

Sustainability in Color

Lesson plan for grades 3-5

Length of lesson: 1 Class Period (60 minutes)

Authored by: Texas State Energy Conservation Office, "Renewable Energy and Sustainability"

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SOURCES AND RESOURCES:

- US Energy Information Administration: Renewable Energy Basics
http://www.eia.gov/kids/energy.cfm?page=renewable_home-basics
- Texas' Renewable Energy Sources: Texas Energy – Past and Present
<http://www.infinitepower.org/txenergy1.htm>
- Original Reading Passage and Definitions:
<http://www.infinitepower.org/pdf/No1%2096-805B.pdf>

POTENTIAL CONCEPTS TEKS ADDRESSED THROUGH THIS LESSON:

§112.14.b Alternative Energy and Sustainability, Grade 3: 7D

§112.15.b Alternative Energy and Sustainability, Grade 4: 7C

§112.16.b Alternative Energy and Sustainability, Grade 5: 7C

PERFORMANCE OBJECTIVES (in order of increasing difficulty to permit tailoring to various age groups):

Students will be able to:

- State the differences between non-renewable and renewable energy sources.
- Identify various forms of alternative energy to fossil fuels.
- Report how burning fossil fuels can cause environmental problems.

MATERIALS (per group of four): This lesson plan assumes a class of 20

- 4 different-colored sheets of construction paper (in this lesson plan, the colors chosen are red, blue, green, and yellow for the sake of example)
- Four sets of safety scissors or age-appropriate scissors
- Five cups of 50-60 lima beans (or other bean/seed).
- 4 copies of the included reading passage: [PDF](#)
- 4 copies of the included reading assessment: [PDF](#)

CONCEPTS:

Energy is the ability to do work.

Energy Efficiency is using less energy to perform the same function.

A **fuel** is something consumed to produce energy (such as wood, gasoline, or coal).

A **fossil fuel** is the naturally occurring carbon or hydrocarbon fuel (e.g. coal, natural gas and oil), formed by the decomposition of pre-historic organisms.

Non-renewable refers to something that cannot be replaced nor replenished (such as fossil fuels).

Pollution refers to material or substances that are harmful to living things.

Renewable Energy refers to forms of energy that are replenished from the natural movements and mechanisms of the environment, such as sunshine (**solar energy**), wind (**wind energy**), the movements of the seas (**hydroelectric energy**), and the heat of the Earth (**geothermal energy**).

To be **sustainable** means to be able to supply our needs today without harming future generation's needs.

BACKGROUND:

This lesson introduces to students the fact that the main energy sources of the present, fossil fuels, are *limited* and *non-renewable* resources. Alternate ways of generating energy can be more environmentally friendly. The students will become familiar with this concept by participating in an original economic activity, engaging in class discussion, reading an accompanying reading passage created by master teachers through the Texas State Energy Conservation Office, and recording their reflections in their daily journals.

PREPARATION:

Have the construction paper and cups of lima beans ready for each group prior to the beginning of the lesson. It may help to create "sets" of materials per table to facilitate the distribution of materials later in the lesson.

ENGAGE: (10 minutes)

The main activity of this lesson involves the students modeling energy consumption in the presence of limited resources. To engage the students without giving too much away, these are some recommended introductory questions:

Ask:

- What are some similarities between ocean waves and the wind?
 - What *causes* the ocean waves and the wind?
 - While it is not expected of the students to understand the mechanics of atmospheric circulation, this question is here because the causes of the wind are in the rotation of the earth and the heating from the sun—both of which are forms of renewable energy later included in the reading material
- How long does a campfire burn for? Why does it stop? How is that different from the sun or a stove?
- We use air conditioners all the time. What does an air conditioner do? What would happen if the AC stopped running? This question is meant for older students, but it is alluding to a later introduction of the greenhouse effect due to gases. The warm air in the building would not be able to escape as easily, and so the classroom temperature would begin to rise.

