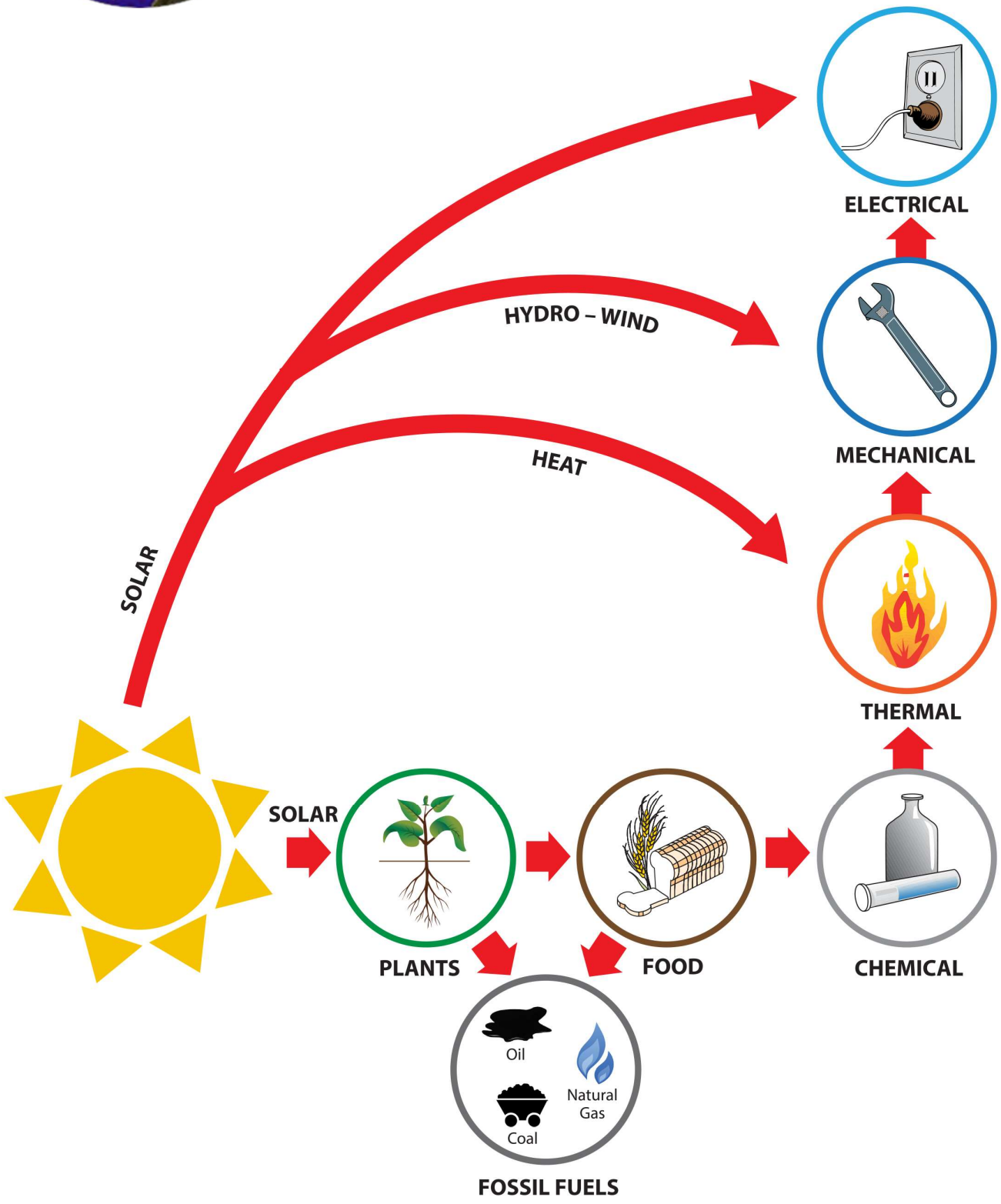
EarthCircles

Acquiring Energy



EarthCircles

Acquiring Energy

TABLE OF CONTENTS

INTRODUCTION 3

LESSON 1: Harnessing Energy 8

LESSON 2: Where Energy Comes From 14

LESSON 3: We Are All Plugged In 18

LESSON 4: Feeding the Multitudes 26

LESSON 5: Ten Gallons of Gas 32

LESSON 6: Power from Nature 36

LESSON 7: Optional – Solar Cookie Bake 41

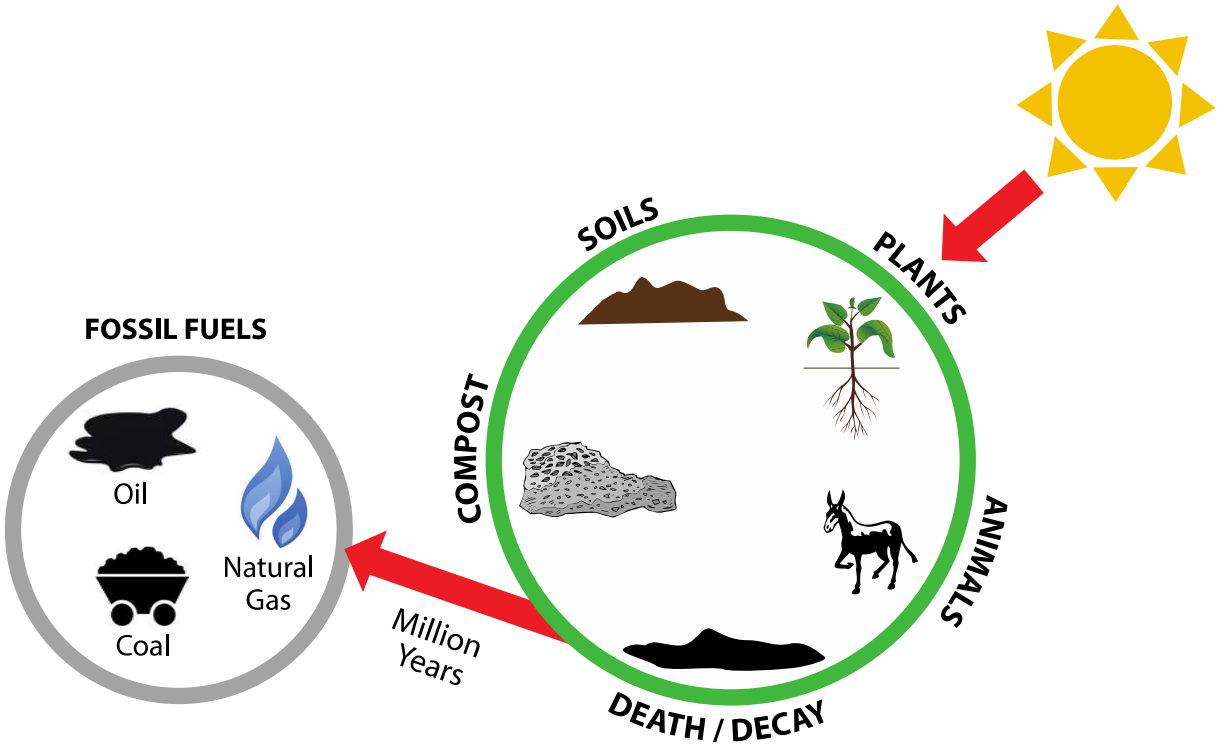
EarthCircles

Acquiring Energy

INTRODUCTION

"You are my sunshine my only sunshine! Please don't take my sunshine away!" are words from a once popular song. Sunshine of course is the ultimate source of our energy supply, whether we live in an advanced, high-tech society dependent on electricity or in a more primitive society that lacks electricity altogether.

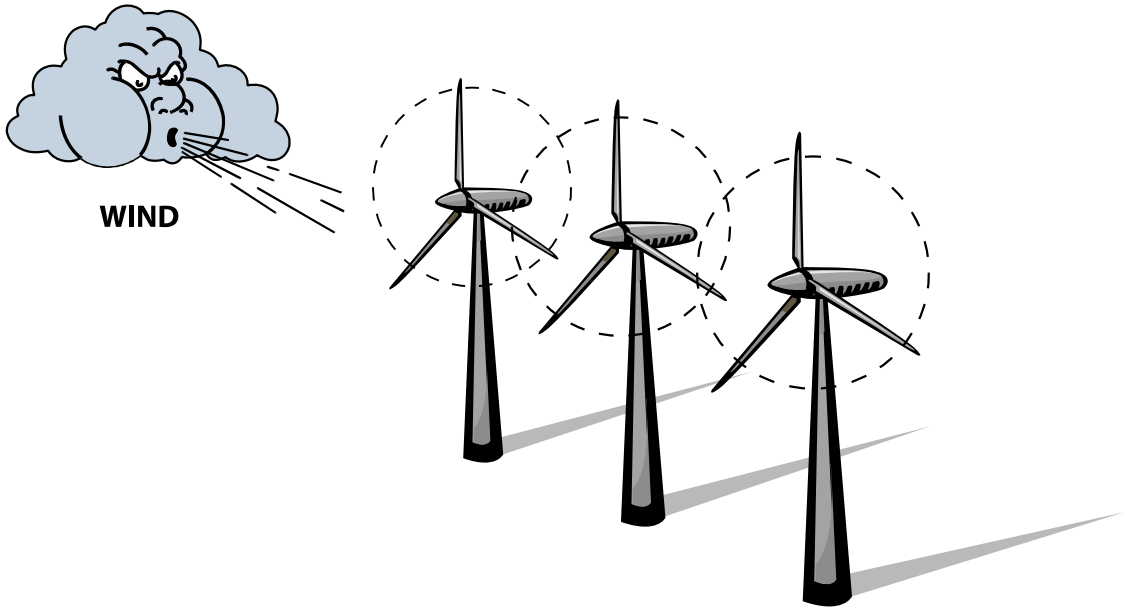
Our way of life requires access to electricity. In turn, this access depends on energy from the sun. The energy in fossil fuels is stored sunshine captured by living plants and stored as carbohydrates. The remains of dead plants are converted into fossil fuels in a process that takes millions of years. That is why we consider them to be non-renewable. Most of the world's electricity is made with energy from fossil fuels. As we deplete the stores of fossil fuels, are we "taking our sunshine away?"



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Stored coal and oil and natural gas are like money in the bank. We can use the money freely until the supply gets low. If we don't (or can't) replace the money at that point, we run into trouble – bounced checks, bankruptcy, even jail if we resort to unlawful tactics. As we use up Earth's stored fossil fuels, the analogy holds. We are using up our store of fossil fuels much faster than they can be replenished, as noted above. What are we doing to replace them?

The source of energy stored in fossil fuels is the sun – the mint, the super banker for energy. When we talk about *renewable energy* such as solar, wind, and water power, we are talking about going directly to the mint for our energy. The sun's rays heat the air, creating winds, and heat the water creating swift moving currents in rivers and oceans. This action can power generators that make the electricity we need. In solar panels the sun's energy agitates the molecules in the panels, causing them to generate electricity directly. Why not go directly to the bank for our energy?



In the last half century this is beginning to happen. More and more people in the United States have solar panels on their houses to generate their own electricity. We see more and more wind farms and hydro-power works across the land.

