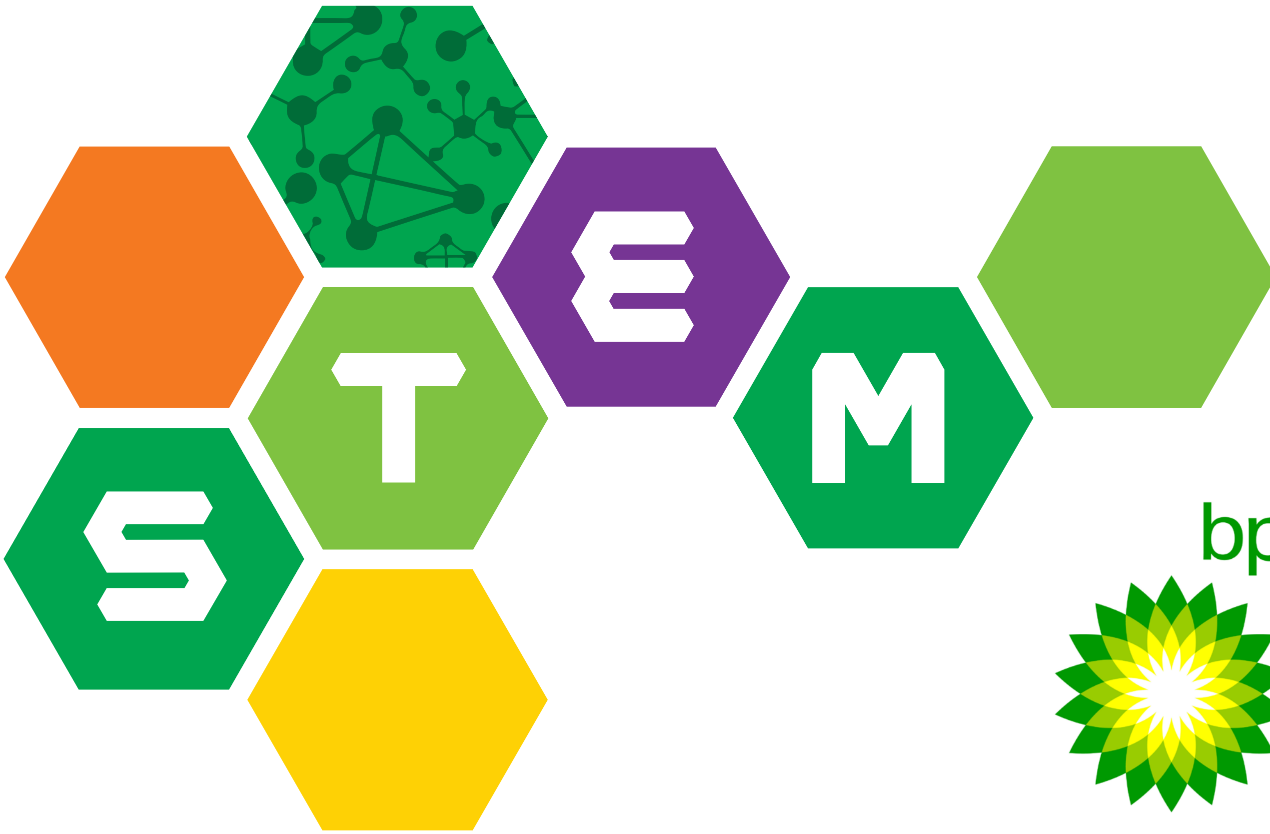
STUDENT GUIDE

ELEMENTARY SCHOOL ENERGY EXPERIMENTS

PRIMARY/ELEMENTARY

bp

NEED
National Energy Education Development



FUELING THE NEXT GENERATION OF INNOVATORS

Science, technology, engineering, and math (STEM) affect nearly every aspect of our lives — from the cars we drive, to the food we eat, to the smartphones we use to communicate.

Innovation is the key to helping the U.S. stay competitive in today's globalized, technology-driven world. As a result, STEM jobs are in high demand and typically pay significantly better than non-STEM fields. To fill the high-skilled jobs that will power the American economy in the future, the U.S. needs more students to study STEM.

Additionally, BP depends on people with strong foundations in STEM to help solve the world's energy challenges. These engineers, scientists, and other professionals find ways to produce and deliver the energy that heats our homes, powers our schools, cooks our food, and fuels our cars. The information and activities in this booklet will help you understand the important role STEM plays in the energy industry.

