



The Math of Renewable Energy

Grades: Middle School

Subjects: Math, Science, Social Studies, Language Arts

Time: 50-60 minutes



***Standards:** Students will...

Mathematics Standard 2: Understand and apply basic and advanced properties of the concepts of numbers.

Benchmark # 1: Understand the relationship between equivalent number representations (e.g., decimals, fractions and percents) and the advantages and disadvantages of this type of representation.

Benchmark # 9: Understand the concepts of ratio, proportion and percent and the relationships among them.

Mathematics Standard 3: Uses basic and advanced procedures while performing the processes of computation.

Benchmark # 6: Use proportional reasoning to solve mathematical and real-world problems (e.g., involving equivalent fractions, proportions, percents).

Science Standard 9: Understand the sources and properties of energy.

Benchmark # 11: Understand the origins and environmental impacts of renewable (e.g., wind, water, solar energy) and non-renewable resources, including energy sources like fossil fuels (e.g., oil, coal, natural gas).

Geography Standard 14: Understand how human actions modify the physical environment.

Benchmark # 3: Understand the ways in which technology influences the human capacity to modify the physical environment (e.g., the effects of the introduction of electricity, combustion engine vehicles, chemicals and fertilizers).

Benchmark # 4: Understand the environmental consequences of both the unintended and intended outcome of major technological changes in human history (e.g., the effects of automobiles using fossil fuels).

Geography Standard 16: Understand the changes that occur in the meaning, use, distribution and importance of resources.

Benchmark # 7: Understand how the development and widespread use of alternative energy sources (e.g., solar, wind thermal) might have an impact on societies (in terms of, e.g., air and water quality, existing energy industries, manufacturing processes).

Geography Standard 18: Understand global development and environmental issues.

Benchmark # 1: Understand how the interaction between physical systems and human systems affects the current conditions on Earth (e.g., relationships involved in economic, political, social, and environmental changes; geographic impact of using non-renewable and renewable energy sources).

Language Arts Standard 8: Use listening and speaking strategies for different purposes.

Benchmark # 1: Play a variety of roles in group discussions (e.g., active listener, discussion leader, facilitator).



Benchmark # 6: Make oral presentations to the class (e.g., use notes and outlines, establish a clear point of view, use evidence and arguments to support opinions, use visual media).

Objectives: Students will be able to...

- Differentiate between renewable and non-renewable energy sources.
- Describe the effects human actions have had on the environment over time and explain the need for alternative energy sources.
- Add and subtract fractions with unlike denominators.
- Multiply and divide fractions.
- Solve word problems involving fractions, decimals and percents.

[Please click here to view both the creative artwork for this great lesson and the downloadable PDF.](#)

Materials:

- "Renewable Energy Math Worksheet" provided below
- Markers, pencils
- Chart paper
- Poster board
- Measurement tools (rulers, protractors, compass)
- Internet access

Overview: Demand for energy has increased in the past century. Energy is used to power our electrical devices, to heat our homes and businesses and to fuel most forms of transportation. The sources we use for energy are currently drawn from both renewable and non-renewable resources.

Non-renewable resources are natural resources derived from fossil fuels. They include coal, oil, and natural gas. Non-renewable resources are not environmentally friendly, and once they are consumed there will no longer be any more to draw upon.

Renewable energy sources are those that can be replenished from natural processes and are derived from the sun, wind, rains, tides, plants, and heat from deep inside the earth. These energy resources provide us with solar power, wind power, hydropower, biomass and geothermal power. They are Earth friendly power sources that have the potential for providing clean energy to even the most remote locations on Earth.

Kid's Speak: We use more and more energy each and every day. We use it to make electricity, heat and fuel. It powers our laptops and TVs, gives us hot water and warm, comfy spaces, and helps transport us from one location to another.

Energy sources can be divided into two main groups: a) renewable resources, and b) non-renewable resources. Renewable energy, such as solar power, wind power, hydropower, biomass and geothermal power comes from natural resources such as the sun, wind, rains, tides, plants, and heat from deep inside the earth. They are available in almost inexhaustible supplies and are more environmentally friendly than non-renewable resources. Non-renewable energy comes from burning fossil fuels, such as coal, oil and natural gas. These fuels are available in limited supplies and once they are gone they cannot be replaced. Therefore, it is important that we continue to develop and incorporate renewable energy sources into our everyday lives, not only to power our world, but to also improve the quality of life on it.

Eco-Fact: In 2005 the US was the largest energy consumer, using 100 quadrillion BTUs.



Procedures:

Before Doing Math Calculations:

- Review math skills related to fractions, decimals and percentages.
- Provide students with background information on renewable and non-renewable energy sources.
- Explain to students that by identifying energy usage statistics, and then calculating the differences in usage between renewable and non-renewable sources we can better understand the need for, and benefits of, renewable energy.