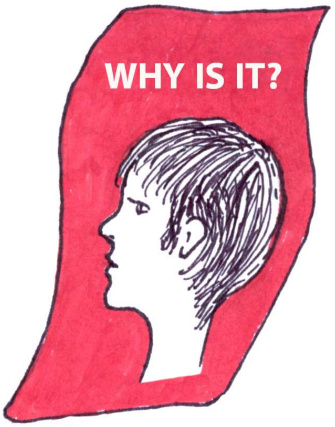
Meanwhile the energy industry is trying to pull every last lump of coal, drop of oil, and supply of natural gas from Earth, regardless of impact on lands of value to people who live on them. As a result, Earth's crust is suffering from more severe and numerous earthquakes and sink holes. People across the planet are suffering from the impact of severe weather and the intrusion of oil and natural gas pipelines through neighborhoods and across agricultural and tribal lands. The legality of such intrusions on occupied lands is in question and citizen protest movements are working to curtail such projects and establish protections under the law.

It is possible for folks to be using clean energy now by adding solar panels to their houses. In some places they may purchase Renewable Energy through their electric company. When there is enough demand, the electric grid responds with more "green" energy sources.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

This is perhaps more information than you need for this lesson but Kids may have questions.

- Where do we get power?
- What do power companies do for us? At what cost?
- Is electricity a safe and clean power source?
- What about energy options?
- What do people do where there is no electricity?
- What are *Renewable Energy* resources?



The purpose of this unit is to involve Kids in some simple activities to develop an understanding of how people power their lifestyles and the sources of that power including solar and wind. Lessons in this unit ask Kids to explore these questions.

LESSON PLANS

Lesson 1: Harnessing Energy

Concept: Energy from the sun is the source of almost all of our power. Electricity is a secondary form of energy that we manufacture.

Action: Kids create an energy timeline of the sources and uses of power over the ages.

Lesson 2: Where Energy Comes From

Concept: The energy in fossil fuels and in food is stored heat and light from the sun, captured by green plants via chemical reaction. Burning of fossil fuels releases stored energy and generates heat. Heat makes machines and muscles move (*kinetic energy)*.

Action: Kids make oil lamps and compare this source of light with electric light.

Lesson 3: We Are All Plugged In

Concept: We depend on electricity to do many things we used to do for ourselves. But many people across the world do not have electricity.

Action: Kids become familiar with a home electric bill and the meter that records kilowatt hours. Then they prioritize the importance of various electric and electronic appliances in their lives and consider what life is like with no electricity.

Lesson 4: Feeding the Multitudes

Concept: The way food is grown and brought to market has energy costs.

Action: Using a world map, Kids trace the origin of some favorite foods and estimate energy costs for getting it to their plates.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Lesson 5: Ten Gallons of Gas

Concept: Limited resources such as gasoline can be conserved through collaboration and change in how we use them.

Action: Kids figure out how much gas it takes to get to school, then plan a vacation destination based on ten gallons of gas each to get there and back.

Lesson 6: Power from Nature

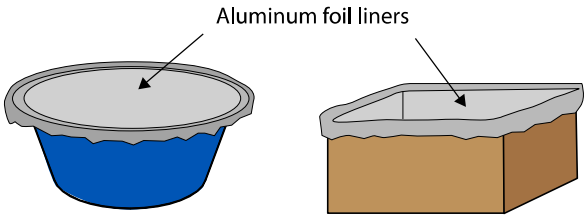
Concept: We can use natural energy sources to provide us with needed power.

Action: Kids make simple windmills or water wheels and investigate how gears work to change forms of energy.

Lesson 7: Optional Solar Cookie Bake

Concept: Energy from the sun can be used directly for tasks such as cooking.

Action: Kids make simple solar ovens and bake cookies. They consider how energy changes from one form to another.



Resources:

Books for Kids:

Bang, Molly, and Chisholm, Penny, *Buried Sunlight, How Fossil Fuels Changed The Earth,* Blue Sky Press (Scholastic Inc.), New York, N.Y., 2014
This award-winning book explores the wonder of how our sun gives life to most living things – including us.

Capeci, Anne, *The Magic School Bus Rides The Wind,* Scholastic, Inc., NY, 2006
Kids ride in the magic school bus with Ms. Frizzle and learn all about wind and wind energy.

Casey, Dawn and Wilson, Anne, *The Barefoot Book of Earth Tales,* Barefoot Books, Cambridge, MA, 2009
This collection of stories from cultures around the world relates how different peoples/cultures set out to live in harmony with nature.

Drummond, Allan, *Energy Island,* Farrar Straus Giroux, New York, N. Y., 2011
This inspiring true story is about people on an island in Denmark and why and how they became energy independent. Several informative factual columns enhance the story.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

McKinney, Barbara Shaw McKinney, *Pass the Energy Please,* Dawn Publications, East Rutherford, N.J., 2011
This upbeat rhyming story connects all creatures on Earth in a fascinating food chain dependent on green plants for their energy.

Rockwell, Anne, *What's So Bad About Gasoline?* Harper Collins Publishers, New York, N.Y., 2009
In this book Kids can find out where oil and gasoline come from, how we use them, and the harm they do to our planet. The energy options we can use are described, along with the message of everyone's responsibility to do what each of us can do for planet Earth.

For Teachers:

Bailey, Jacqui, *What's The Point of Being Green?* Barron's, Hauppauge, N.Y., 2010
Informative paragraphs about the health of our planet including global warming, factoids on every other page, ample what-to-dos, and fun illustrations make this book a worthwhile resource for any classroom.

On the Web:

Energy Kid's page: http://www.eia.doe.gov/kids

EPA website: http://www.epa.gov/education

NASA website: https://mynasadata.larc.nasa.gov/lesson-plans/lessons
This site has ideas for lessons using NASA data.

Acknowledgements:

We are most grateful for the many people who helped develop and teach these lessons as they were designed and piloted with UU Kids. Janet Powers, co-author, and Lisa Rubin, Director of Religious Education at First Parish UU in Bedford were especially supportive. Dozens of people helped with typing, reviewing, editing, illustrating, trial teaching of lessons, finalizing design and layout. How could we have done this without each and every one of them!

We also appreciate support grants from the Social Responsibility Council at First Parish and a generous grant from the Unitarian Sunday School Society. These grants helped us develop a more professional teaching resource.

Thank you, everyone, for helping to make our environment a reality for religious education!

— Maureen Oates and Janet Powers

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 1: Harnessing Energy

OVERVIEW:

Concept:

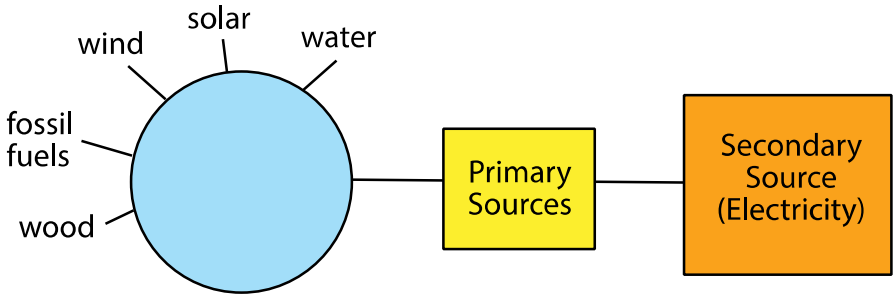
Energy from the sun is the source of almost all of our power. Electricity is a secondary form of energy that we manufacture.

Background for Teachers:

Where does energy come from and how do we use it? Everything needs energy to function. The sun provides energy to plant life, which uses it to make and store nutrients. Animal life, including human, consumes plants and other animals for food. Living creatures need the energy stored in food to carry out life functions. Machines need the energy stored in chemical fuels such as coal, oil, and natural gas or direct energy from solar power to do their work.

Primary Sources of energy are those that can produce power by themselves. These include wood, coal, oil, natural gas, wind, water, and solar energy. A secondary source is one that needs a primary energy source to produce it. Electricity is an essential example. In turn electronics use electricity for a power source.

Electronics is the careful, precise control of tiny electric currents. Electronic components are built into a circuit to perform a particular task. A *transistor* is a component used as an electronic switch.



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

People have always consumed food to obtain energy needed to live their lives. Through the ages people basically did everything themselves – hunt, fish, gather edible plants, make their own shelters and clothing, walk or run anywhere they needed to go. Wood fires, and then coal were used for thousands of years, until the late 1800s. This is still how cooking is done in some parts of the world.

Fire was an important tool for early man, one that was never completely mastered. Fire is still a source of fear, even terror, when it gets out of hand. But a controlled fire is a wonderful tool even today, and a source of comfort and delight.

Simple tools were developed starting around 70,000 years ago. The first tools required human energy to make them work. Then about 15,000 years ago beginning with pigs, then sheep and goats, people learned to tame animals to help with the work of living. These animals also depended on food for energy. Horses were in use and the cat was domesticated about 6,000 years ago.

The wheel was invented about 7,000 years ago, first for making pottery. Simple machines such as water wheels came into use about 4,000 B.C. The first windmills appeared in Greece about 100 A.D. These machines used solar power to function. In the mid-19th century the use of fossil fuels and electricity made more complex machines to do work once done "by hand" possible, leading to the Industrial Revolution. The 20th century saw amazing developments in transportation, communication, and the growing, processing, distribution, and cooking of food. Now in the 21st century, electronic technology is changing the world into a global community.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON:

Action:

Kids try out some primitive tools that we still use. Then they create an energy timeline of sources and uses of energy over the ages.

Materials:

For introduction:
- Full, heavy box or carton
- Lever
- Roller
- Mechanical mover

For activity:
- Timeline notes
- Construction paper
- White paper
- Markers or colored pencils
- Tape

Book: *Earth, Fire, Water, Air*, by Mary Hoffman and Jane Ray

Preparation:

For Introduction:
- You will need a box full of heavy, full water bottles or canned food. You may be able to borrow such a full carton from the kitchen crew or from a parent.
- For a lever, ask the custodian to loan you a crowbar, or a parent may have one you can borrow.
- For a roller, any sturdy cylinder such as a large rolling pin will do.
- A mechanical mover may be harder to come by. Markets have forklift carts that move heavy cartons to the shelves in the store. Kids may have seen this in action.
- Place the heavy box in the middle of the circle. Have the lever and roller near where you sit.

For action:

Make copies of *Timeline Notes* (p. 11), one for each Kid.

Gather paper, markers, and tape for each team. Put them on the supply table.

Make copies of the *Timeline Notes* (p. 11). How many depends on the number of Kids in each of four groups of Kids. For example, if there are three Kids in each of the four groups, you will need three copies of each of the four cards.

- Gather paper, marker, and tape for each team. Put them on the supply table.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON:

Opening Circle:

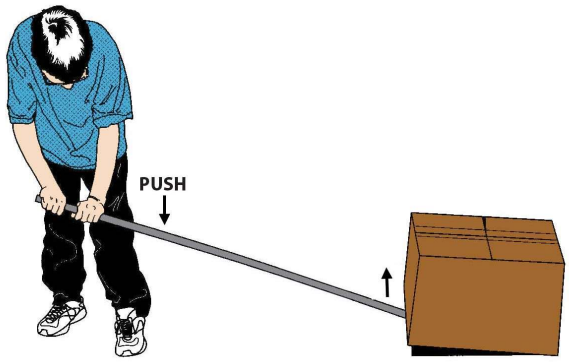
Greet the Kids as they settle into the circle of chairs. Note who is present.

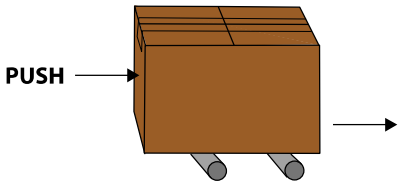
Discussion:

Use background information to talk about how over the ages people have depended on their own energy that came from food for all the tasks of survival. Describe how the energy stored in food came from the Sun. You could ask whether early man cooked food and if they did, how do Kids think it was cooked. Use background information to enrich discussion.

