

JANUARY 2006: RENEWABLE ENERGY

GREENTIMES TEACHER GUIDE

Dear Teacher,

The intended role of *Greentimes Teacher Guides* is to assist you in using each issue of *Greentimes* in various classroom settings. We offer a selection of cross-disciplinary activity and lesson ideas that partner the concepts presented in the newsletter with curriculum areas. There are also reproducible pages that you can give to your students (if they read most or all of the newsletter). Please feel free to tell us what you want to see in these guides in the future – just e-mail Heather at hfreeman@greenscreen.org!



BACKGROUND INFORMATION

Geothermal Energy: Geothermal energy is a widely used source of energy and holds even more potential for the future. The article on geothermal energy in this issue of *Greentimes* conveys the general idea that heat from inside the Earth can supply us with large amounts of energy to heat our homes and create electricity. However, this energy is harvested in many different ways. Also, geothermal energy is *not* always renewable. Check out the geothermal energy section on this site to review a comprehensive list of these technologies, www.ucsusa.org.

Biomass: Biomass is an interesting and diverse source of energy. The primary method of consuming this energy mentioned in *Greentimes* is to burn it. Biomass is also converted into a utilizable energy source through bacterial decay, fermentation and conversion. For a complete discussion on biomass and its uses visit <http://lsa.colorado.edu/essence/texts/biomass.htm>.

Biomass and Ethanol: <http://www.eia.doe.gov/kids/energyfacts/sources/renewable/biomass.html>

Solar Power: The technologies used to convert **solar power** to electricity are also many. In addition, several types of devices collect solar power passively. To learn about all the different types of solar power devices check out http://www.eere.energy.gov/RE/solar_basics.html.

Wind Energy: <http://www.energyquest.ca.gov/story/chapter16.html>

For Students: <http://www.eere.energy.gov/kids/> - **A site for young students** that explains various sources of renewable energy.

WRITING

- Have students practice writing events in **chronological order** by using the article ‘All Aboard Solar Power Express!’ Have them put in order the following events by using the context of the article: the creation of the sun, the first recorded use of solar power, the creation of photovoltaic cells. To make this exercise more challenging add when humans appeared on Earth, Mouchot’s 1861 patent for the 1st machine that converted the sun’s energy into electricity, the creation of the Solar Motor Co. in 1900, the first company committed to selling solar power, the oil crisis of the 1970s.
- Which type of renewable energy do students think is most interesting? Have students pick an energy source and write a **personified** story about a day in the life of their energy. For example, a student interested in solar power could write a story that is narrated by the sun. You can easily add to this activity by asking your students to practice things they are learning in English (such as verb tenses, punctuation, format).
- Engage students in a verbal or written **debate** about **hydropower**. Each student can either argue that hydropower is a good source of renewable energy because it is clean or a bad source of renewable energy because it harms the environment.



SPOTLIGHT ICELAND

Iceland is featured in an article in this issue of *Greentimes*. Here are some additional facts that you can share with your class and ways of integrating science, history, and geography into a discussion.

- The first pioneers, from Ireland and Norway, settled in Iceland in the 9th century. Do students know who the first pioneers to the United States were? (The Vikings discovered the United States in approximately 1000 AD. To read more about the Vikings' treks through the United States visit <http://www.pbs.org/wgbh/nova/transcripts/2708vikings.html> and scroll half way down the page.)
- The capital of Iceland is Reykjavik. Locate Reykjavik on a map. What other European capitals do students know?
- Geothermal energy is used to create a large majority of the electricity used in Iceland's capital. Ask students why Massachusetts does not use geothermal energy.
- Iceland is Europe's most western country and is also its second biggest island. Where is Massachusetts located in terms of the United States? Do we have islands (Martha's Vineyard, Nantucket and the Harbor Islands)?
- Iceland tends to have winters that are cool (not too cold) and windy and summers that are damp and mildly warm. Neither season is extreme. Ask students how this compares to New England's climate. Do students know what causes this difference? Explain that even though Iceland is located further north than New England, it is an island surrounded by the ocean. Since water takes more energy to heat or cool than land does and Iceland is surrounded by water, its weather is less extreme. This concept is also explained in the article 'Wind Energy Today'.
- Ask students to notice what seas and oceans surround Iceland. What other oceans and seas can they name and locate on a map?