Math Activities:

1. Provide each student with a Renewable Energy Math Worksheet. Ask them to solve each problem independently.
2. Divide the class into seven groups. Assign each group one of the problems. Have students share their solutions with the group members. Discuss any differences and come to an agreement on a solution to the math problem.
3. Have the group briefly research additional facts and statistics related to the type of energy mentioned in the problem. Have the group develop a visual presentation that incorporates both the math problem and additional information.

Renewable Energy Math Worksheet:

Note: The following math problems can be found on the worksheet provided below.

1. Biomass accounts for approximately 14% of all fuel consumption in the world. What fraction of all fuel consumed is biomass?
2. In a developing country, most of their biomass fuel comes from wood ($\frac{1}{4}$), crop residues ($\frac{1}{3}$) and animal waste ($\frac{1}{8}$). What is the total fraction, decimal, and percentage amount from these three sources?
3. Suppose you are interested in incorporating several solar energy concepts into your home. You are told that you can save approximately $\frac{1}{5}$ on basic electric costs and an additional $\frac{1}{3}$ on heating costs.
 - What fraction of your utility bill will you save by using solar heat?
 - If your monthly utility bill is approximately \$125.00, how much money could you save on your bill each month?
4. If wind turbines were installed in the Great Plains, along coasts, and in windy areas, wind energy could fulfill 20% of the US energy need. What fraction of the US energy need wouldn't be filled?
5. Only 7.5% of the energy consumed in the US is renewable energy, and 40.8% of the energy consumed in the US is petroleum gas. What fraction of the total energy used in the US is renewable energy and what fraction is petroleum?
6. In percent, how much more petroleum is consumed than renewable energy?
7. If energy efficient light bulbs use 75% less energy, what fraction of energy is wasted by a traditional light bulb?

After Doing Math Activities:

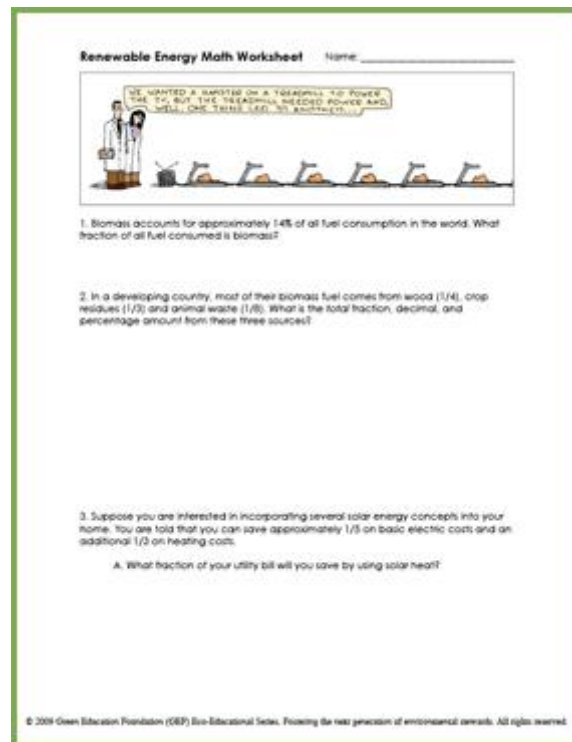
- Have each group present their solution to the problem using the visual tool they developed. Post the visuals for future reference.
- Discuss how energy can be saved by making green energy choices.

Adaptations: Use the statistics on non-renewable and renewable energy to create more advanced problems for more advanced students and more simplified problems for less advanced students.

Extensions: Check out other renewable energy lessons on this GEF website.



GEF Community: Join the GEF Community! First, add your school, class or group as a GEF member. It just takes a minute and your students will learn about technology and social networking all in one. Use your class or group page to keep a record of your students' projects, ideas, and photos. You can share them with other schools across the nation. Simply complete the basic information and then join the Green Energy Challenge where you can share your math of renewable energy tools.



To view full-size lesson plan and print, follow these directions:

1. Click on the image above
2. Click on the small "print" icon at the top left of the lesson
3. Make sure your "Page Scaling" is set to "Fit to Printable Area"
4. Click "OK" and your lesson will be printed!

Click on the second icon from the print button to save your lesson to your computer.

For technical assistance with printing any of the GEF lessons, please contact: service@greeneducationfoundation.org

© 2009 Green Education Foundation (GEF) Eco-Challenge Series All rights reserved.
Fostering the new generation of environmental stewards



* All lessons listed on the GEF website have been aligned with the McREL Compendium of Standards and Benchmarks for K-12 Education. GEF curriculum has been developed in accordance with the McREL standards in order to reflect nationwide guidelines for learning, teaching, and assessment, and to provide continuity in the integrity of GEF curricular content from state to state. The decision to utilize McRel's standards was based upon their rigorous and extensive research, as well as their review of standards documents from a variety of professional subject matter organizations in fourteen content areas. Their result is a comprehensive database that represents what many educational institutions and departments believe to be the best standards research accomplished to date. To access the McREL standards database, or for additional information regarding the supporting documentation used in its development, please visit <http://www.mcrel.org>.