Tell Kids that the original wheel was invented for making pottery just a few thousand years ago. What would we have to do without in today's world if the wheel were never invented?

Activity 1:





- Point to the box and ask for one or two volunteers to try moving it by picking it up. They may find it difficult to get fingers under the box. Show them the lever.
- Do Kids know how to use it? Let Kids use it on the box to lift a side and let fingers under the box.
- With the edge of the box lifted. Kids can place the roller under it and roll the box along its width, then move the roller to the leading side of the box to roll it again.
- Mention that when early man made a new tool, it took a long time for people to learn to use it.

Activity 2:

Introduce this activity with a question:

> What would it be like without machines and appliances that use fossil fuels directly for power such as most cars or lawn mowers? Or appliances that use electricity such as refrigerators, or electronic devices? How would we adapt?

Divide the class into four teams and provide each kid with a copy of the time line notes. Allow a few minutes for the Kids to look over the notes. Ask them to especially notice how long it took for the ways to do things such as get food to change for the better. Do they have questions at this point?

Ask the four teams to create a timeline from information in these notes. You may assign one time frame to each of the four groups of Kids, or let the teams self-select. Each team's task is to

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

make 4-6 energy use posters to illustrate their timeline card. Or teams may choose to create a poem or rap song about the changes over time. Allow 10-15 minutes for teams to create their sections of the timeline.

When the teams are ready, have them use tape to mount their timelines in sequence around the classroom.

In light of global warming and climate change, what do the Kids think might be next on the timeline?

- Do Kids think that electricity is a cleaner power source than burning fossil fuels? Point out that power in electricity also comes from the Sun by the way of fossil fuels or directly from the Sun as solar power. (Power can also come from geothermal energy, which is from the Earth's interior.)

Story: *A Bad Master*, p. 44, *Earth, Fire, Water, Air,* by Mary Hoffman and Jane Ray

Discussion:

What good experiences have Kids had with fire? (campfire, birthday candles, etc.)
How about bad experiences? (house fires, forest fires, etc.)
What uses of fire today can Kids describe?

- Fire was a primitive tool for early man. How does modern man use it?

Principles in Practice:

Ask Kids:
What do we have in common with early man?
Our ancestors from the Stone Age?
From the Cro-Magnon?
From the last few thousand years?
(We all need food every day, shelter from storms, safety, love.)
What else do we need to survive, or do we want from our advanced way of life?

- What could we do without if we had to?

Closing Words:

"The Earth is what we all have in common."
— *Wendell Berry*

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

TIMELINE NOTES

EARLY MAN: 200,000 years ago in Africa

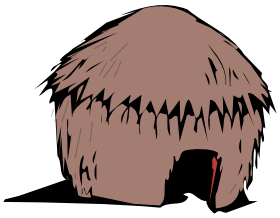
Tribes of people lived in caves
170,000 years ago – humans began to wear clothing
82,000 years ago – sea shell jewelry
70,000 years ago – early cave art
- 64,000 years ago – spears and daggers for hunting

$$\frac{\sqrt{K^2}}{5R} + \frac{3.2}{4} = ?$$

But I just don't have the technology to do it!"

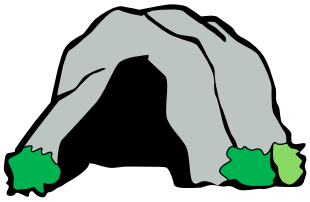
CRO-MAGNON: 25,000 – 5,000 years ago

25,00 years ago – hamlets, huts built of rocks and stones, oldest human settlement
20,000 years ago – bow and arrows, cooking vessels in China
15,000-12,000 years ago – domestic pigs, goats, cattle
11,000 years ago – Jericho, world's oldest city
10,000 years ago – growing wheat and barley, using plant sticks
7,200 years ago – first farming settlement, domestic cats
7,000 years ago – wheel; prewriting
6,000 years ago – horse domesticated
- 5,200 years ago – writing invented, beginning of history



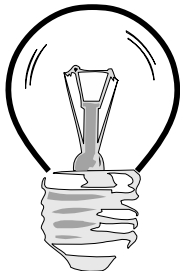
STONE AGE: 50,000 – 25,000 years ago

50,000 years ago – needles
42,000 years ago – canoes from logs, deep sea fishing
40,000 years ago – cave paintings
- 28,000 years ago – harpoons, saws, pottery



MODERN MAN: 5,000 years ago to present

- 4000 B.C. – water wheel
- 2400 B.C. – chariot, stand alone for battles
- 700 B.C. – chariots with horses
- 3500 B.C. – early plow
- 1,837 A.D. – modern plow
- 100 A.D. – wind mill, printing press
- 1800s A.D. – coal, gas, oil for energy
- 1850 A.D. – electricity



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 2: Where Energy Comes From

OVERVIEW:

Concept:

The energy in fossil fuels and in food is stored heat and light from the sun, captured by green plants via chemical reactions.

Background for Teachers:

How do we define energy? We know what it does, but we are less clear on what exactly it is, so we describe it more than we define it.

First we set up two categories. Energy on the move, doing something, is called *kinetic energy*. Energy that is stored is called *potential energy*. Kinetic energy moves things, heats things, and gives us light. Fossil fuels, food, batteries, and the nucleus of an atom store potential energy. Most stored energy comes from the Sun. Green plants use this energy to make and store nutrients, and are the basis of the food chain for most living things. Fossil fuels were formed from dead plant and animal materials over millions of years.

Energy is constantly changing. To be doing work, it has to be in its kinetic form. Stored in chemical form in fuel or food, it is *potential energy*. When the food or fuel is burned, this potential energy changes to a kinetic form, heat, which is *thermal energy*. The heat can be used to form steam to turn the blades of a turbine, thus changing the thermal energy to *mechanical energy*. This turbine can turn an electric generator, and some of the mechanical energy will become *electric energy*.

Whenever energy changes from one form to another, there is a heat loss. This heat energy leaks away and gradually warms up the atmosphere. When fossil fuels are burned, it releases CO_2 as well as heat into the atmosphere. This CO_2 creates a barrier that prevents heat from escaping Earth's atmosphere into space. For hundreds of years, the temperature of the Earth's atmosphere has risen 1°C every 100 years. In the 20th century, it rose 3°C.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

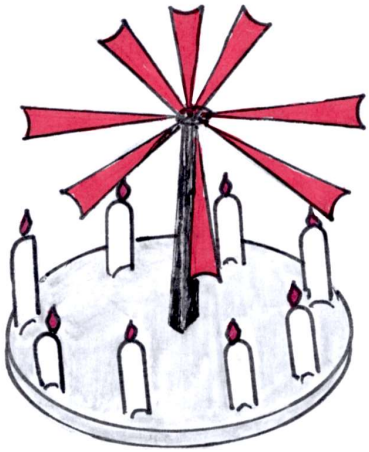
LESSON PLAN:

Materials:

For demonstration:

Candle whirligig or similar device (pinwheel?)
Candles to fit whirligig
Matches

- Large additional candle



For activity:

Small glass jars (not plastic)
White cotton shoestring (lengths 3-4 inches long)
1 pint vegetable oil

Book: *People and the Planet,* by Torrey Maloof

Preparation:

Review the background, demo, and activity and decide how you will use them.
Borrow a Christmas whirligig or similar device, or plan to use candles with a pinwheel.
Obtain small candles to fit this apparatus, and one large candle for the demo.
You will need matches.
Recycle baby food or small jelly jars, always glass, to make useable oil lamp models.
A week in advance, ask each Kid to bring in 1 or 2 such jars, with a ½ inch hole punched in the metal lid. Send a note to parents to ask for the contribution.
Cut white cotton shoestring into 4-inch lengths to use for wicks.

- You will need a pint of vegetable oil (olive, canola, corn, etc.).

LESSON PLAN:

Opening Circle:

Greet the Kids as they come in and note who is present. When all are settled in the circle of chairs, tell the group that we will be looking into energy, where it comes from, and how it makes global warming.

What do they already know about these topics?

- What questions and concerns do they have? (list on board)

Use background information to talk about how over the ages people have depended on their own energy that came from food for all the tasks of survival. Describe how the energy stored in food came from the Sun.

Discussion:

Tell Kids that the original wheel was invented for pottery making.

What would we have to do without in today's world if the wheel were never invented?

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

What would it be like without machines and appliances that use fossil fuels directly for power such as most cars or lawn mowers? Or appliances that use electricity, such as refrigerators or electronic devices?

- Do Kids think that electricity is a cleaner power source than burning fossil fuels?

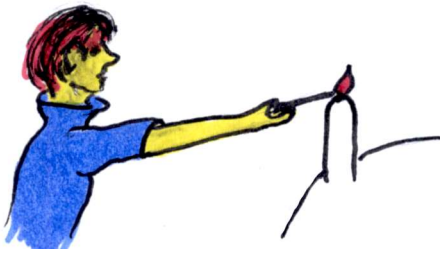
Point out that power in electricity also comes from the Sun by way of fossil fuels or directly from the Sun as solar power. (Power can also come from geothermal energy, which is heat stored deep in Earth's core.)

Demonstration:

If you have a whirligig, place it on a small table in the middle of the circle or wherever Kids can observe what happens. Light one candle for them to observe how the ring of figures moves.

If you do not have a whirligig, use a ring of five large candles and a pinwheel. With Kids seated in the circle, light one candle and hold the pinwheel about a foot directly over the flame, or have a Kid do this. Have the Kids observe how the pinwheel moves.

How do Kids explain what they observe? (Hot air rising moves the circle of figures in the whirligig or spins the pinwheel.)



Have another Kid light a second candle in the ring. Does the circle of figures or the pinwheel move any faster? Have the Kids explain why this might be. (More heat rising.)

Repeat the candle lighting sequence three more times, involving different Kids.

Help Kids apply these observations to winds on the planet. Do they recognize that, because the sun shines more directly around the equator than at the North and South poles, warmer air at the equator and colder air at the poles mix or collide to create weather?

Activity:

Kids make small oil lamps.

- Explain that this kind of device, called an oil lamp, was how people brought light into homes for centuries. Sometimes in today's world, we use an oil lamp during power outages.

To make a small lamp:

- Provide each Kid with a piece of cotton shoestring and a small jar with a metal lid. The lid should have a small hole in the center.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Directions for making a lamp:

Pull the shoelace up through the hole in the lid, so that about an inch of the shoelace will be sticking out of the jar when the lid is closed. Most of the shoelace will be curled up in the bottom of the jar.

As each Kid is ready, you pour half an inch of oil into the jar, covering the lower end of the shoelace wick. (If Kids need an explanation, a wick is made of material that absorbs oil and moves it along its fibers. With a lit wick, as the flame burns up oil, more oil moves up the wick until it is all used up.)

- You may have Kids light their oil lamps and watch for heat rising and pollutants going into the air. After 5-10 minutes, or if time is short, suggest they do this exploration with a parent at home to talk about next class.

Discussion:

What do Kids observe?

Have their parents used a similar device during a power outage? How did Kids feel about that? Would they want this kind of device to be the only source of light in their homes?

- Our homes have good light sources that are generally reliable. How about people living in third world countries?

Story:

Meloof, Torey, *People and the Planet,* Teacher Created Materials, Hunting Beach, CA, 2015
How human activity is causing major changes on planet Earth is covered with simple language and telling illustrations. The text also suggests simple things we can do to help save our planet, our only home.

