Summary: Students play a competitive game to simulate consumption of energy resources and explore how decreasing nonrenewable energy consumption, through the use of renewable energy, can help to sustain future energy supplies.

Renewable Candy Resources

Grade Level: K–4 (5-8)

Subject Areas: English Language Arts, Mathematics, Science, Social Studies (Economics)

Setting: Classroom

Time:
Preparation: 30 minutes
Activity: One 50-minute class period

Vocabulary: Finite, Nonrenewable energy resource, Renewable energy resource

Major Concept Areas:
Theme II
- Development of energy resources
- Development of renewable energy resources

Theme III
- Quality of life
  - Lifestyles

Theme IV
- Future outlooks for the development and use of energy resources

Standards Addressed:
Wisconsin Model Academic:
SC: A.8.8, B.8.6, D.8.9, E.8.6, F.8.10, H.8.2
SS: A.8.10, A.8.11, B.8.8, B.8.9, D.8.2, D.8.4, D.8.11

Common Core ELA: L.3-5.3, L.K-5.4, L.4-5.6, RI.K.4, RI.2-4.3, RI.2-5.4, RI.3.1, RI.4.7, RI.5.1, RL.K-1.4, RL.3-4.4, RL.4-5.1, RL.4-5.7, SL.K-2.1, SL.K-1.2, SL.K-5.3, SL.K-3.6, SL.3-5.2, SL.3-5.4, W.K-5.2, W.K-2.8

Common Core Math: K.CC.1, K.CC.4a, K.CC.4b, K.CC.5, K.CC.6, K.OA.2, K.OA.3, K.OA.4, 1.NBT.1, 3.NF.1, 3.NF.3a, 4.NF.2

(Standards cont.)

Objectives
Students will be able to
- distinguish between renewable and nonrenewable resources;
- explain how their energy use impacts future generations' ability to access energy resources; and
- list sources of renewable energy.

Rationale
Appreciating the potential endless supply of renewable energy resources will help students consider use of alternative energy sources in their lives.

Materials
Each group of students will need the following:
- Around 190 pieces of hard candy of one color (candy A)
- Around 60 pieces of hard candy of a different color (candy B)

NOTE: Another option is to use colored legos or pieces of colored paper.

Background
Of the energy consumed in Wisconsin, 94.3 percent is from nonrenewable resources. There is a limited and finite supply of nonrenewable resources, which means they are non-replenishable. For example, fossil fuels such as coal and oil take millions of years to be created and, once used, are converted into a form that is not useful as an energy resource by humans. The remaining 5.7 percent of energy used in Wisconsin comes from renewable resources. This means that it comes from sources that are replenishable. Sources of renewable energy such as the sun and wind are limitless; however, other sources such as biomass can be exhausted if used faster than they can be replenished. For example, corn can be used to create ethanol, but a corn crop might not be able to supply enough fuel as an energy source if consumed unwisely.

Renewable resources people commonly use are solar, wind, hydropower, biomass, and geothermal. See the ***Renewable Energy Fact Sheets*** on the KEEP website for information about these resources.

Why does Wisconsin use only 5.7 percent renewable energy if renewable energy is virtually limitless?

Wisconsin Resource Energy Consumption, by Type of Fuel 2012
(Trillions of Btu and Percent of Total)

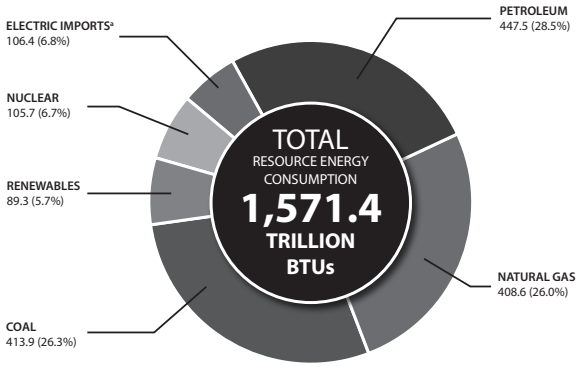

*Figure 1: Wisconsin Resource Energy Consumption, by Type of Fuel (Trillions of Btu and Percent of Total) *Wisconsin State Energy Office. Wisconsin Energy Statistics.*

There are barriers that prevent renewable energy from being a popular alternative for many homeowners, businesses, utilities, and governments.

Cost is one example of a barrier. The up front costs of systems, such as solar panels, may discourage people from buying and installing systems. When consumers consider purchasing renewable energy systems, they are often concerned about payback; they want to recover the initial cost of purchasing and installing a renewable energy system through its production of energy. With the current prices of energy, some renewable energy systems will accomplish a full payback within their lifespan. Factors that influence payback include the type of technology, resource used, and location. If demand, production, and technological advances in renewable energy increase, equipment and installation prices will be reduced and the likelihood of payback will increase. Moreover, although renewable energy resource technologies appear more expensive than nonrenewable resources like coal and oil, external costs and subsidies associated with nonrenewable energy should be considered. Government subsidies reduce the costs of nonrenewable resources, although incentives for using renewable energy are also becoming more common. External costs, or externalities, include environmental damage, property damage, civil unrest, war, and health care. These externalities are not reflected in the market price of nonrenewable energy.