TABLE OF CONTENTS

What is Energy?

Energy helps us do things. It gives us light. It warms our bodies and homes. It bakes cakes and keeps milk cold. It runs our TVs and our cars. It makes us grow and move and think. Energy is the power to change things. It is the ability to do work.

Energy is Light

Light is a form of energy we use all the time. We use it so we can see. We get most of our light from the sun. Working during the day saves money because sunlight is free.

At night, we must make our own light. Usually, we use electricity to make light. Flashlights use electricity, too. This electricity comes from batteries.

Energy is Heat

We use energy to make heat. The food we eat keeps our bodies warm. Sometimes, when we run or work hard, we get really hot. In the winter, our jackets and blankets hold in our body heat.

We use the energy stored in plants and other things to make heat. We burn wood and natural gas to cook food and warm our houses. Factories burn fuel to make the products they sell. Power plants burn coal and natural gas to make electricity.

Energy Makes Things Grow

All living things need energy to grow. Plants use light from the sun to grow. Plants change the energy from the sun into sugar and store it in their roots and leaves. This is called photosynthesis.

Animals can't change light energy into sugars. Animals, including people, eat plants and use the energy stored in them to grow. Animals can store the energy from plants in their bodies.

Energy Makes Things Move

It takes energy to make things move. Cars and motorcycles run on the energy stored in gasoline. Many toys run on the energy stored in batteries. Sail boats are pushed by the energy in the wind.

After a long day, do you ever feel too tired to move? You've run out of energy. You need to eat some food to refuel.

Energy Runs Machines

It takes energy to run our TVs, computers, and video games—energy in the form of electricity. We use electricity many times every day. It gives us light and heat, it makes things move, and it runs our toys, electronics, and microwaves. Imagine what your life would be like without electricity.

We make electricity by burning coal, oil, gas, and even trash. We make it from the energy that holds atoms together. We make it with energy from the sun, the wind, and falling water. Sometimes, we use heat from inside the Earth to make electricity.

Energy Doesn't Disappear

There is the same amount of energy today as there was when the world began. When we use energy, we don't use it up completely; we change it into other forms of energy. When we burn wood, we change its energy into heat and light. When we drive a car, we change the energy in the gasoline into heat and motion.

There will always be the same amount of energy in the world, but more and more of it will be changed into heat. Most of that heat will go into the air. It will still be there, but it will be hard to use.

Photo courtesy of BP

Colors and Light

Grade Levels: 1-4

Background

Light energy can turn into heat when it hits an object. Light can also be reflected from an object so it doesn't turn into heat.

Question

Do some colors absorb more sunlight than others?

Possible Hypotheses

All colors absorb the same amount of sunlight.

Some colors absorb more sunlight than others.

Materials

- Four tall clear glasses
- Water
- Food coloring
- Immersion thermometer

✔Procedure

1. Fill the glasses with the same amount of cold water. Record the temperature of the water.
2. Add 20 drops of red food coloring to one glass, 20 drops of yellow to one glass, and 20 drops of blue to one glass. One glass will have no food coloring.
3. Place all four glasses in a sunny place for 15 minutes.
4. Record the temperature of the water in all four glasses.

Analysis and Conclusion

Did the temperature of the water change? Which water got warmest? What did you learn about colors and light?

Hot Ice

Grade Levels: 1-4

Background

Heat energy is in everything. Some items have more heat energy, some have less. In order to freeze something, heat energy must be taken away.

Question

Which will become ice faster, hot or cold water?

Possible Hypothesis

Cold water will freeze faster/slower than hot water.