Principles in Practice:

What can Kids agree to do, either each one alone or as a group, to make a difference in our planet's health?

Closing Circle:

Ask the Kids to repeat these closing words together:

"Unless someone like you cares a whole awful lot
Nothing is going to get better. It's not!"

— Dr.Seuss, *The Lorax*

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

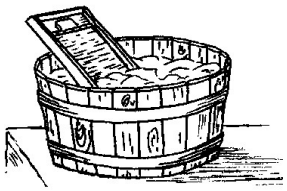
LESSON 3: We Are All Plugged In

OVERVIEW:

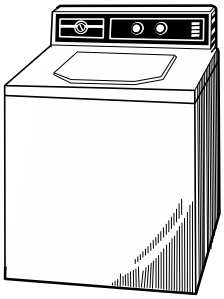
Concept: We depend on electricity to do many things people used to do by ourselves.

Background for Teachers:

Inventions start with ideas for solving problems and making life easier. A century ago inventions to save time and energy in the home were just beginning to appear. Growing up in the 1930s, I can remember our first refrigerator, our first telephone, my mother's washing machine with a wringer attached, our first phonograph that had to be wound up to play. Television and computers have been a major part of home life for less than 60 years. The 20th century was amazingly fruitful with new ways to use electricity and electronics

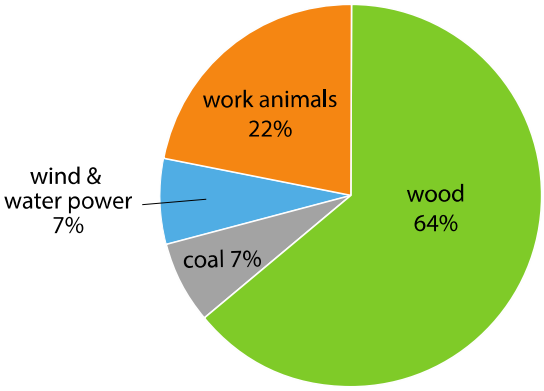


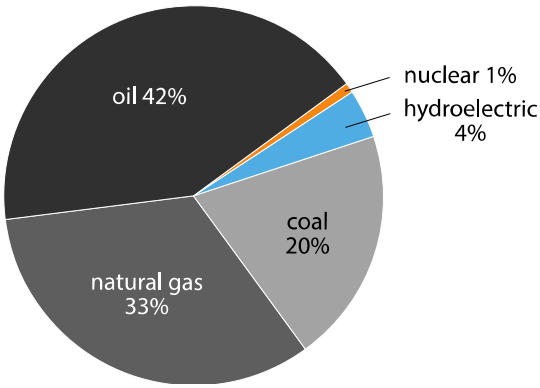
1850



1950

As a result, our use of electricity in daily life has increased rapidly. Electricity is a secondary energy source, dependent on primary sources such as oil and coal to generate it. Thus it may or may not help to use electricity as a non-polluting source of power. As the cost of fossil fuels rises because of dwindling resources, the cost of electricity also rises. Development of solar, wind, and waterpower contributes to keeping electricity available. Limits on our use of electricity may be in our future.





Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

More than a billion people on Earth have no electricity. The story for this lesson is about life in rural India, where the majority of people still use kerosene lamps to ward off darkness. Just providing solar-powered lamps to families living in poverty improves their lives immensely. It also reduces air pollution from ash and fumes from their kerosene lamps, improving health in the region.

LESSON:

Action:

Kids become familiar with a home electric bill and the meter that records kilowatt hours. Then they prioritize how important electric and electronic appliances are for their lifestyle. They consider what life is like without electricity.

Materials:

Candles or a hurricane lamp
Energy pie graph poster or one drawn on the chalkboard board
Electric bill
Kilowatt Krunch Survey table
Kilowatt Meter (available at library or from a local electrician)

- Light bulbs

Book/Story: *Uttar Pradesh,* adapted from National Geographic article, December 2015.

Preparation:

Read through the activity and decide how you will use it.

Kilowatt-hour (KWH) values are averages from figures in the report, *Stalking the Wary Kilowatt,* Minnesota Environmental Sciences.
You will need several candles or a hurricane lamp for the introductory activity.
If using a lamp, you will need oil for it.
Make a copy of an electric bill (p. 22) and a copy of the *Kilowatt Krunch Survey* sheet (p. 23) for each Kid.
For the lesson, close the window shades and turn out the lights. Block windows to reduce light.
Borrow a Kilowatt Meter from a local library if available, or from an electrician.
Purchase light bulbs, or ask parents to lend one each for the lesson.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON PLAN:

Opening Circle:

Greet the Kids as they come in and seat themselves in the circle of chairs.

Do Kids have comments about how dim the room is without the lights?

- Are any Kids familiar with their home's monthly electric bill. (Probably no one.)

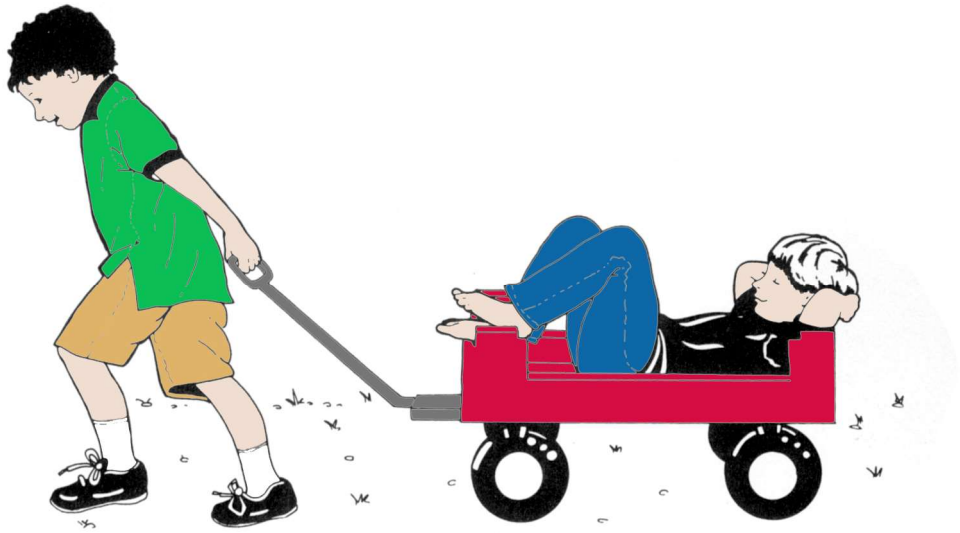
Tell them today's lesson is about how much electricity an average family uses, and how this aspect of daily life impacts our environment.

Discussion:

How would Kids feel about going to school all day in this kind of environment?
Traditionally it was Kids' jobs to sweep the floor, carry water from the well, wash and dry dishes, cut and carry wood for heat, and collect eggs from chickens.
What about other work such as cooking, clothes washing and drying, general house cleaning?
Where did the energy to do all that work come from?
How many appliances now use electricity to make this work easier?
Entertainment is another example. Music and song were once homegrown, now they are available 24 hours per day at the press of a button.

- How about transportation?

Even gas-fueled machines such as cars need an electric spark from a battery to start the engine. Cars are moving more and more toward electric engines to reduce pollution. However that depends on the source of electricity.



When you asked me to go for a ride in an alternative energy vehicle,
I thought you meant a solar powered car!

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Kilowatt Activity*:*

Do Kids see a connection between our current critical energy situation and our dependency on electricity in our daily lives?

Provide each Kid with a copy of an electric bill (p. 22) and point out the record of kilowatt hours used for billing. Have they seen an electric bill at home?

Do they know where the electric meter that records their family's use of electricity is located?

They may want to check these things at home with a parent's help.

- Meanwhile, the class can visit the church's electric meter in the utility room, and/or use the meter borrowed from the library to check electricity use in appliances such as the refrigerator, a computer, a radio, and/or a vacuum cleaner in the church.

Ask Kids to suppose that electricity is rationed and that all households are required to reduce their use of electricity by 20%.

Provide each Kid with a copy of the *Kilowatt Krunch Survey* sheet (p. 23).

Which appliances on the list would each Kid be willing to do without and how many kilowatt hours could that save?

- Can they reduce use of electricity by 20%?

Kids may work in groups of 3 or 4 to share in this decision making, but each Kid should complete their own survey sheet. Kids may also choose to work alone.

When Kids have completed their surveys, bring the class together to discuss the choices made and the reason for their choices.

How do they think tasks done by the appliances they choose to dispense with would be done now? ("Mom or Dad would take care of it" is not an acceptable answer.)

Kids tally which appliances were chosen most often and discuss tradeoffs in these situations. (For example, a dishwasher run when full uses less water than washing dishes by hand.)

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Discussion:

Show the pie graphs again and ask Kids what they think a 2050 graph may look like. What resources may no longer be in use, the way using wood for heating the home and cooking meals was nearly gone by 1950? What new resources may be in use?

Activity (Optional):

- Kids create posters or rap songs about "Energy Hog Appliances."

Story: *Uttar Pradesh*, *India* (p. 21)

Principles in Practice:

Thinking in social justice terms, how do Kids feel about for-profit companies making money in poor areas such as Uttar Pradesh?

What do Kids think motivates Simpa – social responsibility or an opportunity for profit? Or both?

In Kids' opinions which is more important for people in our own country – environmental health or saving money?

- What can we as individuals do to promote solar power in places in India and Africa? In our country or town?

Closing Circle:

Ask the Kids to repeat these closing words together:

Let the words of my mouth,
The meditations of my heart,
And the actions of my life be as one,
That I may live in harmony
With Mother Earth. Amen

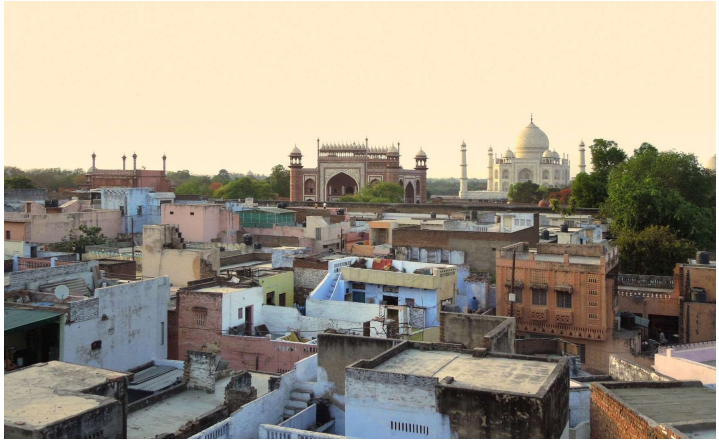
— Jennie Frost Butler*, Earth Prayers*

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

UTTAR PRADESH, INDIA — Population 200,000,000

Hello! I am Shiv Mandel. I live with my Mom and Dad in Madhotanda, a town in the north Indian state of Uttar Pradesh. We are very poor. The walls and ceiling of our house are made of plastic tarps stretched over a wooden frame. We have no electricity or plumbing, just a shelter where we sleep and stay out of the sun in the daytime. To support our family, my Dad sells tea to travelers along the road to the north. Most people depend on kerosene lamps that release grimy black soot into the air. Where there are electric grids, they are often not working.

Until recently we dwelt in darkness from sunset to sunrise or used smelly kerosene lamps or acid batteries for light. Dad had to walk for more than a mile to buy kerosene or get the battery charged. His business was open only during daylight hours, limiting his earnings. Then Simpa Network, a for-profit solar power business, came to town. It costs about 35 cents per day for power enough for two lights and a fan. That is about 15% of Dad's earnings but now he can keep the business open until 9 o'clock at night. People see the light from the road and come into the tent for tea and the fan. His income has more than doubled, making school books and medicines as well as food more affordable. And we have a light for our hut!