EXPLORE: (10 minutes)

The purpose of this exercise is to introduce the concepts of limited resources without any specific reference to energy or fuels. This is to lead into a discussion of how energy can be converted into many forms. However, as they will discover, we currently depend mostly on limited resources for generating the energy we use.

1. Divide your classroom into groups of 4-6. In this example, I am considering a class of twenty students divided equally into five groups. Please feel free to modify this as you see fit for your class.
2. Give clear instructions to the group on what the expectations are prior to distributing materials.
3. Each student in the group of four will receive a sheet of blue, red, yellow, or green construction paper. To avoid fighting over colors, it is recommended that the instructors assign colors.
4. The students should fold their paper in half three times so as to create 16 equally sized boxes; they should cut along the creases of the paper to end with sixteen cards.
5. The student with the red sheet of paper in each group will also receive a cup of lima beans.
6. The task for the students in the suggested time limit of 5 minutes is to acquire fifteen lima beans by trading with the student with the red paper and the lima beans and taking turns.
7. When a trade is made, the student with the red paper will roll a die. If the first student's color is blue, then the first student will have to trade

Die Roll	Exchange Rate (Blue Cards to Lima Bean to Red Cards)
1 or 2	1:1:1
3 or 4	2:1:2
5 or 6	3:1:3

That is, he/she will also receive as many red cards as the number of blue cards that are traded. These red cards will not be usable in any further transaction.

8. The student with the red paper will receive one lima bean per transaction.
9. If the next student's color is green, then the process will be repeated and likewise for the color yellow.
10. If or when no more exchanges can be made, have the students write in their journals:
 - a. How many lima beans they were able to obtain.
 - b. How many of their original colored paper (r/g/y/b) cards they have.
 - c. How many total traded cards they have.
 - d. How many **red** cards they have.
 - e. Why their group could no longer continue trading for lima beans.

EXPLAIN: (10 minutes)

After the allotted time has expired, gather the students' attention. Regardless of the remaining number of lima beans in each group, have all students stop their transactions, record their data in part 9 above, and return the

lima beans to their respective cups. To prevent distractions, collect all cups from the tables. Below are some sample questions to begin a class discussion.

- How many students were able to get 10 lima beans? 9? 8? Less than 5?
- Why did your group have to stop?
- Did you end up with more lima beans or more of your original colored cards?
- If you had more time and more materials, what would you change so that everyone in your group could have ten (or more) lima beans?

This discussion section is intended to relate the students' collective experience with the real world of limited resources as it applies to energy production. The main idea behind the previous exercise was for the students to simulate an environment in which their "consumption" of colored cards to obtain a specific product (lima beans) is limited by the amount of resources (colored cards) available. In addition, a byproduct is produced in each transaction that cannot be used to create more lima beans. This extra product—symbolized by the red cards—forms an analogy to pollution. The instructor may introduce terms such as fuel, energy, fossil fuel, non-renewable, or pollution at this time. It is important for the instructor to guide the students into relating the activity to real energy problems while not simply lecturing. A way to lead into the reading passage may be to ask questions like,

- What if we could allow for the red cards to be traded for lima beans? What if we eliminated them?
- What if we could cut each square in half but keep the exchange rates the same?
- What if we changed the rules to reduce the number of cards needed per lima bean?
- What if I gave you all more sheets of paper? How many lima beans do you think you could produce?

ELABORATE: (20 minutes)

In this portion, the students will apply their understanding of limited resources as they read about the various forms of alternative energy and their role in the midst of problems affecting the world such as global warming. Prior to distributing the material for this section, engage the students by asking them of some possible complications that pollution can cause as well as their thoughts on solutions to these problems.

EVALUATE: (10 minutes)

As a check for understanding, have the students record their responses to the following questions in their journal either in class or for homework:

1. List at least two forms of **non-renewable** energy sources to generate electricity.
2. Explain the difference between renewable and non-renewable energy sources.
3. What are some disadvantages of using fossil fuels for generating electricity?
4. What are some ways scientists recommend we reduce energy consumption?