Materials

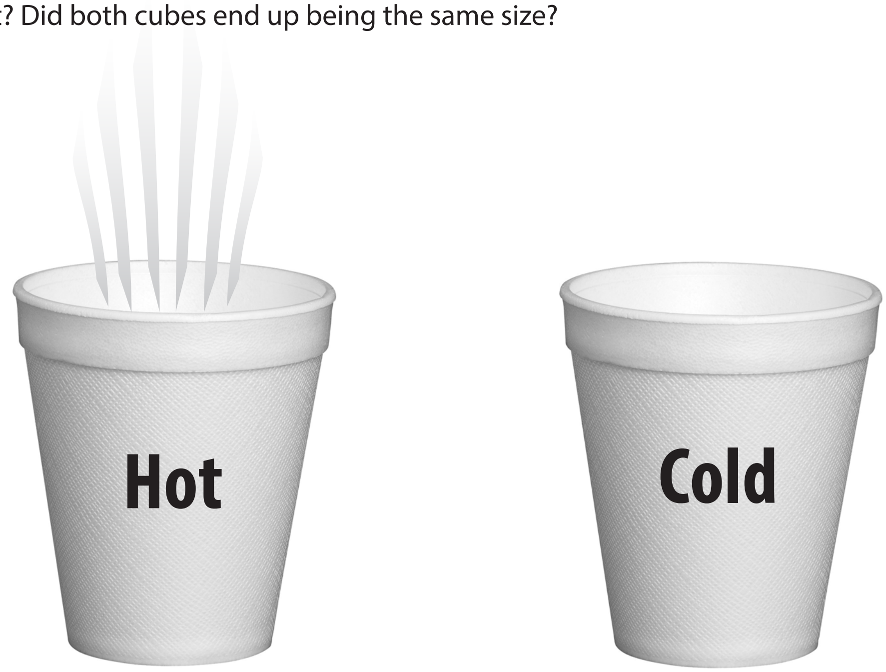
- 2 Styrofoam cups
- Hot tap water
- Cold tap water
- Freezer

Procedure

1. With the help of an adult, fill one cup with very cold water. Fill the other with the same amount of very hot water. Label one cup hot and the other cup cold.
2. Put both cups in the freezer and check every 10-15 minutes. Record which one begins to freeze first.
3. Leave them in the freezer until the following day. Take them out and see if there is any difference in the ice cubes.

Analysis and Conclusion

Which one froze first? Did both cubes end up being the same size?



Salty Ice Cubes

Grade Levels: 1-4

Background

Energy comes in many different forms, and often, those forms can change into other forms of energy. For example, when you eat food then run, the chemical energy from the food turns into motion. Chemical energy can change into other forms of energy too.

Question

Will salt water freeze?

Possible Hypothesis

Salt water will/will not freeze.

Materials

- Three small plastic cups
- Water
- Salt
- Freezer

Procedure

1. Fill the cups half-full with the same amount of water.
2. Add 1 tablespoon of salt to one cup. Mark it with a 1. Add 2 tablespoons of salt to another cup. Mark it with a 2. Mark the third cup with a 0. This is your control. It will have no salt. Stir the cups.
3. Place the cups in the freezer. Observe the cups every 15 minutes for two hours.

Analysis and Conclusion

Did all the cups of water freeze? Which froze first? What does this experiment tell you about salt?

Real World Connection

Who might be able to use this information in the real world? Why might it be important to them?

Sun Or Shade?

Grade Levels: 1-4

Background

Light energy can turn into heat when it hits objects. Heat moves around a lot when it is a gas form—like the air around us. It wants to find a balance, and hot air and cold air will often change temperature until they meet right in the middle.

Question

Is the air the same temperature in the sun and in the shade?

Possible Hypothesis

The air is/is not the same temperature in the sun and in the shade.

Materials

- Thermometer

✔ Procedure

1. Hang a thermometer in the shade for five minutes. Record the temperature of the air.
2. Hang the thermometer in the sun for five minutes. Record the temperature of the air.

Analysis and Conclusion

Is the air really warmer in the sun? Why might air feel warmer in some places?

Comparing Light Bulbs

Grade Levels: 1-4

Background

We use light bulbs to see when it is dark. Many light bulbs also produce heat. It requires a lot more energy to make heat than it does to make light. Some light bulbs use less energy than others.

Questions

Do incandescent and fluorescent bulbs produce the same kind of light? Do incandescent and fluorescent bulbs produce the same amount of heat?

Possible Hypotheses

Incandescent and fluorescent bulbs do/do not produce the same kind of light.

Incandescent and fluorescent bulbs do/do not produce the same amount of heat.

Materials

- One incandescent and one compact fluorescent bulb that have the same number of lumens (look at the box to see how many lumens each bulb produces)
- Thermometer
- Lamp

✔Procedure

1. Have an adult place the fluorescent bulb in the lamp and turn it on. Observe the light that is produced.
2. Hold a thermometer six inches above the bulb for one minute and record the temperature. Turn off the lamp and let the bulb cool.
3. Have an adult remove the fluorescent bulb, place the incandescent bulb in the lamp and turn it on. Observe the light that is produced.
4. Hold a thermometer six inches above the bulb for one minute and record the temperature.