Note: The Simpa Network is one of several solar power companies supplying solar power units to low-income families in India and Africa. Simpa reckons that only 37% of the 200 million people who live in Uttar Pradesh have access to electricity. The Simpa manager says "Rural areas like these lag behind major cities. Our customers can't wait for better power grids to be built. They need power now."

Simpa also notes that while people decide to buy solar power services primarily for financial reasons, health and environmental benefits do come with it – less air pollution and less lung disease from burning kerosene.

Reference: "Cool It!" *National Geographic*, December 2016.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

nationalgrid

SERVICE FOR
JOHN SMITH
1010 ANY STREET
ANYTOWN MA 99999

BILLING PERIOD
Feb 12, 2016 to Mar 15, 2016

PAGE 1 of 2

ACCOUNT NUMBER	PLEASE PAY BY	AMOUNT DUE
99999-99999	Apr 9, 2016	$ 87.62

www.nationalgridus.com

CUSTOMER SERVICE
1-800-322-3223
CREDIT DEPARTMENT
1-888-211-1313
POWER OUTAGE OR DOWNED LINE
1-800-465-1212
CONTACT US
ngrid.com/ma-contactus
CORRESPONDENCE ADDRESS
PO Box 960
Northborough, MA 01532-0960
ELECTRIC PAYMENT ADDRESS
PO Box 11737
Newark, NJ 07101-4737
DATE BILL ISSUED
Mar 16, 2016

ACCOUNT BALANCE

Previous Balance		101.67
Payment Received on MAR 1 (*ACH*)	*THANK YOU*	- 101.67
Current Charges		+ 87.62
	Amount Due ▶	**$ 87.62**

- **Go paperless!** Electronic billing and payments make managing your monthly bill easier. Save time, money, and natural resources www.ngrid.com/paperless.
- **Payment concerns?** We are here to help. To learn about solutions to help you take control of your energy use and bills, visit www.ngrid.com/billhelp.

DETAIL OF CURRENT CHARGES

Delivery Services

Service Period	No. of days	Current Reading	-	Previous Reading	=	Total Usage
Feb 12 - Mar 15	32	7104 *Actual*		6713 *Actual*		391 kWh

METER NUMBER 12345678 **NEXT SCHEDULED READ DATE ON OR ABOUT** Apr 18

RATE Residential Regular R-1

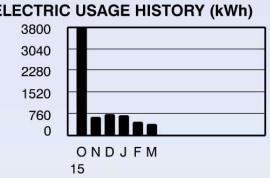
Customer Charge				4.00
Dist Chg First 391 KWH	0.04058558	x	391 kWh	15.87
Transition Charge	-0.00103529	x	391 kWh	-0.40
Transmission Charge	0.02714779	x	391 kWh	10.62
Energy Efficiency Chg	0.01624	x	391 kWh	6.35
Renewable Energy Chg	0.0005	x	391 kWh	0.20
	Total Delivery Services			**$ 36.64**

Supply Services

SUPPLIER National Grid

Basic Service Fixed	0.13038	x	391 kWh	50.98
	Total Supply Services			**$ 50.98**

ELECTRIC USAGE HISTORY (kWh)



Daily Averages	Mar 16
kWh	12.2
Cost	$ 2.73

■ Actual ☐ Estimated

KEEP THIS PORTION FOR YOUR RECORDS.

RETURN THIS PORTION WITH YOUR PAYMENT.

nationalgrid

ACCOUNT NUMBER	PLEASE PAY BY	AMOUNT DUE
99999-99999	Apr 9, 2016	$ 87.62

PO Box 960
Northborough MA 01532

ENTER AMOUNT ENCLOSED
$

Write account number on check and make payable to National Grid
Please pay Gas & Electric bills separately

JOHN SMITH
1010 ANY STREET
ANYTOWN MA 99999

063663

NATIONAL GRID
PO BOX 11737
NEWARK NJ 07101-4737

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

KILOWATT KRUNCH SURVEY

Name _____ Date _____

	KWH	Write the KWH value of appliances in your home:
Air conditioner	1500	_____
Clothes dryer	100	_____
Clothes washer	8	_____
Dishwasher	100	_____
Microwave	12	_____
Iron	600	_____
Lights	100	_____
Electric stove	150	_____
Refrigerator/freezer	150	_____
Color television	150	_____
Water heater	300	_____

Add up the total KWH in your house: _____

Multiply by 20 cents per KWH: _____ X .20 _____

Cost of electricity (1): _____

Pretend there was a natural disaster and all Massachusetts residents have to limit the use of electricity to just five appliances. What would you choose?

Add up your total KWH "Can't live without!" _____

Multiply by 20 cents per KWH: _____ X .20 _____

Cost of electricity with five appliances (2): (1) _____

Subtract cost of electricity (2) from cost of electricity (1): (2) _____

Total savings per month by using only five appliances: _____

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 4: Feeding the Multitudes

OVERVIEW:

Concept: The way food is grown and brought to market has energy costs.

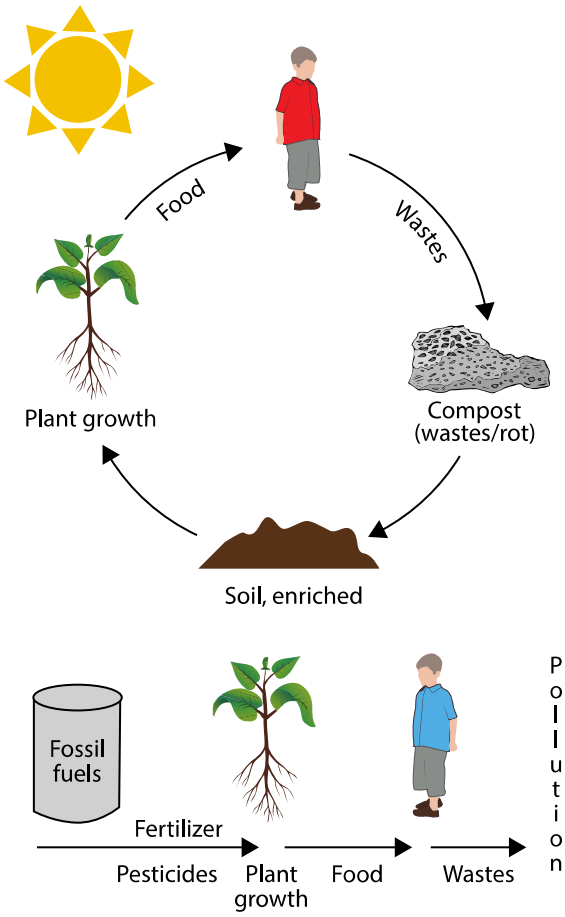
Background for Teachers:

Food starts as the product of an ecosystem no matter how it is processed. Modern technology preserves foods for extended periods of time and transports it around the world. Refrigeration, transportation, and specialized packaging and storage make it possible to bring foods to market over great distances.

In the United States there are two methods of growing foods in current use. One is *organic* farming, which relies on natural systems and resources to grow food. Organic farming is labor intensive, employing more people. This circular system works in harmony with natural cycles of growth and decay, using wastes to enrich the soil with organic matter. Organic farms are smaller and often local enterprises. Their goal is to produce healthier food without harm to the environment. This method prevailed before World War II.

The other method is *agribusiness*, which uses petrochemicals for fertilizers and insecticides, and farms with fuel-driven machinery on immense acreage. Large scale mechanical farming causes massive soil loss and loss of soil fertility. Chemical fertilizers replace organic matter, and pesticides destroy the natural soil organisms that make nutrients available to growing plants. Wastes often are not recycled and contribute to water and air pollution. High yield and mass distribution are the goals.

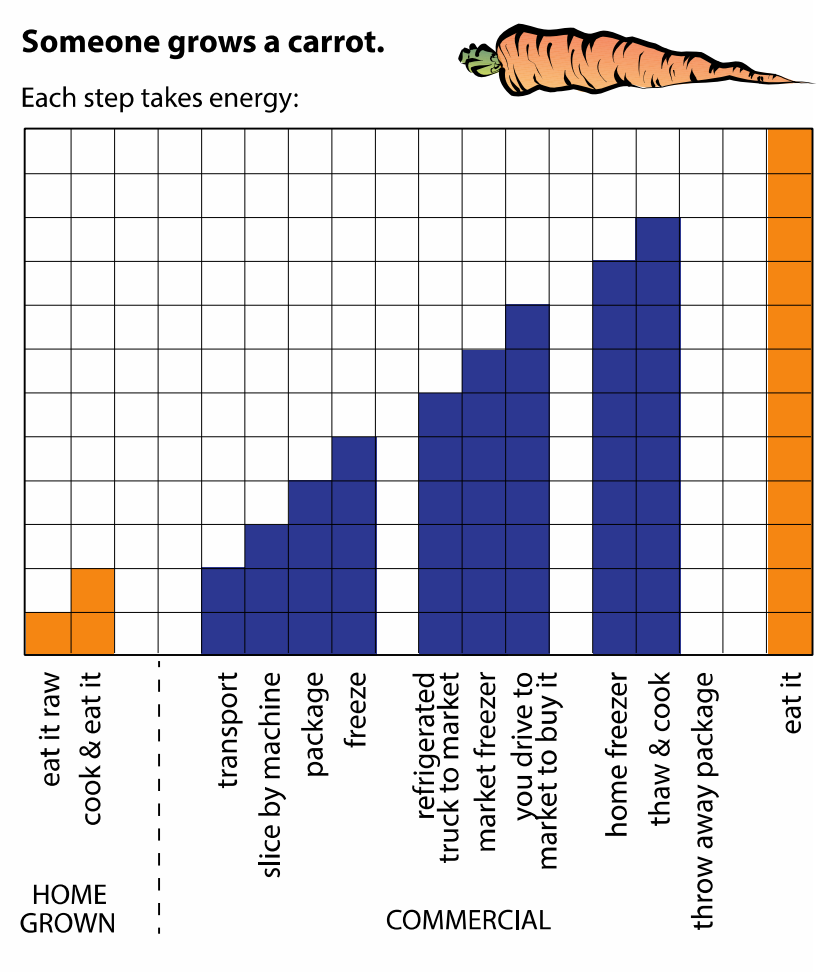
Organic vs. Agribusiness Food Systems



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

However people obtain their food, there are energy costs. Plants use energy from the sun to make nutrients, storing some of the sun's energy in carbohydrate form. These nutrients are basic to the food supply for all of animal life including humans. Whether we eat meat, fish, dairy products or plant crops, it is the sun's energy that powers our lives. Some heat goes into the atmosphere with every exchange of energy, as we know from experience. Think of how you may overheat and perspire when using energy for work or play!

In developing countries and remote parts of the world technologies such as these often are not available. People in some of these areas still hunt and gather, for example, the Inuit nation in northern Alaska. Subsistence farming may sustain lives in warmer climates such as parts of Africa and many island nations.



