do nothing? Rising global temperatures will cause sea level to rise and alter local climate conditions, affecting forests, crop yields, and water supplies. It may also affect human health, animals, and many types of ecosystems. Deserts may expand and some of our countryside may be permanently altered.
- What will happen in the future if we do nothing?
 - Climate model simulations predict an increase in average surface air temperature of about 2.5°C by the year 2100 (Kattenberg et al., 1996).
 - The likelihood of "killer" heat waves during the warm season will increase (Karl et al., 1997)
 - The IPCC Second Assessment Report estimates that sea-levels will rise by approximately 49 cm over the next 100 years, with a range of uncertainty of 20-86 cm.
 - Sea-level rise will lead to increased coastal flooding through direct inundation and an increase in the base for storm surges, allowing flooding of larger areas and higher elevations.
 - Further melting of the Arctic Ice Caps (at the current rate) could be sufficient to turn off the ocean currents that drive the Gulf Stream, which keeps Britain up to 6°C warmer than it would otherwise be.
- In February 2007, the IPCC (Intergovernmental Panel on Climate Change) issued its latest assessment report on climate change, which concluded that global warming is "unequivocal" and gave the strongest warning yet that it is very likely (> 90%) caused by human activities. The evidence for global warming and climate change includes the following:-
 - Sea temperatures have risen by on average 0.5 degrees C (0.9 degree F) over the last 40 years [Tim Barnett, Scripps Institution of Oceanography in La Jolla, California]
 - 20,000 square kilometers of fresh water ice melted in the Arctic between 1965 and 1995 [Ruth Curry, Woods Hole Oceanographic Institution in Connecticut]
 - Worldwide measurements from tidal gauges indicate that global mean sea level has risen between 10 and 25 cm (18 cm average) during the last 100 years [Warrick et al., 1996]
 - Global surface temperatures have risen about 0.7°C in the past 100 years [Met Office]
 - 11 of the last 12 years rank amongst the 12 warmest years on record for global temperatures (since 1850) [IPCC, 2007]
 - Since 1975, the increase of the 5-year mean temperature is about 0.5°C - a rate that is faster than for any previous period of equal length [NASA, 1999]
 - Average annual temperature in the Arctic has increased by about 1° C over the last century -- a rate that is approximately double that of global average temperatures [IPCC, 1998]
 - There is widespread evidence that glaciers are retreating in many mountain areas of the world. For example, since 1850 the glaciers of the European Alps have lost about 30 to 40% of their surface area and about half of their volume [Haeberli and Beniston, 1998]
- Global Warming and Climate Change
 - The Earth's greenhouse effect is a natural occurrence that helps regulate the temperature of our planet. When the Sun heats the Earth, some of this heat escapes back to space. The rest of the heat, also known as infrared radiation, is trapped in the atmosphere by clouds and greenhouse gases, such as water vapor and carbon dioxide.
 - If all of these greenhouse gases were to suddenly disappear, our planet would be 60°F (33°C) colder and would not support life as we know it.