Analysis and Conclusion

Could you tell any difference in the kind of light the two bulbs produced? Did one bulb produce more heat than the other? Which bulb uses less energy?

Magnets and Heat

Grade Levels: 1-4

Background

Almost half of the energy that we use in our houses is used for heating and for cooling. The hot or cool air can sneak out of our house through doors, windows, and even the walls. If we try harder to keep the air in, we will use less energy for heating and cooling. This can save money.

Question

Does temperature affect the force of a magnet?

Possible Hypothesis

Temperature does/does not affect the force of a magnet.

Materials

- Magnet
- Paper clips
- Freezer
- Hair dryer
- Pot holder or gloves (optional)

✔ Procedure

1. Record the number of paper clips the magnet can lift at room temperature.
2. Place the magnet in a freezer for 15 minutes. Record the number of paper clips the magnet can lift.
3. Use a hair dryer to warm the magnet. Use gloves or a potholder if the magnet gets too hot. Record the number of paper clips the magnet can lift.

Analysis and Conclusion

Does changing the temperature of a magnet affect its force?

Saving Hot Water

Grade Levels: 4-6

Background

Almost 20% of the energy we use in our houses is used to heat water. If we can save water when we shower or take a bath, we are also saving the energy that it takes to heat the water.

Question

Does it save more water to take a shower or a bath?

Possible Hypothesis

It takes ____ water to take a shower than a bath.

Materials

- Bathtub with a shower
- Ruler
- Thermometer

✔ Procedure

1. Have each member of your family plug the drain when taking a shower for one week.
2. Measure the amount of water they used with your ruler. Write down how high the water was for each person in your family each time they showered for a week.
3. The next week, have each person take a bath instead of a shower. Use your ruler to measure how much water they use for their bath. (Make sure the person isn't in the tub! That will change your measurements!)
4. During the showers and baths, also have your family take the temperature of the water.

Analysis and Conclusion

Compare the amount of water used for baths and showers for each member of your family. Which saved more water and energy: a shower or a bath? Which member of your family used the least amount of water? Who is using the most energy to heat the water?

Real World Connection

Low-flow showerheads use less water than regular showerheads, but it feels like a regular shower. Does your family have low-flow showerheads? You may want to put them into your shower and try your experiment again? Did they really use less water? Also, try taking colder showers for a month. Do you notice a change in your utility bill?

Colors and Heat

Grade Levels: 1-4

Background

Light energy can turn into heat when it hits an object. Light can also be reflected from an object so it doesn't turn into heat.

Question

Do different colors of paper reflect heat differently?

Possible Hypothesis

______________________________ colors reflect heat better.

Materials

- Variety of colored paper, including black and white
- Ice cubes that are all the same size
- Clock or stopwatch

Procedure

1. On a warm, sunny day, place the colored paper on the ground. Make sure that all of the sheets of paper receive the same amount of sunlight. Put one ice cube on each sheet of paper.
2. Begin timing and record the time each cube takes to melt. Record your answers.

Analysis and Conclusion

Did the ice cubes melt at the same speed? Did the ice cubes on the lighter colored paper melt differently than the cubes on the darker paper?

Real World Connection

How could this affect your daily life? If you wanted to stay cool on a sunny day, what color might you wear?

Decaying Food

Grade Levels: 1-4

Background

Materials break down or decay over time. Different forms of energy can make the decay happen faster or slower.

Question

What makes food decay faster?

Possible Hypotheses

Heat does/does not make food decay faster.

Light does/does not make food decay faster.

Water does/does not make food decay faster.

Materials

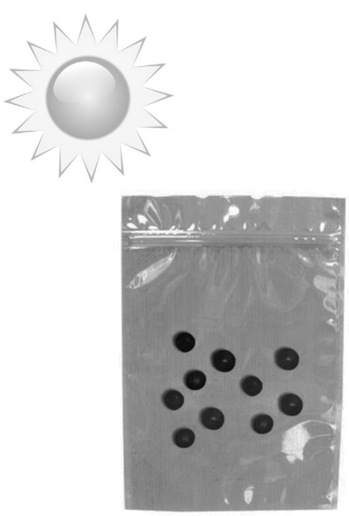
- Packet of dried beans
- Four ziplock bags
- Water
- Refrigerator