It takes 96 calories of energy to bring one calorie of lettuce from farms in California to people in Massachusetts. — *Bill McKibben*

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON:

Action:

Kids trace transportation distances for some favorite foods on a world map. Then they estimate energy costs for the transportation of these foods**.**

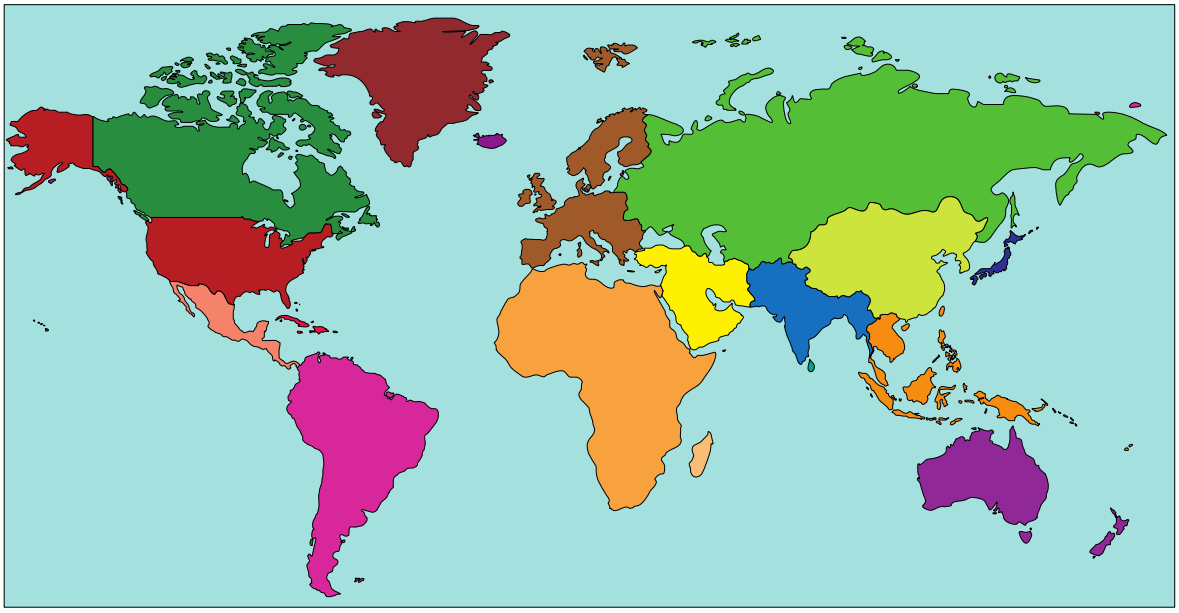
Materials:

Empty packages from Kids' favorite foods, one per Kid
World map, poster size
Push pins
Carrot graph – copy on chalkboard?
Colored pencils
Yarn or string
- Graph paper

Book: *Pass The Energy Please*, by Barbara Shaw McKinney

Preparation:

Select packages of Kids' favorite foods with different distances to be transported, that is, some of local origin, some from other parts of the U.S., some from other parts of the world. One per Kid. Kids may bring empty packages in themselves but you would not have control of the variety needed.
Mount the world map on a wall where pushpins can be used.
Place pushpins and yarn near the map.
Sketch the carrot energy graph on the chalkboard.
- Put several colored pencils on the table for Kids to share.



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON PLAN:

Opening Circle:

Greet the Kids as they settle into the circle of chairs and note who is present.

Discussion:

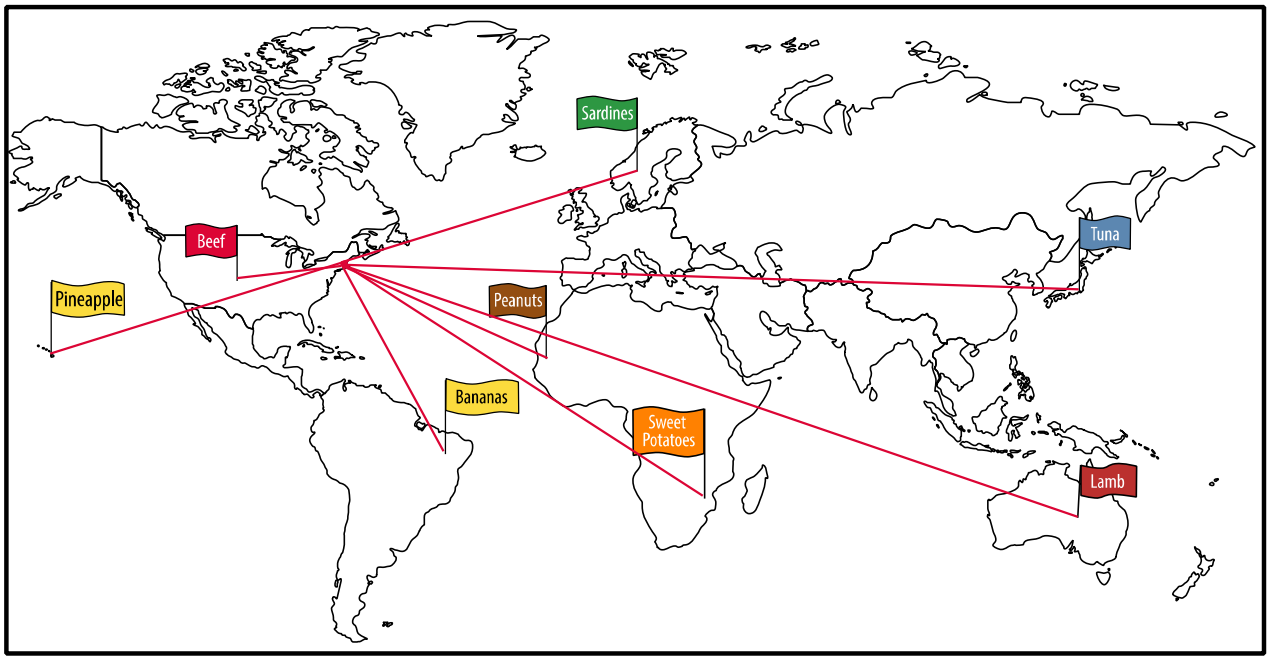
Have food packages stacked on the table. Hold up three or four packages in turn and ask for Kids' comments.

Is this a favorite food of yours?
What does this food do for you?
Do you think it would take much energy to make this food and get it to your plate?
How would this be done?

- Ask Kids to brainstorm what happens in farming or fishing, in processing and packaging, transportation, and food storage and preparation.

Food for Energy Activity:

In this activity Kids trace the journey of a food item from its point of origin to their area on the world map and construct an energy graph for this journey. Each Kid gets one food package, two push pins, a length of yarn or string, and a piece of graph paper. Two or three Kids can work on the map while the rest work on graphs. Kids rotate until all have completed both.



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Food Journey Mapping:

Kids read the labels on their food packages to find out where each item comes from. They note whether it was frozen, canned or packaged.

- In turn, each Kid finds the point of origin for his or her food item on the world map and inserts a pushpin with one end of the string attached there. Then they draw the string across to their own location and use the other pushpin to hold it in place. (The map should have many strings that lead from places of origin to Kids' own area.)

Graphing:

Referring to the carrot graph on the chalkboard for a model, ask each Kid to create a graph for a food item of their own on graph paper.

Discussion:

When mapping and graphing are completed, bring the Kids together to share their results.

Were they surprised at how much energy it can take to get food to their plates?
What foods took the most energy to get to them?

- How do they think some of that energy could be saved?

They may post their graphs around the room and take a few minutes to survey each other's work.

A quote from Bill McKibbon, environmental activist and author:
"It takes 96 calories of energy to bring one calorie of lettuce
from farms in California to people in Massachusetts."

Do Kids think a head of lettuce is worth the energy cost? How about other produce that comes across the country, or from other countries, for example oranges, bananas, and broccoli?

In 1850, 85% of the food in Massachusetts was grown in-state. In 1950, 85% of the food in Massachusetts came from out-of-state and from other countries.

Describe the *Organic vs. Agribusiness Food Systems* illustrated on page 24, sketching them on the chalkboard.

- Which system do Kids think is more Earth friendly? More people friendly?

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Book:

McKinney, Barbara Shaw, *Pass The Energy Please,* Dawn Publications, East Rutherford, N.J., 2011
This upbeat rhyming story connects all creatures on Earth in a fascinating food chain dependent on green plants for their energy.

Principles in Practice:

Which Principles do we honor when we recycle food packaging and compost any leftover food?

- How can we shop for food in ways that support our Principles?
- How about growing our own food?

Closing Circle:

All present recite this quote about Earth together:

This planet must be cared for.
It's lonely.
It's small.
It's isolated.
There is no resupply.
And we are mistreating it.

— *Scott Carpenter*

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 5: Ten Gallons of Gas

OVERVIEW:

Concept: Limited resources such as gasoline can be conserved through collaboration and changes in how we use them.

Background for Teachers:

We are all painfully aware of rising gasoline prices and of our dependence on foreign oil for our gasoline among other things. How will we resolve this problem?

The following *Transportation Table* provides interesting data on total mileage per gallon of various vehicles with full capacity. Using this data, the Kids can see that a train can provide mileage capacity of one mile for one person or 1000 miles for 1000 people total capacity. The miles/gallon is very low, less than the figure for cars. The train is considered to be the more efficient mode of transportation. The key is the probability of each kind of transportation being used at full capacity. Trains and buses have a higher probability of running at full capacity than do cars. A full train is more efficient than a car with one or two passengers.

TRANSPORTATION TABLE

	Passengers	MPG	Gallons per Passenger Mile
CAR	4 – 5	30	6 – 7
BUS	40	15	1/3 – 1/2
TRAIN	1,000	5	.005
Estimates at full capacity			

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON:

Action: Kids figure out the most Earth friendly ways to get to school and then plan vacations using ten gallons of gas each.

Materials:

Large map of your town.
Gong, loud whistle, or drum.
Assorted vacation brochures for New England areas.
For each Kid:
- Transportation Table.
- Map of eastern US and Canada.
- Piece of string long enough to travel the length of the longest distance within town to the school.
- Ruler or photocopy of scale from the town map.

Book: *What's So Bad About Gasoline?* by Anne Rockwell

Preparation:

Put the map of your town up on the wall where Kids can reach it. Mark the location of the Kids' school with a pushpin.

LESSON PLAN:

Opening Circle: Greet the Kids as they come in and settle into the circle of chairs. Note who is present.

Getting to School Activity:

Ask how Kids get to school and home again? Do they ride the bus? Walk? Bike? Do their parents drive them? Once in a while or everyday? How far is it from where they live to the school?

1) Kids, in turn, can use a piece of string to measure the distance from home to school on the map, then have them return to their seats.
2) Use a ruler to find out how long the measured part of the string is in inches, figure how many inches are in a mile from the scale on the map and then have the Kids calculate the distance from their home to their school. Or, the Kids can calculate how far each Kid travels to school by measuring their string along the photocopies of the scale from the map.
3) Briefly calculate the gallons of gas it takes the Bus to take 40 Kids versus 20 cars to take 2 Kids if the route is 5 miles.
   - Bus gets an average of 7 MPG.
   - Autos get an average of 24 MPG.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

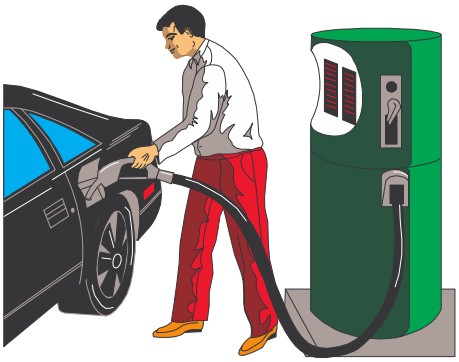
Discussion:

Why do Kids travel the way they do to school?
Which way do they prefer to travel to school and why?