GEOGRAPHY

Canada: Our neighbor to the North, Canada, also is pushing to become more energy independent and environmentally friendly by using renewable energy. Use the map featured on <http://atlas.gc.ca/site/english/maps/economic/renewableenergy/casestudy> to discuss how energy sources are distributed, and to learn additional facts about Canada. What provinces use solar energy? Bioenergy? Wind energy? Identify and discuss major cities in these provinces.

What geographical aspects make each province better equipped to provide the given renewable energy?

Africa: Africa relies on oil and coal for their primary sources of energy. Still, renewable energy is used in several areas. It has the potential to become a larger influence if more money and support become available to buy and establish these technologies. Show students Africa on a map. Point out Africa's diversity in terms of geography and languages spoken. For additional information on Africa visit <http://en.wikipedia.org/wiki/Africa>. For information on renewable energy in Africa visit <http://www.odysen.com/news/Africa.php>.

Although Africa has not yet prevalently begun to use renewable energy, some areas have made great progress. **Egypt, Congo, Kenya and Zimbabwe all use large amounts of hydroelectric power.** Familiarize students with their general locations on a map. Divide students into groups and have them identify major cities and geographical aspects (lakes, deserts, mountains, etc.) in their assigned area.

<http://www.ahsd25.k12.il.us/Curriculum%20Info/africa/aboutaf.htm>

Emphasize to students **why renewable energy is particularly important in Africa.** Since Africa is an already poor continent, the rising costs of oil are devastating to Africa's development and quality of life for its people. In addition, large amounts of air pollution from burning fossil fuels and biomass are cause for concern. Pollution is a significant problem and its repercussions include disease and death.

Africa's natural resources provide several opportunities to harness clean renewable energy, such as geothermal, wind

CONCEPTUAL THINKING

Pose the following questions to your class after reading *Greentimes*.

An indirect source of solar energy is water power. How is this so? Get students to think of the water cycle and what keeps the water cycle moving. For example, the sun causes water to evaporate. How is wind power driven by solar energy? Cooler, heavier air produces a high-pressure area in the atmosphere. The sun also heats air causing it to become warmer and lighter. The air that flows from high pressure areas to the low pressure areas (the hot air rising and the cooler air sinking) are what we know as wind.

Denmark has 17 % of the world's wind generators. This is a relatively high number considering the size of the country (its only about twice the size of Massachusetts!). What does this generally imply about Denmark's weather and its access to other sources of energy?

How do the resources described in *Greentimes Natural Resources* (fossil fuels) and *Greentimes Renewable Energy* (clean energy) compare? What are the advantages and disadvantages of using either type of energy? If renewable energies are less harmful to the environment and last indefinitely, why don't we use them more? Is it economical? Political?

HISTORY

Use the following suggestions to enforce historical concepts while reading *Greentimes* or refer to the specified article during your history lesson.

Renewable Energy History

- When steel blades were developed in the late 1880s, making windmills more efficient, 6 million windmills appeared across America. At this time settlers were moving to the west. Why was the frontier expanding towards the west? How did the geography of the Midwest make it a practical area to use windmills? What other advances in technology made these settlements possible? Visit <http://www.kshs.org/research/topics/agriculture/essay.htm> for more information.
- Concerns about the use of fossil fuels first arose during the Industrial Revolution. Auguste Mouchout invented the first active solar motor in 1861. However, solar energy was extremely expensive to produce while the cost of coal was falling. When reading either article about solar power mention to students that people have been actively promoting the use of solar energy for over 100 years! This is also a good time to discuss concepts in **economics**. Explain the significance of using cheap fuels to power the Industrial Revolution instead of expensive solar power. A similar issue is explored in this issue's article on **hydrogen energy** where students learned that hydrogen energy is expensive because few people use it, but would be less expensive if more people utilized it.