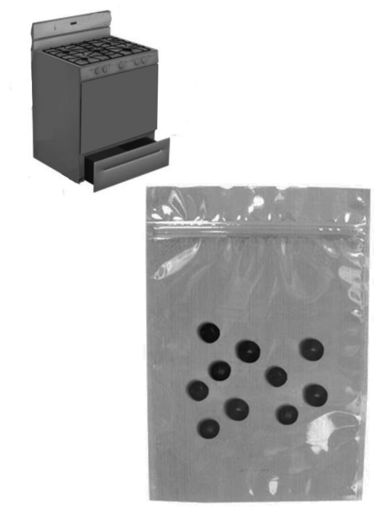
✔ Procedure

1. Place ten beans in a ziplock bag as the control. Soak the rest of the beans in water overnight.
2. Place 10 soaked beans into each of the other three bags. Squeeze out the air, and seal them.
3. Put one bag in a warm, bright place, one in a warm, dark place, and one bag in the refrigerator for a week.
4. Place the control in each condition for two days during the experiment. Observe what happens to the beans.

Analysis and Conclusion

How did the beans change during the week? Which condition made the beans decay faster? What is the best way to keep food fresh?





Melting Ice

Grade Levels: 1-4

Background

Energy comes in many different forms, and often, those forms can change into other forms of energy. For example, when you eat food then run, the chemical energy from the food turns into motion. Chemical energy can change into other forms of energy too.

Question

Will salt make ice melt faster?

Possible Hypothesis

Salt will/will not make ice melt faster.

Materials

- 4 Ice cubes —the same size
- 4 Small plastic cups
- Marker
- Salt
- Teaspoon

Procedure

1. Place one ice cube in each cup.
2. One cup will only have an ice cube with no salt. Mark this cup "0." Place one teaspoon of salt in the next cup, and mark it "1." Place two teaspoons into the next cup and mark it "2." Finally, put 3 teaspoons in the last cup and mark it "3."
3. Place the cups in a sunny place and observe. You can also use a stopwatch to record the time.

Analysis and Conclusion

Which ice cube melted fastest? Did salt make the ice melt faster?

Real World Connection

On an icy day, how could you make your driveway safer?

Sprouting Seeds

Grade Levels: 1-4

Background

Energy comes in many different forms. Two of those forms are growth and light. Energy is never created or disappears—it only changes. When a plant grows, it gets its energy from the light of the sun.

Question

How much sun does a seed need to sprout?

Possible Hypothesis

A seed needs ____ sun to sprout.

Materials

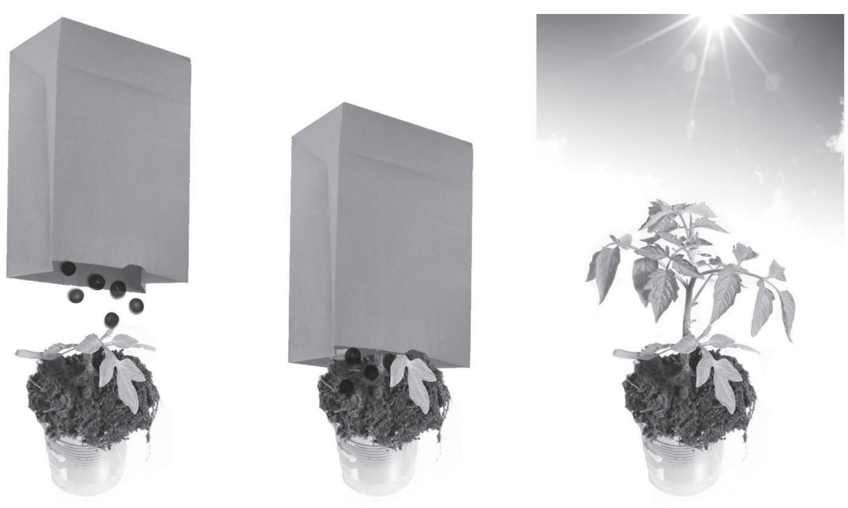
- Three potting containers with potting soil
- Packet of pea or bean seeds
- Water
- Brown paper bags

Procedure

1. Plant three seeds in each potting container.
2. Give all pots the same amount of water.
3. Place one pot in a sunny place all day, every day for two weeks.
4. Place one pot in a sunny place for an hour a day for two weeks. Cover the pot with a paper bag the rest of the time.
5. Cover one pot with a paper bag all of the time for two weeks.
6. Observe the sprouting seeds.

Analysis and Conclusion

Which seeds sprouted and grew the best? What did you learn about a seed's need for sun?