Renewable Energy and Sustainability



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HIGHLIGHTS

- **New energy sources are being used today**
- **Earth is a spaceship**
- **Renewable energy use is sustainable**
- **Global warming can upset the balance of life**
- **Sustainable energy is the fuel of the future—starting now**

THE AGE OF NEW ENERGY

New sources of energy are being used every day. Many types of energy that we use today were not on hand 20 years ago.

Instead of getting electricity from a power plant that burns coal, your home may have a roof with special shingles or panels that change sunshine into electricity.

Out in the countryside, you may see something new in the pastures and fields. Among the cows and crops are huge towers with slow-turning propellers that change wind energy into electricity. Fields with these towers are called wind farms.

Your house may have large, south-facing windows that gather free light and heat from the sun. And your new refrigerator and other appliances may only use one-half to one-fourth the energy that they used 20 years ago.

Although today we rely mostly on fossil fuels—coal, oil and natural gas—things are changing. There is only a limited supply of fossil fuels. Once they are used up, they are gone forever. In other words, coal, oil, and natural gas are non-renewable resources. Fossil fuels also create pollution when they are burned. Pollution is harmful to plants, animals, and people.



*"WE DO NOT INHERIT
THE EARTH FROM OUR
PARENTS, WE BORROW
IT FROM OUR CHILDREN."
CHIEF SEATTLE*

New sources of energy are found in sunlight, the wind, and water. These sources are called renewable energy because they cannot be used up. They do not make pollution when they are used. This type of energy is also known as sustainable energy.

EARTH IS A SPACESHIP

As the Earth travels around the sun through space, our planet carries a limited supply of air, fresh water, coal, oil and natural gas. All of our trash and pollution must stay with us "on board" our spaceship. As more and more people live on Earth, we use more of these limited supplies. Pollution also increases.

Spaceship Earth is so huge that in the past, people believed that its resources would never run out. Some also thought that it could not be hurt by pollution. Recently, many people have decided that we are treating the Earth badly. This is not fair to the people living in the future who will inherit this planet.

SUSTAINABILITY

Non-renewable energy sources were formed millions of years ago, when dinosaurs walked the Earth. Oceans covered most of the Earth. They were filled with tiny sea plants and animals. When the plants and animals died, they sank to the bottom and were covered by sand and mud. Layers of dead plants, animals, sand and mud built up over time.



Heat and pressure turned these layers into fossil fuels such as:

- coal
- oil
- natural gas

Eventually, we will run out of non-renewable energy supplies like coal, oil and natural gas. Long before that happens, the pollution caused by using these energy sources will become a serious problem.

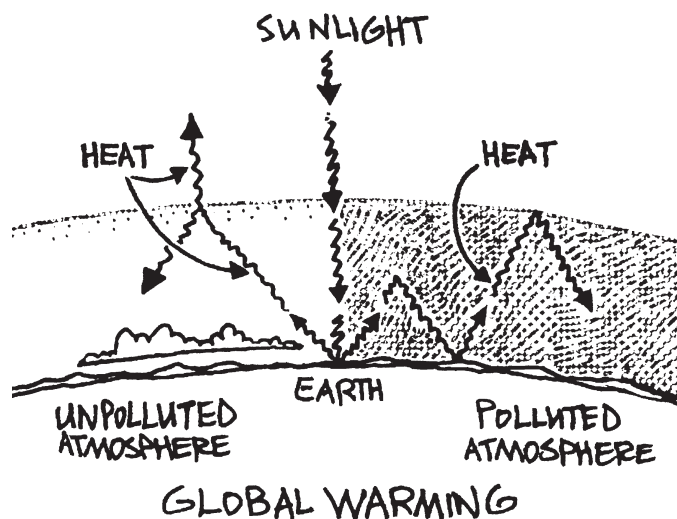
Sustainability means that we make sure we meet our energy needs now without stopping the people in the future from meeting theirs. Renewable energy sources are sources that we will not run out of. They are always being re-made by nature.