- Human activities have enhanced the natural greenhouse effect by adding greenhouse gases to the atmosphere, very likely (greater than 90 percent chance) causing the Earth's average temperature to rise. These additional greenhouse gases come from burning fossil fuels such as coal, natural gas, and oil to power our cars, factories, power plants, homes, offices, and schools. Cutting down trees, generating waste and farming also produce greenhouse gases. If humans continue to emit greenhouse gases at or above the current pace, we will probably see an average global temperature increase of 3 to 7°F (2 to 4°C) by 2100, and greater warming after that. Temperatures in some parts of the globe (e.g., over land and in the Polar Regions) are expected to rise even more.
- Even if we drastically reduce greenhouse gas emissions, returning them to year 2000 levels and holding them constant, the Earth would still warm about 1°F (0.6°C) over the next 100 years. This is due to the long lifetime of many greenhouse gases and the slow cycling of heat from the ocean to the atmosphere.
- Rising global temperatures are expected to raise sea level, and change precipitation and other local climate conditions. Changing regional climate could alter forests, crop yields, and water supplies.
- It could also affect human health, animals, and change the features of many types of ecosystems.
- Deserts may expand into existing rangelands, and some of our National Parks may be permanently altered.
- Some of the debate over climate change and, in particular, melting ice caps stems from the observed natural cycles of climate variability.
- It is possible that the warming trend in the Arctic may lessen if there is a shift in the current cycle.
- However, reducing the concentration of greenhouse gases in the atmosphere may help slow or reverse the melting of the ice caps and prevent extreme events and other unforeseen consequences of climate change.
- Natural variations within the Earth's climate system can cause small changes over decades to centuries.
- Larger changes can occur through factors such as gradual changes in Earth's orbit around the Sun, which are thought to be the key contributors in the comings and goings of past ice ages over many millennia.
- The Sun's energy can also vary over time.
- Large volcanic eruptions and collisions with large meteorites can cool the planet for a few years by spewing out particles that reflect sunlight back out to space.
- However, while natural variations have altered the climate significantly in the past, it is very unlikely that the changes in climate observed since the mid-20th century can be explained by natural processes alone.
- What is a carbon footprint?
 - A carbon footprint is 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 tons (or kg) of carbon dioxide equivalent.
 - The term "carbon footprint" is used to describe the amount of greenhouse gases (GHG) that are emitted into the atmosphere each year by an entity such as a person, household, building, organization, or company. It is usually measured in units of carbon dioxide equivalents.
 - The primary footprint is a measure of our direct emissions of CO₂ from the burning of fossil fuels including domestic energy consumption and transportation (e.g. car and plane). We have direct control of these.

- The secondary footprint is a measure of the indirect CO2 emissions from the whole lifecycle of products we use - those associated with their manufacture and eventual breakdown. To put it very simply – the more we buy the more emissions will be caused on our behalf.
- A carbon footprint usually includes both direct and indirect GHG emissions:
 - Direct emissions are considered to be emissions that are directly under the control of the person or company. For example, when a person drives his or her car it emits GHGs. For a company, if it chooses to heat its factory by burning a fuel, those are direct emissions.
 - Indirect emissions are emissions that are a consequence of the activities of the reporting entity, but that occur at sources owned or controlled by another entity. For example, purchased electricity is considered an indirect emission. While a person or company can control the amount of electricity that is purchased, they cannot control the emissions that are associated with the generation of that electricity. Those emissions are under the direct control of someone else.
- For example, a person with a small carbon footprint would engage in activities that limit the amount of GHGs he or she emits in the course of a year. Carbon dioxide is the primary GHG emitted in industrialized countries, and emissions of other GHGs are often expressed in terms of their equivalent value in carbon or carbon dioxide. A person's carbon footprint would include all the GHG emissions associated with his or her activities, not just those of carbon dioxide.
- Tips for Reducing Carbon Footprint
 - Turn it off when not in use (lights, television, DVD player, Hi Fi, computer etc. etc. ...)
 - Turn down the central heating slightly (try just 1 to 2 degrees C). Just 1 degree will help reduce your heating bill by about 8%.
 - Turn down the water heating setting (just 2 degrees will make a significant saving)
 - Check the central heating timer setting - remember there is no point heating the house after you have left for work
 - Fill your dish washer and washing machine with a full load - this will save you water, electricity, and washing powder
 - Fill the kettle with only as much water as you need
 - Do your weekly shopping in a single trip
 - Hang out the washing to dry rather than tumble drying it
 - The following is a list of items that may take an initial investment, but should pay for themselves over the course of 1-4 years through savings on your energy bills.
 - Fit energy saving light bulbs
 - Install thermostatic valves on your radiators
 - Insulate your hot water tank, your loft and your walls
 - Installing cavity wall installation
 - By installing 180mm thick loft insulation
 - Recycle your grey water
 - Replace your old fridge / freezer (if it is over 15 years old), with a new one with energy efficiency rating of "A"
 - Replace your old boiler with a new energy efficient condensing boiler
 - Travel less and travel more carbon footprint friendly.
 - Car share to work, or for the kids school run
 - Use the bus or a train rather than your car
 - For short journeys either walk or cycle
 - Try to reduce the number of flights you take
 - See if your employer will allow you to work from home one day a week
 - Next time you replace your car - check out diesel engines. With one of these you can even make your own Biodiesel fuel.