Another important consideration is that most renewable energy sources, such as the sun, wind, and water, are free. Development and production investments go toward materials and labor rather than purchasing fuel. Moreover, the money for developing, purchasing, and installing technology is usually spent within the United States and is frequently spent within the same state or town where the resource is located. Therefore, buying and using renewable energy resources can help make the United States less dependent on other nations for fossil fuels. Renewable energy use is growing worldwide and technologies related to using alternative fuel sources continue to improve and become more efficient. In the future, it is inevitable that the percent of renewable energy resources used will increase and could become a significant source of energy resource consumption in Wisconsin as well as the rest of the United States.

NGSS: K-ESS3-3, 4-ESS3-1, 5-ESS3-1
SEP: Obtaining, Evaluating, and Communicating Information
DCI: ESS3.A: Natural Resources, ESS3.C: Human Impacts on Earth Systems
CCC: Connections to Nature of Science, Cause and Effect, Systems and System Models

Procedure

Orientation

Ask students if they like candy. If they had a large supply of candy, would they eat it all at once, randomly as desired, or spread their candy consumption out over time? Although energy may not seem as interesting as candy, it is an important part of our lives. Ask students what they like to do for fun and write a list on the chalkboard. Circle activities that require an energy source (battery, electricity, fuel). Ask students if they can find the connection between all the circled items. Do students think we have an endless supply of energy to do these things?

Steps

1. Ask four students to volunteer to come to the front of class to simulate energy consumption (an alternative is to divide the class into groups of four and have each group participate).

2. Place the candy (190 pieces of candy A and 11 pieces of candy B) on a table or on the floor in the middle of the students and explain that it represents an energy resource. NOTE: If students ask about the different colors say that you will explain later.

3. Tell students that they represent energy consumers and will have five seconds to grab or consume the energy they need. At this time they should not speak to each other nor eat the candy. If they ask for details (such as how much energy they should grab) tell them they'll need to figure it out for themselves. Explain that they will need 11 pieces of candy to meet their current energy use, but that each student may choose the number of pieces to collect.

4. Give students five seconds to grab or consume the energy they need. Students can only collect one piece at a time. If necessary, try to foster some competition by noting if one student is getting more than the others.

5. Note if there are any candies left in the pile. Tell them that these are the remaining resources that are available for them to consume in the next round.

6. Before beginning the next round, ask them to show what candy they have and count the number of candy B's. For every piece of candy B they have, add an equal number of candy B back into the pile. For example, if

the students happened to grab three candy B's, add three candy B's to the central pile. Remind students they are not to speak yet.

7. Give students another five seconds to grab resources and replace any of the candy B pieces they grab. Continue rounds until there are only candy B's left.

8. After students have returned to their seats (they can eat some candy at this time), discuss the results of the game. Were students able to obtain a consistent amount of energy for each round? What affect would this energy consumption have on future users?

9. Ask students what they think candy B represented. Help them to understand that it was a renewable energy resource and that it could be replenished (candy A represented nonrenewable resources). Ask students to list sources of renewable energy. Note that there were only eleven pieces of candy B in the pile; tell them this represents the amount of renewable energy resources currently used in Wisconsin. Do students think this is enough? Discuss reasons why the percentage isn't higher and garner students' reactions.

10. Tell students that learning about the types of renewable energy resources will help them understand why they are or are not being used. Review each of the types of renewable energy commonly used in Wisconsin (see **Background**). Have students in groups or individually research one or more of these resources on the Internet or in the library and prepare reports on current and potential renewable energy use in Wisconsin.

Closure

Have students share the results of their research and discuss outlooks for increased renewable resource use in Wisconsin. Make sure they explain why each resource is renewable or replenishable.

Comment on ways they can promote use of renewable energy. Tell students they can begin using renewable energy now. How might they use the wind and sun for energy? For example, to some extent they can use the sun to heat their homes and the wind for cooling. Challenge students to look for examples of renewable energy use in Wisconsin and post their observations on a bulletin board or in a class journal.

Assessment

Formative

- Can students distinguish between renewable and nonrenewable resources?
- Can students explain how today's consumption of energy might affect future generations?
- Can students list examples of renewable energy resources?

Summative

Have students suggest how the "Renewable Candy Resources" activity could be further adjusted to allow more people to use the same amount of energy resources. For example, appliances are becoming more efficient and need less energy. Therefore, the game could be adjusted so that each member only needs five energy units instead of eleven. Utilize the questions in the discussion session of the **Procedure** above to assess learning and critical thinking skills.