Energy for Life

Grade Levels: 1-4

Background

Energy comes in many different forms. Two of those forms are growth and light. Energy is never created or disappears—it only changes. When a plant grows, it gets its energy from the light of the sun.

Question

Must plants have energy from the sun to live?

Possible Hypothesis

Plants need/do not need the sun's energy to live.

Materials

- Two similar plants
- Brown paper bag
- Water

Procedure

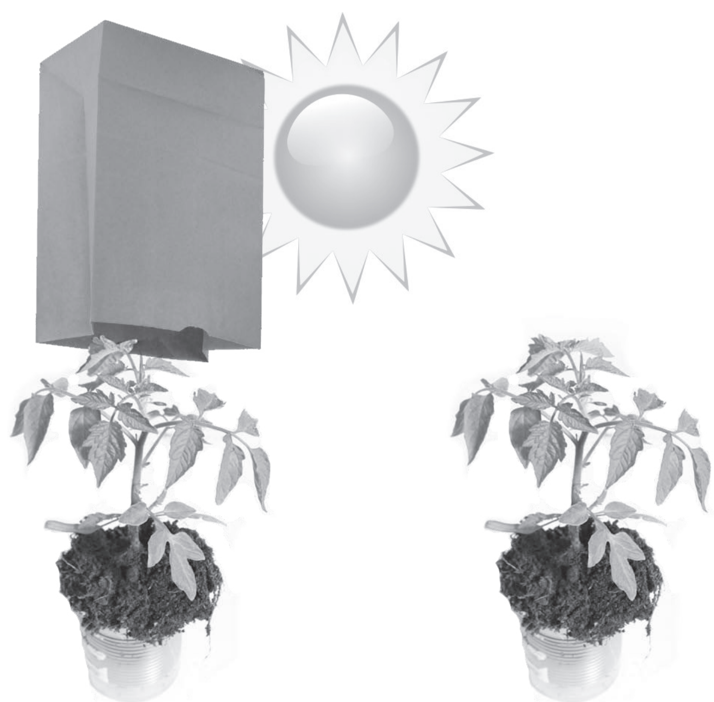
1. Place two plants in a sunny place.
2. Cover one plant with a brown paper bag.
3. Give both plants the same amount of water.
4. Observe the plants for two weeks.

Analysis and Conclusion

Which plant looked healthier after two weeks? Was your hypothesis correct? What energy transformations did your experiment show?

Real World Connection

Who could use your results in real life? What would they learn from your experiment?



Recycled or New Paper

Grade Levels: 1-4

Background

Recycling means using old materials to make new things instead of brand new materials. For example, when we make paper, we can either cut down trees and grind them up to make paper pulp, or we can take paper that has already been used, grind it up, and make paper pulp. Recycling paper means we cut down less trees, and it also uses less energy to make the paper, too. What happens when the paper gets to a landfill though?

Question

Does recycled paper break down faster than new paper?

Possible Hypothesis

Recycled paper will/will not break down faster than new paper.

Materials

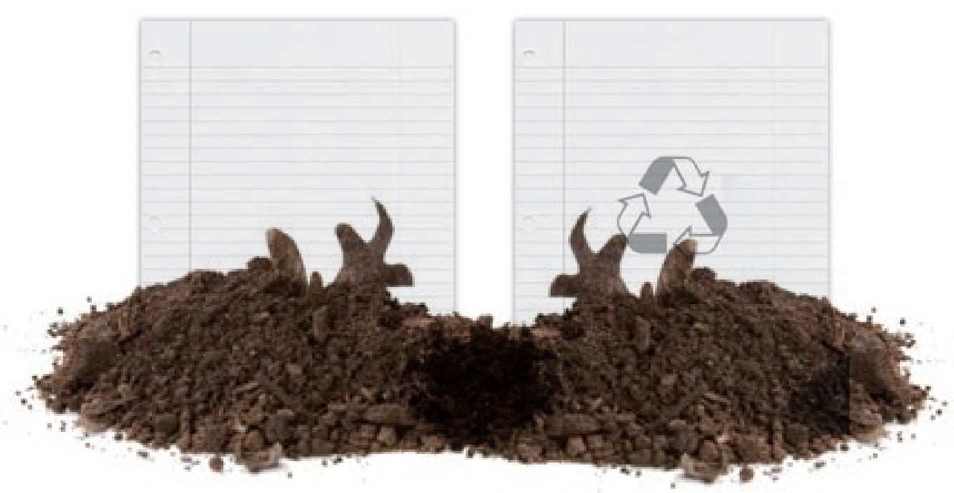
- 1 Piece of recycled paper
- 1 Piece of new paper the same size and thickness of the recycled paper
- Small plot of soil
- Shovel
- Plant/plot marker

✔ Procedure

1. Dig a hole about two inches deep and large enough to lay the pieces of paper side by side. Place the pieces in the hole and bury them with the same amount of soil on top. Mark the plot of soil.
2. After one month, uncover the samples and examine them. Record your observations.