The Hoover Dam

- Why was the Hoover Dam built and what was its historical importance? To read more about this visit <http://www.sunsetcities.com/hoover-dam.html>
- What was **President Hoover's** role in the creation of the dam? What problems did he incur and how did he solve them? <http://www.pbs.org/wgbh/amex/hoover/peoplevents/pandeAMEX86.html>
- **The Great Depression:** Why was President Hoover so anxious to start construction of the Hoover Dam? How did he plan to use the construction of the Hoover Dam as a means to create jobs and incomes for the vast numbers of unemployed people? What president beat Hoover in the 1932 election? (Franklin Roosevelt).



Name _____

Date _____

Greentimes Renewable Energy Math Worksheet

The sun is 4.5 billion years old, humans have existed for 50,000 years, and the sun will continue to burn for another 5.5 billion years. Create and arrange the numbers 4.5 billion, 50,000 and 5.5 billion on a number line.

The Grand Coulee Dam took 9 years to build and 77 people died during its construction. On average, how many people died creating the dam per year?

$\frac{1}{5}$ of the world's electricity comes from hydropower. What percentage of the world's electricity is created by hydropower? What percentage of the world's electricity comes from other sources of energy?

Construction of the Hoover Dam finished in 1935. Write this number in expanded notation.

5. About half (50 %) of Mexico's energy comes from fossil fuels, 25 % comes from hydropower, and the remaining 25 % from other sources. Create a pie chart that represents this data.

Name _____ Date _____

Greentimes Renewable Energy Short Answer Worksheet

1. What technology makes a calculator run without batteries? Explain your answer.

2. What is the difference between **stored energy** and **kinetic energy**?

3. Define the term **renewable energy**.

4. Name 2 types of **biomass energy**.

5. How does the **sun** create the **wind**?

MATH

The following suggestions are meant to be used when discussing or reading the specified articles, or for reference during your math lesson.

Relative size comparisons and number format. In the article ‘All Aboard Solar Power Express!’ students learned that the sun has a lifetime of 11 billion years. Humans have only existed for thousands of years. Have students compare these values and express them with exponents and in expanded notation.

Equivalent fractions and percentages. In the article ‘Vegetables Are Not Just For Eating’ we’re told that gasohol is made up of 90% gasoline and 10% ethanol. Remind students what the decimal and fractional equivalents would be. Can students identify more than one fraction that is equivalent to these numbers?



SUGGESTED READING (FOR BOTH TEACHERS AND STUDENTS)



Renewable Energy: Power for a Sustainable Future by Godfrey Boyle. This book is targeted towards **adults**.

Renewable Energy in Nontechnical Language, by Ann Chambers. This book is targeted at **adults**. It is true to its name and breaks down the mechanics of renewable energy for an audience that is not expert in the topic.

Solar Power (True Books) by Christine Petersen. This book is targeted at **kids** and is an excellent choice because it reaches beyond the explanation of solar power. Petersen also explains that the sun is essential for all life and even to the formation of fossil fuels. This book can be found on Amazon.com for a modest price of \$6.95. Another book by Petersen that is appropriate for students is entitled Alternative Energy.

Geothermal and Bio-energy Forever (Energy Forever) by Ian Graham. This book is targeted at **students**.

What Energy Sources Should Be Pursued? By Stuart A. Kallen (editor). This book is a collection of essays that debate the pros and cons of various sources of energy. Targeted at **adults**, the variety of authors and viewpoints paints a clear picture of why there is conflict as to what types of energy we should be using.

MASSACHUSETTS TECHNOLOGY COLLABORATIVE

The Massachusetts Technology Collaborative offers a useful and comprehensive guide to teaching renewable energy in curriculum related ways. The guide includes classroom activities, resources and curriculum materials and integrates science, technology, engineering, mathematics, history and social science into its lessons.

For more information on this guide visit <http://www.masstech.org/cleanenergy/curriculum/about.htm> or go to [masstech.org](http://www.masstech.org) and scroll down to ‘Energy Information’ where you will find the link for ‘Teaching Clean Energy.’

Also, check out how solar power is being used in Massachusetts at soltrex.masstech.org. You and your students will be able to see the amount of electricity being produced in various locations across the state and how environmental, seasonal and weather related conditions affect the efficiency of this technology.