- What is the most Earth-friendly way to travel to school?

Ten Gallons of Gas Activity:

1) Sound the gong to announce to the Kids that they have just won the gong show contest because of their heavenly chorus. As a prize, each Kid is given a free vacation at a place of his or her choice and 10 gallons of gas to get there and back.
2) Rules of the Game:
   - Kids have free use of whichever transportation means they choose. They may use their own 10 gallons each to travel to a vacation spot by themselves.
   - Or they may pool their 10 gallons each to travel to a more distant vacation spot together.
   - Kids may not use their own money to purchase more gas.
   - They must include returning home in their plans.



3) Have Kids generate a list of vacation spots they want to visit in the Eastern U.S. or Canada. Assume a home base of Boston. List their suggestions on the chalkboard.
4) Have Kids work in teams of 2. Provide each Kid with a copy of the *Transportation Table*, map and ruler.
5) The challenge is to decide how to use their 10 gallons of gas, either alone or as a group. With this data they discuss where they want to go and how they will get there. They use the map and ruler to estimate distances. A Kid may choose to go alone limiting how far her or she may go. The team may pool their 10 gallons of gas each for a group trip. Two or more teams may negotiate pooling resources for an even more distant destination. Remind Kids that travelers have to get home again.
6) When teams have reached consensus on their travel plans, bring the class together for reporting and discussion.
   Where did Kids decide to go?
   How would they get there?
   - Why did they make these choices?

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Discussion:

Referring to the *Transportation Table*, ask if mass transit systems such as buses and trains are always more efficient than cars?

Why do Kids think trains are considered to be more efficient than cars when the data on the table suggests the opposite? What mode of travel is most earth friendly?
Are too many cars in the city or on the highway a problem where you live?
Is rush hour a traffic nightmare?

- Tell Kids that the mayor has asked for Kids ideas on these serious problems. What would Kids say to the mayor? Have each Kid write a sample letter including some of the *Transportation Table* data in his or her comments.

References:

Project WALSE, *The Mobility Factor*, EdCo, Brookline, MA, 1979.

Principles in Practice:

What principles are we following when we choose to walk or bike?

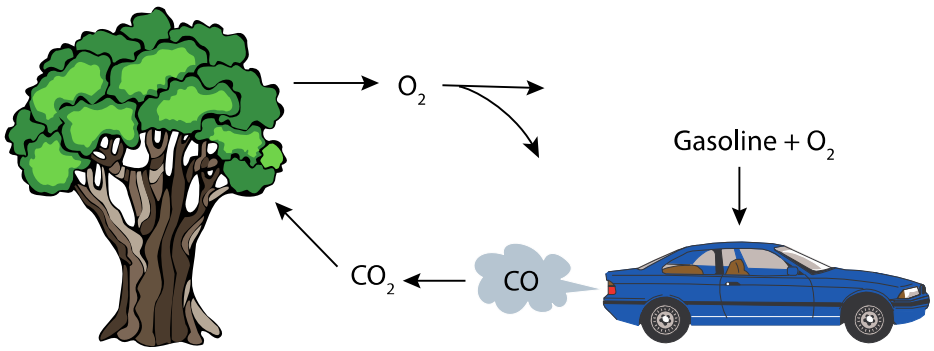
- What can you do to honor the seventh principle when you travel?

Closing Circle:

All present recite these words together:

Let the words of my mouth,
The meditations of my heart,
And the actions of my life be as one,
That I may live in harmony
With Mother Earth. Amen.

— Jennie Frost Butler, *Earth Prayers*



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 6: Power from Nature

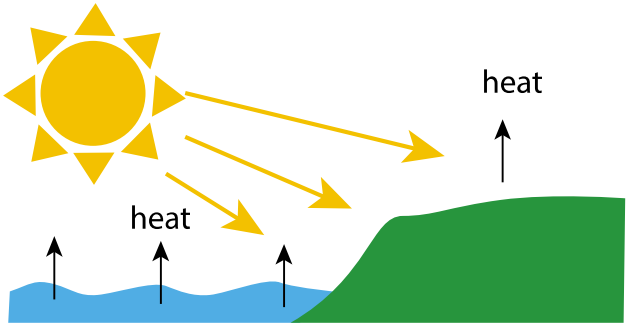
OVERVIEW:

Concept:

Energy comes from the sun and cycles through nature as wind or water power or as food energy through plants.

Background for Teachers:

Air and water are in constant circulation around planet Earth, powered by energy from the sun. Hot air and water molecules move faster than cold air and water, creating currents. When an air current hits the blades of a windmill, its energy moves the blades and causes the windmill to turn. When water moves over a waterwheel, it affects the wheel in the same way. The currents of air or water are warmed by the sun and move with more power as they absorb the sun's energy. With a system of gears, the energy in this movement can be passed along to a variety of machine parts that can do work, or to a generator that can make electricity.

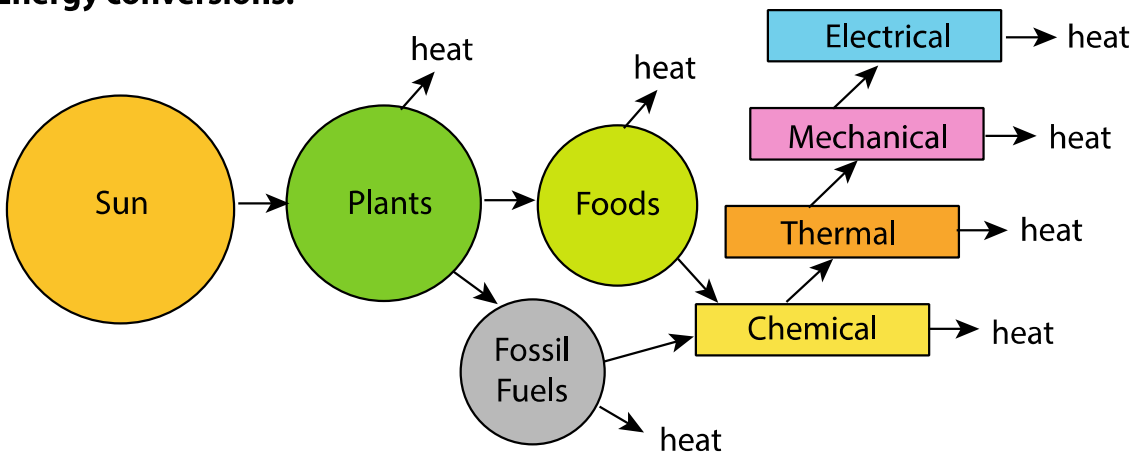


Energy is always changing. Energy that is stored in food or in fossil fuels is called *potential energy.* To be doing work, it has to be in *kinetic* (moving) form. When a fuel with potential energy is burned, this potential energy changes into a kinetic form, *heat,* (*thermal* energy). This heat can be used to form steam to turn the blades of a turbine, changing the heat to *mechanical energy.* In turn, the turbine can turn an electric generator, forming *electricity*. Whenever energy changes from one form to another, there is a heat loss that makes some of the energy unavailable for use. This heat leaks away and gradually warms up the atmosphere.

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

When fossil fuels are burned, heat energy is released into the atmosphere, contributing steadily to global warming.

Energy conversions:



It is not possible to change all of a given amount of heat energy to another form, but other forms can be converted to heat. For example, all of the chemical energy stored in a candle is converted to heat when it burns, but this process is not reversible.

This information may be more than you will need to share with the Kids, but it can be helpful when they have questions. An understanding of energy sources and the transformations that make use of energy possible makes for greater respect for these resources in harmony with our First and Seventh Principles.

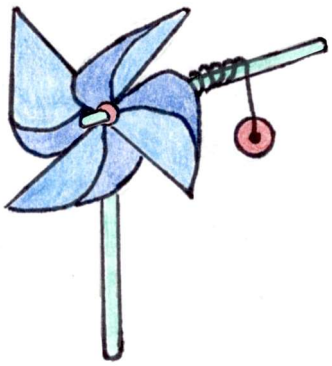
LESSON:

Action: Kids make simple windmills and use them to observe energy transfers.

Materials:

For introduction:
- Balloon
- Plastic pinwheel

For each team of two Kids:
- Used manila folder or light cardboard
- Tape, scissors, ruler
- Pencil
- 2 soda straws
- 15” length of string
- *Power from Nature* directions sheet (p. 38)



Book: *Pass The Energy Please,* by Barbara Shaw McKinney

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Preparation:

Read through the activity and decide how to use it with your Kids.

Construct a pinwheel to use for the introduction and as a model for the Kids to use. (See p. 38 for directions.)
Recyclables are a source for used folders or light cardboard. Cardboard needs to be light enough and large enough for a 4-inch square to be cut out.
Purchase a few balloons and soda straws.
Plastic disks can come from the tops of deli containers.
Other materials are available in general supplies.
Place materials on a supply table in the classroom.
Reserve the book at the library in advance.

- Make a copy of the pinwheel directions (p. 38) for each Kid.

LESSON PLAN:

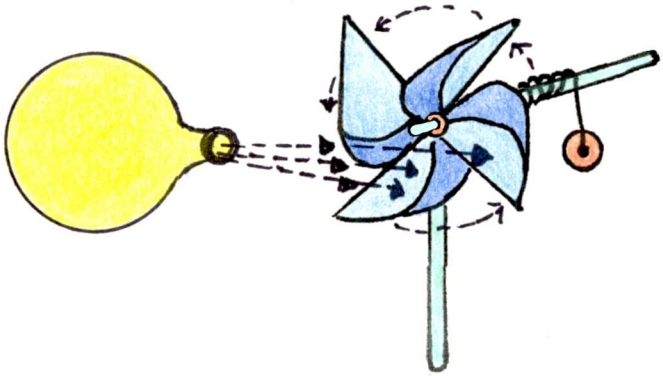
Opening Circle: Greet the Kids and note who is present. Have a balloon and pinwheel in hand.

Demonstration and Discussion:

First, blow up the balloon. When Kids ask why you are doing this, you can tell them you are changing the form of energy.

Ask, can anyone explain where the energy is coming from, and where it goes? Use background information to enrich discussion and facilitate the Kids' thinking.
Do Kids realize that energy can change from one form to another? What do they think will happen if you point the balloon at the pinwheel and let the air out?
After Kids have made predictions, power the pinwheel with air from the balloon. Tell the Kids that a windmill runs in like fashion.

- How do they think this power can be put to work?



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Activity:

Tell the Kids that today they can make a simple machine that is powered by moving air. Ask where does the air get the power for motion?

Have Kids work in teams of two. Provide each Kid with a copy of the *Power From Nature* (p. 38) lab sheet. Kids read their lab sheets and gather materials from the supply table. Allow about 15 minutes for teams to work.

When teams have finished their models, have a show-and-tell session. Kids demonstrate how their models work.

Did some teams have difficulty getting the string to wind around the pencil?

- What did they do to fix the problem?

Discussion:

Can Kids describe the energy changes from sun to operating machine?
Does this string of changes suggest an Earth Circle? Why or why not?

- Can Kids suggest ways to modify this design to make a water wheel to use for power?

Story:

Read aloud the story, *Pass The Energy Please,* by Barbara Shaw McKinney, Dawn Publications, East Rutherford, N.J., 2011

- Ask, How does the story relate to today's activity?