Analysis and Conclusion

Which type of paper decomposed faster? Do you think you would get the same result with recycled plastic, glass, or aluminum?



Static Power

Grade Levels: 1-4

Background

When coal is burned in a power plant, small particles, called ash and soot, are produced. Too much soot can hurt living things if they breathe too much of it. Coal companies use many different ways to stop all the bad products from being released into the air. One way is to separate the soot from the air released.

Question

Can a mixture of salt, sugar, and pepper be separated using filters, water, and/or static electricity?

Possible Hypothesis

A mixture of salt, sugar and pepper ____.

Materials

- Sugar, salt, and pepper
- Small plate
- Plastic comb
- Piece of wool
- Flour sifter
- Bowl of water

Procedure

1. Make three small mixtures of the salt, sugar, and pepper. Put each mix in its own pile or container. Each mix will use a different method of separation. On the plate, make a small pile of salt, sugar, and pepper, but don't mix these together.
2. Sift: Pour one pile of the mixture into a flour sifter. Does it separate the three spices?
3. Water: Pour the second pile into the water. Do some of the spices sink while others float?
4. Electricity: Stroke the comb with wool to give it an electric charge. Using the unmixed spices. Start a few inches above the plate, and move the comb closer to the particles. Observe to see if one type of spice reacts before the others.
5. Repeat the electricity experiment with the last pile of salt, sugar, and pepper mixed together.

Analysis and Conclusion

What methods worked for separating the spices? Are the spices attracted to the comb at different heights above the plate? Can you separate a mixture of salt, sugar, and pepper using static electricity?

Real World Connection

How could power companies that burn coal reduce the amount of ash and soot they put into the air?

Finding Drafts

Grade Levels: 1-4

Background

Almost half of the energy that we use in our houses is used for heating and for cooling. The hot or cool air can sneak out of our house through doors, windows, and even the walls. If we try harder to keep the air in, we will use less energy for heating and cooling. This can save money.

Question

Where in your house or school is hot or cold air escaping?

Possible Hypothesis

Hot/cold air is escaping from ____.

Materials

- Really cold day (when your family uses heat) or a really hot day (when your family is using air conditioning)
- Thermometer
- Pencil and paper

✔ Procedure

1. Make a list of every place you think might be letting air in or out of your house.
2. Take the temperature of each room, in the middle of the room. Also take the temperature outside. Make sure to give the thermometer enough time to change. Wait at least two minutes in each space to take the new temperature. Record your results.
3. Go around your house and check these areas:
   - edges of doors (the bottoms, sides, and tops, windows);
   - against walls (walls between rooms and the outside of the house);
   - around your fireplace (if you have one); and
   - different parts of the floor.

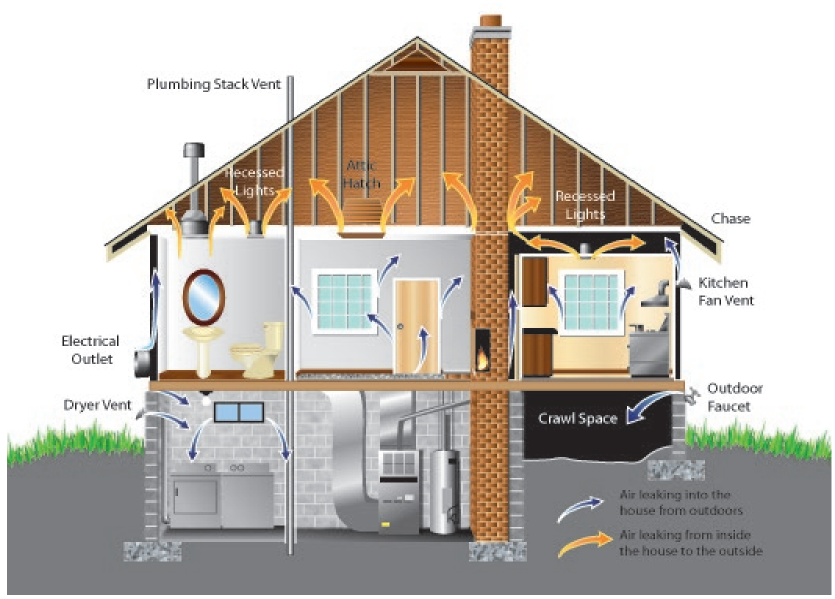
   Record temperatures in these areas and make observations.