- When staying in a hotel - turn the lights and air-conditioning off when you leave your hotel room, and ask for your room towels to be washed every other day, rather than every day
- As well as your primary carbon footprint, there is also a secondary footprint that you cause through your buying habits.
- Don't buy bottled water if your tap water is safe to drink
- Buy local fruit and vegetables, or even try growing your own
- Buy foods that are in season locally
- Don't buy fresh fruit and vegetables which are out of season, they may have been flown in
- Reduce your consumption of meat
- Try to only buy products made close to home (look out and avoid items that are made in the distant lands)
- Buy organic produce
- Don't buy over packaged products
- Recycle as much as possible
- Think carefully about the type of activities you do in your spare time. Do any of these cause an increase in carbon emissions? E.g. Saunas, Health clubs, restaurants and pubs, go-karting etc. etc...

Sources

<http://www.carbonfootprint.com/>

<http://www.nature.org/initiatives/climatechange/activities/art19630.html>

<http://www.epa.gov/climatechange/fq/science.html>

C) Calculation of Carbon Footprint

D) Reflection: What steps can you take to reduce your carbon footprint?

Materials/Resources:

Movie: No Impact Man (<http://noimpactproject.org/movie/>)

PowerPoint Presentation slideshow

Energy and Alternative Energy

Methods and Activities:

A) Lecture and Discussion (PowerPoint):

- An overview of energy use in the United States today and tomorrow.
 - Energy sources in the U.S.
 - Transportation = Petroleum
 - Alternatives to Petroleum
 - Natural Gas
 - Hydrogen
 - Biofuels
 - What are the major sources of electrical energy in the US?
 - Coal
 - Nuclear
 - Natural Gas
 - Hydro
 - Oil
 - Biomass
 - Geothermal
 - Wind
 - Solar

- Other Electricity Options?

B) Movie: Green Revolution (<http://www.revolutiongreen.com/>)

C) Hands-On Activity: Building and Testing of Solar Cells

D) Reflection: Which type of alternative energy do you feel would be the most effective and efficient in Southwest Virginia and why?

Materials/Resources:

Movie: Green Revolution (<http://www.revolutiongreen.com/>)

PowerPoint Presentation slideshow

What is Service Learning?

Methods and Activities

A) Lecture and Discussion (PowerPoint):

- What is Service Learning?
 - A teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities.
- Define the terms 'community' and 'service'
 - A community is any group sharing common interests or characteristics and perceived or perceiving itself as distinct.
 - In the context of service-learning, service is the implementation of a plan, designed or influenced by students, that combines classroom learning with meeting an authentic community need.

B) Design a small scale service learning project, such as designing and constructing recycling bins to be used on school grounds.

C) Reflection: How can the design and construction of the recycling bins be further used for Service-learning?

Materials/Resources:

PowerPoint Presentation slideshow

Design of Recycling Containers

Methods and Activities:

A) Research of various designs of consumer recycling containers

Students were allowed time in the computer lab to research the various designs of recycling containers on the consumer market.

B) Design of recycling containers

Students were to pair up in groups of 2-4 persons. Each group designed a recycling container to be placed at the athletic fields during the sporting seasons. Each design handed in must have included dimensions and a complete list of materials needed.

Materials/Resources:

Computer Lab

Design paper and markers

Construction of Recycling Containers

Methods and Activities:

Students took their designs and materials purchased and constructed their recycling containers.

Materials/Resources:

Construction materials

Service-learning Project – Recycling Helps Conserve Energy

Methods and Activities:

- A) Research- Students need to research any further questions about recycling and litter prevention.
- B) Community Campaign- Students will put together a community campaign about the counties recycling program and litter prevention.

Materials/Resources:

PowerPoint Presentation slideshow

Partners

Lebanon Middle and High School Teachers, Staff and Volunteers

Russell County Public Schools Administration

Alcoa

Virginia Department of Environmental Quality (DEQ)

Southeast Recycling Development Council (SERDC)

Russell County Environmental Control and Recycling Center

Local media