

Fossil Fuels & Chemical Energy

Lesson Objective & Summary

Objective: Students will understand that chemical energy can be converted into heat, light, and motion. Students will identify the differences between renewable energy and non-renewable energy. Students will be able to identify sustainable energy sources like wind, solar, and hydroelectric power. Students will understand ways each person can conserve energy in their daily lives.

Summary: In the first lesson, students will watch [Mud Volcanoes](#), [Yanar Dag](#), [How Does Wind Power Work](#), and [What is a Fossil Fuel](#) and discuss the types of energy addressed in these episodes. Students will identify ways to reduce their daily consumption of energy, practice doing so at home, and journal their experiences. Students will write and perform a persuasive speech articulating the importance of reducing energy consumption.

In the second lesson, students will understand that motor vehicles is a primary mode by which Americans consume petroleum. Students will understand that different cars use different amounts of fuel, and they will cross compare the miles-per-gallon of various cars on the market today. Students will advocate for the car of their choice, citing reasons why today's consumers should take miles-per-gallon into consideration when purchasing a new car.

Standards & Benchmarks

From the National Science Education Standards Grades 5 – 8

- Energy is the property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei and nature of a chemical. Energy is transferred in many ways.
- Soil consists of weathered rocks and decomposed organic material from dead plants, animals, and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

From the Common Core Standards for Language Arts

- Writing arguments to support claims with clear reasons and relevant evidence.
(*Writing/Text Types and Purposes/Grades 6 – 12*)
- Write routinely over extended time frames (time for research, reflection and revision) and shorter time frames (a single day or two) for a range of discipline specific tasks, purposes, and audiences.
(*Writing/Range of Writing/Grades 6 – 12*)

Grade Level:
Middle School

DURATION:
2 Lessons

SUBJECTS:
Science, Language Arts, Math

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From the Common Core Standards for Math

- Understand ratio concepts and use ratio reasoning to solve problems.
(*Ratios and Proportional Relationships: Grade 6*)
- Analyze proportional relationships and use them to solve real world and mathematical problems.
(*Ratios and Proportional Relationships: Grade 7*)

Background Information for Educators

Chemical energy is the kind of energy stored between atoms and molecules. Fossil fuels like natural gas, coal, and petroleum all store chemical energy. In a chemical reaction heat is produced, whether naturally or artificially, and this process causes the molecules of a substance to rearrange, thereby transforming the substance into an entirely different material or byproduct. Natural gas and petroleum are transformed in ways that yield motion, light, and/or heat once a chemical reaction has occurred. We use chemical energy every day when we heat our homes, take hot showers, cook our food, turn on our lights, and drive our cars. Natural gas and petroleum are not renewable forms of energy, and is therefore not sustainable over time. Once they are used, they are no longer available to us as a useful resource.

Unlike fossil fuels, wind energy, solar energy, and hydroelectric power (the energy caused by moving rivers or streams) are considered renewable resources because they do not utilize finite resources. These kinds of renewable energy sources are constantly replenished and will never run out.

Azerbaijan is one of the oldest countries in the world to export oil and other natural gas. European countries are some of the largest consumers of Azerbaijan's natural gas and oil resources. Presently wind, solar, and hydroelectric power make up only 3% of the nation's energy production. However, by 2020 the government of this Caspian country aims to increase these renewable energy sources to over 9%. That is three times its present production in less than six years.

Automobiles are the primary cause for petroleum consumption worldwide. According to the World Bank, in 2011 there were 797 cars per every 1,000 people in the United States. By comparison, China (which has the largest population in the world) had only 83 cars per every 1000 citizens. That means Americans use more than nine times more gasoline than that of the Chinese despite their higher population!

Key Vocabulary

Conservation
Consume
Fossil Fuels
Peat

Nonrenewable Energy
Renewable Energy
Sustainability

Lesson Plan 1A (class demo & discussion)

Materials Needed: oil or kerosene lamp

1. Watch the following episodes with the class: [Mud Volcanoes](#), [Yanar Dag](#), [How Does Wind Power Work](#), and [What is a Fossil Fuel](#).
2. Light an oil or kerosene lamp and discuss where the fuel originated (e.g: organic matter like decomposed plants and animals, or peat). Point out that these kinds of energy sources take millions of years to create and just minutes to consume.
3. As the fire of the lamp burns, explain that the oil in the lamp is being transformed into heat, or fire, by way of a chemical reaction. The oil in the lamp therefore contains chemical energy.

Lesson Plan 1B (take home & individual project)

4. Create a class list of the ways we use natural gas or oil in our daily lives (e.g: heating or cooling our homes, cooking dinner, watching television, leaving the lights on, running a hot bath).
5. Discuss and list the things each of us can change in an effort to conserve energy. Conservation ideas include:
 - Modifying the clothing we wear to use less heat or air-conditioning
 - Watching less television
 - Minimizing the time spent playing video games
 - Turning off the lights
 - Taking shorter showers
6. Ask the students to agree on one change per day that they can make at home for four nights (eg.: Monday, Tuesday, Wednesday and Thursday), and ask that they journal their experiences. Guiding Questions for Journal Entries Might Be:
 - What did you find difficult about making this change?
 - What did you find easy about making this change?
 - What did your friends and family think about the change you made?
 - Would you recommend this change to others? Why or why not?
7. Each day the students return to school, ask one or two of them to read out loud to the class the entry from the night before. Discuss similarities, differences, and unique experiences had by the students.
8. After the last day of journaling, ask the students to identify one change they made during the week that they would recommend to others and write a speech about it.
9. The speech they will write should argue (1) why making changes in energy usage is important, (2) how small steps can make a big difference, and (3) which changes they would recommend others make and why.