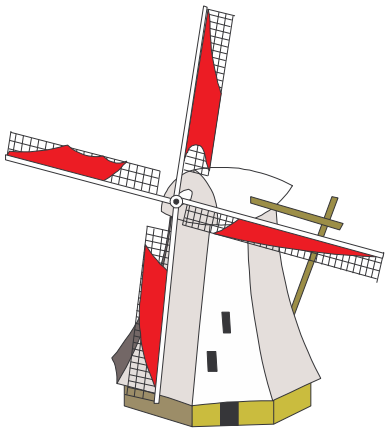
Principles in Practice:

When we use wind or water to power our machines, which of our Seven Principles do we honor?

Closing Circle:

All present recite the following words together.
Ancient Sun, eternally young,
Giver of life and source of energy,
In coal and oil, in plant and wind and tide,
You kindle the heaven, you shine within us,
For we are suns with hearts afire –
We give thanks for your rays.

— Yokuts Indian prayer, *Earth Prayers*



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

POWER FROM NATURE

Follow these directions to see how wind provides power to do work for us.

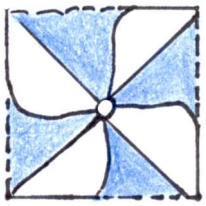
You will need:

- Piece of manila folder or light weight cardboard
- Ruler and scissors
- Scotch tape or small lump o clay
- 15-inch length of string
- 2 or 3 small weights such as paper clips
- 2 soda straws, one larger diameter than the other

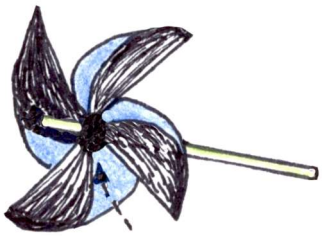
Directions:

1. Cut out a square of lightweight cardboard, 4 x 4 inches.
2. Mark the square corner diagonally corner to corner and cut along the lines almost to the center.
3. Fold each corner to the middle and tape it down or use a bit of clay to hold each corner in place.
4. Use the pencil point or a scissors to make a small hole in the exact middle and push a long straw through it.
5. Use tape or clay to fasten the pinwheel in position on the straw.
6. Cut a 3-inch piece of the larger straw and slide it over the pinwheel straw for a handle.
7. Tape one end of the string to the smaller pinwheel straw.
8. Fasten small weights such as paper clips to the other end of the string.

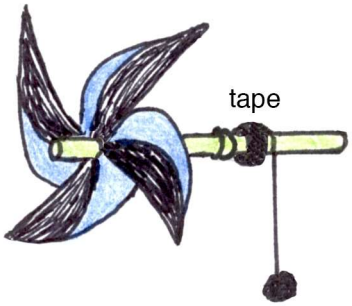
Hold the pinwheel straw up and blow through it. How do you explain what happens?



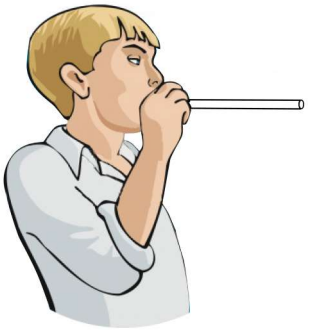
small hole in center

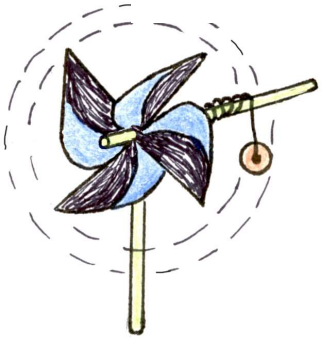


clay holding straw



lump of clay





Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

EarthCircles

Acquiring Energy

LESSON 7: Optional – Solar Cookie Bake

OVERVIEW:

Concept:

Energy from the sun can be used directly for tasks such as cooking.

Background:

Solar Cooking is the practice of using the sun as an energy source to cook food. For millennia humans, have known how to concentrate the sun's rays to cook food. This energy source is billions of years old and provides a renewable source of power.

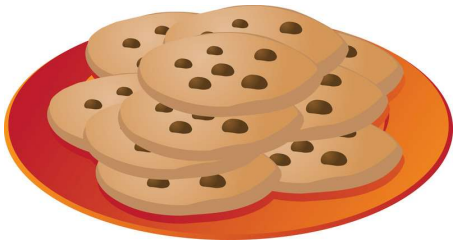
In the 1500s, when glass became cheap, the Dutch built the world's first greenhouse and filled them with crops to grow in all seasons. In the 1700s a Swiss naturalist created glass box for cooking food using the sun's energy. People around the world were soon using this design.

In the 1950s the U.N. created a more sophisticated solar cooking tool to help combat poverty in other parts of the world. But their complex design did not succeed in changing cooking habits. In the current century, with concerns about global warming and environmental quality, solar cooking is having a resurgence.

A solar cooker can be made easily and relatively cheaper. A cardboard box and aluminum foil are the basics, plus cast iron pots and cookie sheets.

Will we all cook with solar energy in the near future?

This lesson introduces Kids to the solar cooking process. Their product can be used in various ways: they can eat the cookies, share them with other kids, donate them to needy people, or sell them to raise money for a good cause.



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON PLAN:

Action: Kids make solar ovens to bake cookies and consider how energy changes from one form to another.

Materials:

For introduction:

- Tape
- Thermometer
- Aluminum foil
- Umbrella
- Cookie dough

For each team of 3-4 students:

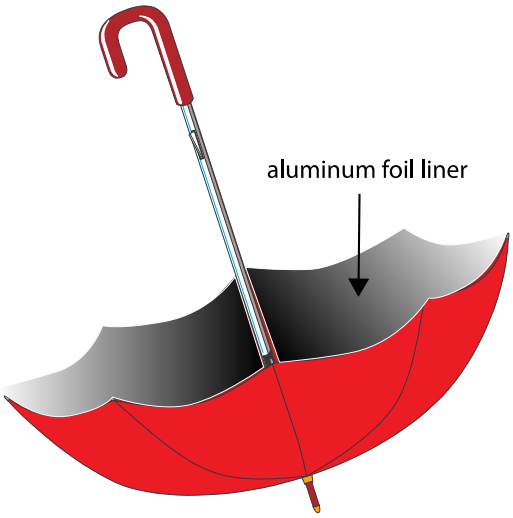
- Empty carton
- Tape
- Thermometer
- Aluminum foil
- Cookie dough

Book: *People and the Planet* by Torey Maloof

Preparation:

Weather: these activities require a sunny day.
Read through the activities and decode what is appropriate for your Kids, and how to use background information in the lesson.
Select a sunny spot outdoors for the activity.
Line the umbrella with aluminum foil and place it near the circle of chairs.
Cartons for Kids' ovens need to be 12-15 inched by 16-20 inches with 3-4 inches deep. You can obtain empty cartons for recycling at a market.
Each team will need about 600 square inches of aluminum foil (about 5 linear feet), plus masking tape.
These items and rolls of cookie dough, half a roll per team, and available at the market. Or you can mix cookie dough yourself or ask a parent volunteer.
Thermometers are available in school supplies stores.

- Place a set of materials in each box and place them on the supply table.



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

LESSON:

Opening Circle:

After greeting the Kids and whoever else is present, lift the umbrella over your head and twirl it. When Kids ask why you have the umbrella, tell them you want to bake a cookie with it. How would they do it, or do they think it is not possible? If so, why not? What does it take to back a cookie? List the Kids' ideas on the whiteboard.

Activity:

For younger Kids:

Place one slice of cookie dough per Kid on the foil near the center of the umbrella. Place the umbrella in a sunny spot, tilted toward the sun. Have the Kids gather around to observe what happens.

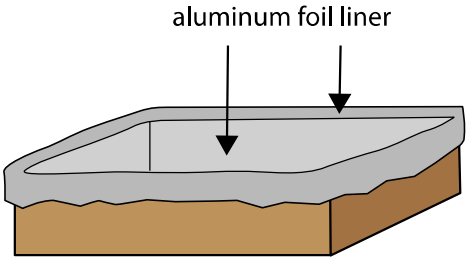
Discussion:

What do they predict will happen? During the 15-20 minutes it takes for the cookies to bake, use the background information to discuss energy changes involved in the baking. What kind of energy do you think is needed to bake a cookie?

Where does is come from?
What happens to it?

- Where does the energy go when they eat a cookie?

When younger Kids; cookies are done, Kids may eat them.



SHALLOW BOX

Activity:

For older Kids:

Discussion:

Kids remain seated. Ask what they think will happen to the cookie dough. How do they explain what they think? Use background information to guide Kids' thinking and enrich discussion.

Have older Kids work in teams of 3 or 4. Challenge them to apply what they have just observed to make a solar oven and bake some cookies of their own Each team takes a box of materials and plans how to make the oven. When it is ready, the teams place 6-8 cookie slices in their oven, and puts it in a sunny spot.

Kids take the air temperature in the box and record it every 2-3 minutes until they deem their cookies are baked.

When all teams have baked their cookies, they may eat them. Bring the class together to discuss the energy changes involved in baking. Use background information to guide Kids'

Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

thinking and enrich discussion. What kind of energy would be used to bake cookies at home? Where does that energy come from? How is it different from solar energy?

Ask Kids to draw a picture or make a diagram of how the cookie was baked, with energy changes labeled.

Story:

Saving Our Planet, pp. 24-27, *People and the Planet* by Torrey Maloof

Principles in Practice:

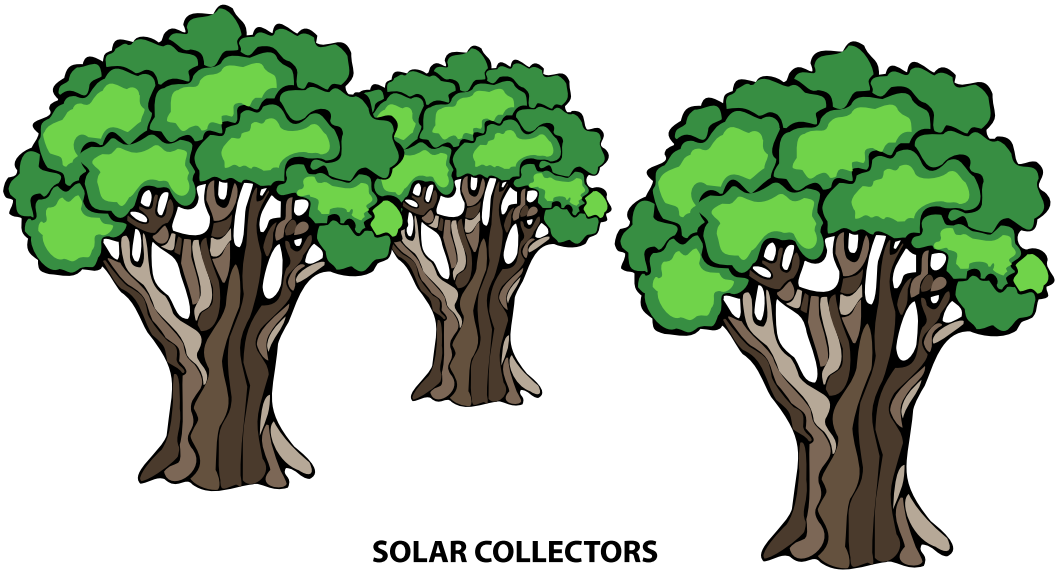
Kids brainstorm what they might do to help save our planet. Is promoting solar cooking at home or at camp a possibility? What else do they suggest?

Closing Circle:

Have all present and repeat this quote together:

"It's the little things citizens do.
That's what will make the difference."

— *Wangare Maathai,*
who worked to plant millions of trees in Kenya



Copyright (C) 2019, Maureen Oates
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.