Extensions

To demonstrate how energy resource consumption is complicated by population growth and rates of growth, divide the class into four unequal groups. Group one is comprised of only one student, group two has half the class, and divide the rest of the class somewhat equally between the other two groups. Tell the students that one student in each group collects the energy for the rest of the group. Play the game in five second rounds and discuss the "fairness" of the game. Tell the students that the different group sizes represent different countries in the world and have them guess which country is represented by the United States versus India or China. Tell students that not only do countries such as the United States consume more energy for fewer people, we also have advanced technologies that enable us to use energy more quickly. Ask students how might the game be adjusted to simulate this? For example, the groups with advanced technologies might have a bowl or a large scoop to help them gather resources or be allowed more time to consume what they want. In 2013, the U.S. utilized about 97 quadrillion Btu of primary energy. This means over 18% of the energy used throughout the world was consumed by 4.5 percent of the world's population (Americans). In 2016, the United States was home to 323 million people and nearly 7.3 billion filled Earth's inhabitable places. Even more importantly, the U.S. population is currently increasing by a rate of one person every 8 seconds. The use of renewable resources coupled with energy conservation and increased efficiency of energy offers us an opportunity to help sustain future energy supplies.

Collect 20 to 40 items that are made from commonly used nonrenewable energy sources. Use products or pictures of items listed on the attached ***Oil (Petroleum) Products*** as a start. Scatter the nonrenewable energy source items over a number of tables, with a labeled number on each. Have the students walk around the room listing items (and their corresponding number) under two topic headings: product of nonrenewable sources and product made of renewable sources. Once students have individually had a chance to list the items under each category, ask them to break into groups of two to three students and combine their lists, debating with reason any products under disagreement. Have student groups then share their combined lists with the rest of the group. Students

may quickly note that the products shown are made of nonrenewable sources and that some products may be efficiently made of renewable resources (e.g., vinyl house siding vs. wood siding). Build on this awareness by admitting to students that all the products on the tables are made of nonrenewable resources. From plastic to unleaded gas, many products we use today are made of depleting resources.

Have students take an 8" x 11" sheet of paper and fold in half multiple times until they are left with a sheet that has creases revealing 16 squares. Instruct students to write onto each square one area that fossil fuels benefit their lives now or will in the future. Utilize the ***Oil (Petroleum) Products*** list for suggestions.

Once students have filled in all 16 squares, have them tear or cut at the folded creases, so that they end up with 16 individual squares.

Next, explain to students that you are going to role play a real situation—an energy crisis. Create a story to illustrate an energy crisis. Due to the energy crisis, fuel prices skyrocket, leaving you and your family with the realization that you will need to do with less energy. Tell students that in order to make ends meet, they will need to give up four squares—or areas that they currently (or in the future hope to) use fossil fuels to meet their needs or desires. Walk around the room with a bucket or hat, having students throw in four squares they have given up to meet the energy crisis. Once you have completed the first round, inform students that the crisis has lasted longer than anticipated and that they will need to give up four more squares. Then, repeat the process one more time until every student has just four squares left. At this point, lead a discussion on the process of this activity. How did it feel to have to give up things they had or wanted? How did they decide what to keep? Is a future energy crisis a real possibility? What options do we have now to prevent a crisis? What squares could they have kept with the use of renewable energy?

Sample of 16 Squares

Fuel for car	Propane stove	Heating	Lighting
Storage (plastic)	Medical supplies	Transportation of foods	Fuel for ATV

Oil (Petroleum) Products (Source: American Petroleum Institute)

Ammonia
Anesthetics
Antifreeze
Antihistamines
Antiseptics
Appliance housings
Artificial turf
Aspirin
Awnings and umbrellas
Balloons
Bandages
Boats
Bubble Gum
Building materials
Cameras
Candles
Car enamel
Car parts
Car sound insulation
Caulking and putty
Charcoal lighters
Cigarette filters
Cleaning utensils
Combs and brushes
Containers
Cortisone
Cosmetics
Crayons
Credit cards
Curtains
Dentures
Deodorant
Detergents
Dishwashing liquids
Dry-cleaning fluids
Dyes
Earphones
Electric blankets
Electrician's tape
Enamel
Epoxy paint
Eyeglasses
Face and hand cream
Faucets
Fertilizers
Fishing equipment
Flashlights
Flavoring
Food preservatives
Furniture
Glues and adhesives
Glycerin
Guitar strings
Hair coloring
Hair curlers
Hearing aids
Heart valves
Hoses
House paint
Imitation leather
Ink
Insecticides
Insect repellent
Insulation
Life jackets
Linoleum
Loudspeakers
Luggage
Motorcycle helmets
Nylon rope
Oil filters
Outboard motor housings
Paint brushes
Paint rollers
Pan handles
Panty hose
Parachutes
Partitions
Perfumes
Permanent-press clothes
Petroleum jelly
Photographs
Pillows and mattress filling
Plastic bags
Plastic pipes
Refrigerants
Roofing
Rubbing alcohol
Rugs
Safety glass
Sails
Sedatives
Shampoo
Sneakers
Soft contact lenses
Solvents
Sports car bodies
Sports equipment
Stretch fabrics
Sunglasses
Sweaters
Synthetic rubber
Tents
Tires
Tool boxes
Tool racks
Toothbrushes
Toothpaste
Toys
Transparent tape
Unbreakable dishes
Underwear
Uniforms
Upholstery
Vacuum bottles
Vaporizers
Vitamin capsules
Waxes and polishes
Yarn
Zippers