Possible Lesson Extensions

Have the students imagine that they are being honored by the White House for their efforts on energy conservation, and ask the students to read their speeches to the class as if they were on television addressing all of the people in the U.S..

If possible, record the speeches and share on a web platform like iEARN, YouTube, Vimeo, Wikispace, or your school's website. Videos tweeted to @projectexplorer will be shared with our global community.

Lesson Plan 2A (class demo & discussion)

Materials Needed: 17 empty 1-gallon milk containers

1. Watch the following episodes with the class: [Mud Volcanoes](#), [Yanar Dag](#), [How Does Wind Power Work](#), and [What is a Fossil Fuel](#) and discuss how cars are a primary mode by which we use petroleum worldwide.
2. Place the 17 empty 1-gallon milk containers on the floor and explain that this is the average size of one tank of gas for a mid-sized vehicle. Explain further that the average miles-per-gallon for a mid-sized vehicle is 25.

3. Write the following word problem on the board and ask the students to fill in the blanks:

The ratio of miles to the gallon for the average car is _____.:_____,
because for every _____ gallon(s) the car will drive _____ miles.

Work with the students to solve the problem, (1:25, 1 and 25 respectively).

4. Now post on the board the average miles-per-gallon for the following two vehicles and ask them to do the same word problem as above, but replace the blanks with the new ratio/figures.
 - 2014 Toyota Prius: 51 miles-per-gallon
 - 2014 For F-150 Pickup Truck: 17 miles-per-gallon
5. Ask students to go home and research the average miles-per-gallon of their family's car and translate the information they receive into the aforementioned statement. (If students do not have a family car have them seek information on make/model from neighbors, extended family, or friends who are car owners.)
6. Use the figures collected by students to chart the findings on the board; and as a class, determine which vehicles are the most fuel-efficient and which ones are the least fuel-efficient.
7. Put students into small groups and ask them to create/write a television commercial for the car of their choice. (They can select from the range of cars had by the students' families, or from ones they have researched elsewhere.) Ask the students to explain in their commercials why miles-per-gallon is an important point to consider when purchasing a new car.
8. If possible, record the speeches and share on a web platform like iEARN, YouTube, Vimeo, Wikispace, or your school's website. Videos tweeted to @projectexplorer will be shared with our global community.

Possible Lesson Extensions

Ask the students to calculate the average number of gallons used by Americans per year based on the average annual mileage rate of 12,000.

Calculate the average cost of gas per car annually based on the average annual mileage rate of 12,000, and cross compare with other more and less fuel-efficient cars on the market today.

Discuss and list the many ways we can reduce our fuel consumption (i.e.: walk, ride bikes, carpool) and have the students create public service announcements advocating for the transportation mode of their choice.

Assessment Rubric	Below Expectations	Meets Expectations	Exceeds Expectations
Chemical Energy	<p>Student identifies energy as that which is needed to power homes, cars, and cities around the world.</p> <p>Student may not clearly understand that chemical energy can cause a chemical reaction that yields heat, light or motion, thereby transforming the original source entirely.</p>	<p>Student identifies chemical energy as the potential within the structure of an energy source that enables a reaction that causes heat, light and motion.</p> <p>Student understands that once this chemical reaction has occurred, the resource has transformed into a new substance, one that is no longer available to us as an energy resource.</p>	<p>Student understands that a chemical reaction must occur for people to have heat, light, and motion. Student understands that natural gas, coal, and petroleum all contain chemical energy. Student understands that a chemical reaction occurs when the atoms and molecules of a substance are rearranged to form a new product entirely. Student also understands that other sources like the wind, sun, and water also contain energy that can be artificially transformed into a useful power source.</p>
Non-renewable Resources vs. Renewable Resources	<p>Student understands that natural gas, coal, and oil are limited resources that comes from deep within the Earth.</p> <p>Student understands that there are other renewable energy sources that are less wasteful. Student may not understand what makes a “renewable resource” renewable.</p>	<p>Student understands that natural gas, coal, and oil are non-renewable resources made up of organic material deep within the Earth that took millions of years to form.</p> <p>Student understands that people are using natural gas, coal, and oil at a faster rate than it is created. Student understands that natural gas, coal, and oil can be used up over time, but that other energy sources like solar, wind, and hydroelectric power are replenished by nature every day.</p>	<p>Student understands that natural gas is a fossil fuel made up of organic material that is millions of years old.</p> <p>Student understands that unlike natural gas, coal, and oil, renewable resources like solar, wind, and hydroelectric power are replenished naturally every day. The student can identify why renewable energy sources are sustainable and why non-renewable energy sources are not.</p>

Energy Conservation

Student can list several ways he/she consumes energy daily.

Student can list several ways he/she consumes energy, and can also identify ways to reduce that consumption.

Student can clearly advocate for energy conservation in more than one way, identifying the importance for reducing energy consumption on a personal and societal level. The student directly correlates energy consumption with the notion of depleting the Earth's natural resources.

Additional Resources

Index Mundi - Provides country profiles of energy production and consumption
<http://www.indexmundi.com/>

Renewable Energy World - The world's renewable energy network for related news and information
<http://www.renewableenergyworld.com/rea/home>

EIA - U.S. Energy Information Administration
<http://www.eia.gov/>

YouTube - A sample student speech on energy conservation
https://www.youtube.com/watch?v=GYD2qS_QnfE

TrueCost Blog - Lists transportation modes by fuel efficiency, including car, bike, train, airplane, etc.
<http://truecostblog.com/2010/05/27/fuel-efficiency-modes-of-transportation-ranked-by-mpg/>