Renewable energy sources are:

- solar thermal
- wind
- hydroelectric
- energy efficiency
- solar electricity
- biomass
- geothermal

GLOBAL WARMING

A blanket of air that traps heat from the sun covers our Earth. Without this blanket, the Earth would be so cold people could



GLOBAL WARMING Pollution in our atmosphere traps more of the sun's heat energy causing global warming.

not live here. But too much trapped heat would make it too hot to live here as well.

Sometimes this blanket can act like the glass on a greenhouse when light from the sun hits the Earth and changes into heat, and the blanket traps the heat. Light can pass through the atmosphere (or glass), but heat cannot escape as easily. This causes a slow warming on our planet as heat builds up. This is called global warming. It can change the fragile balance for life on Earth.

We add to the problem by burning fossil fuels. They produce gasses like carbon dioxide (CO₂) that trap more heat and cause more global warming.

Some scientists suggest that we change the way we use energy. They say that we could cut our energy use in half just by making lights, machines, buildings and cars more efficient. In addition, half of this reduced amount could come from renewable resources such as the sun and wind.

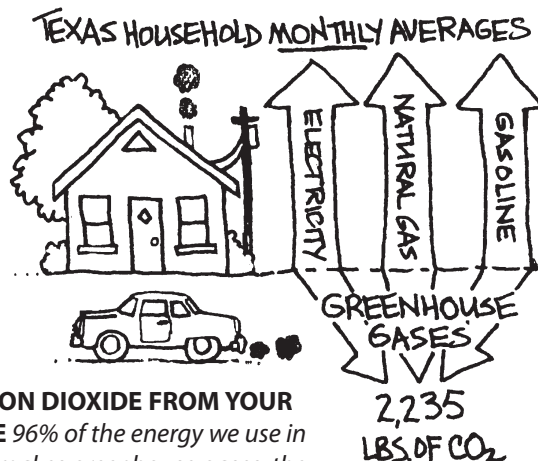
NEW ENERGY TOOLS

Energy helps us do things every day. It gives us light. It warms our bodies and homes. It helps us bake a cake and keeps our milk cold. It runs our TVs and our cars. Cars run on the energy stored in gasoline. Many toys run on the energy stored in batteries.

We are starting to change the way we use energy by using less of it. New energy tools are available today to help us do that. For example, compact fluorescent light bulbs use one-fourth the energy of a typical light bulb. Plus, they save more than \$30 over their lifetime.

We are also starting to use energy coming from different sources. Wind farms make energy for less money than burning fossil fuels. Solar panels that make electricity directly from sunshine are available now, too.

A new age of energy is starting now. Energy efficiency and clean energy from sources that will not run out may totally power your future.



CARBON DIOXIDE FROM YOUR HOME 96% of the energy we use in Texas makes greenhouse gases, the cause of global warming.

1. Recommend at least two renewable energy sources to generate electricity:

1 _____

2 _____

2. List the three types of fossil fuels used in Texas to generate electricity:

1 _____

2 _____

3 _____

3. Explain the difference between renewable and non-renewable energy resources.

4. Imagine that it is twenty years from now, and you have just bought your first energy-efficient home. Describe its energy saving features.

5. Fossil fuels are _____, which means they are in limited supply. What are some disadvantages of using fossil fuels for generating electricity?

6. How does carbon dioxide (CO₂) affect our planet?

7. Explain how our atmosphere is like a greenhouse.

8. How does burning fossil fuels affect our air quality?

9. What are some of the ways scientists recommend we reduce our energy consumption?

10. Has this unit changed your attitude about energy consumption? Give details to support your view.

11. Imagine you have bought your first car. Describe the car in detail. What makes it go? Where did you go?

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