Analysis and Conclusion

Where in your house is the most air getting out and in?

Real World Connection

Heating and cooling your house is expensive. Caulking cracks and insulating walls can save a lot of energy—and a lot of money. Share your results with your family. Think about making changes to make your home more energy efficient and save money.



Covering Your Windows

Grade Levels: 1-4

Background

Almost half of the energy that we use in our houses is used for heating and for cooling. The hot or cool air can sneak out of our house through doors, windows, and even the walls. If we try harder to keep the air in, we will use less energy for heating and cooling. This can save money.

Question

What type of window covering is best at keeping a room cool?

Possible Hypothesis

____ is the best window covering to keep a room cool.

Materials

- Window shade
- Drapery panel
- Window blinds
- Heat lamp
- Thermometer
- Window with easy access on both sides, non-insulated window work best

Procedure

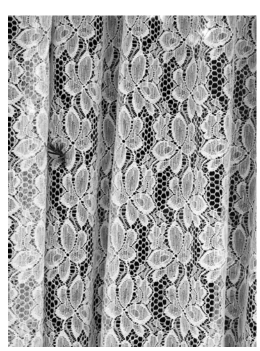
1. Place the heat lamp on the outside of a window. The lamp should be facing the window but not touching it. On the inside of the window, place the thermometer. Turn on the lamp. After three minutes, take a temperature reading. Turn off the lamp and allow temperature to return to normal.
2. Hang the first window covering on the inside of the window. Place the thermometer on the window covering, so that it is farthest away from the lamp. Turn on the lamp and after three minutes, take a temperature reading.
3. Repeat the procedure with other coverings. Be sure to allow the temperature to return to normal between tests.

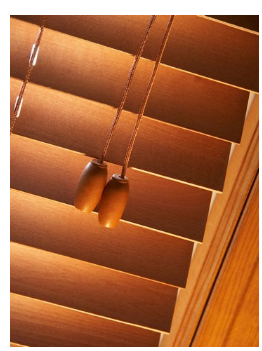
Analysis and Conclusion

Which window covering kept the heat out the best?

Real World Connection

Make suggestions to your family about the best types of window coverings for different rooms of the house.





Water Maker

Grade Levels: 1-4

Background

When light goes into a car, it hits the seats and turns into heat. Light can go through glass, but heat cannot go out. That is why cars get so hot in the summer sun. We call anything that turns the sun's light into heat and then traps it a solar collector.

Question

Can you melt ice or snow to make water when the temperature is below freezing?

Possible Hypothesis

Ice or snow can/cannot melt when the temperature is below freezing.

Materials

- 3 Clear bowls—glass or plastic
- 12 Ice cubes
- Clear plastic
- Black plastic (garbage bag)
- A cold day where the temperature is below 32 degrees Fahrenheit

✔ Procedure

1. Place four ice cubes in each bowl. Leave one bowl uncovered, cover one with clear plastic, and cover one with black plastic.
2. Place the bowls outside on a cold day (below freezing).
3. Check the ice cubes every 15 minutes for an hour and record your observations.
4. Try this experiment on a cold, sunny day and on a cold, cloudy day.

Analysis and Conclusion

Did any of the ice melt when the temperature was below freezing? Did the amount of sun make a difference? Can you explain your results?

Seeing Sound

Grade Levels: 1-4

Background

Sound is a type of energy. Think about it—how does sound get from a radio to your ear? It moves.

Question

Can you turn sound into motion that you can see?

Possible Hypothesis

You can/cannot turn sound into motion that you can see.

Materials

- Plastic bowl
- Plastic bag
- Scissors
- Rubber band
- Uncooked beans
- Uncooked rice
- Pepper
- Big saucepan
- Big spoon

✔ Procedure

1. Cut the plastic bag into a piece slightly bigger than your bowl. The whole top should be covered. Stretch the plastic over the bowl and use a rubber band to secure it. It should look a little bit like a drum.
2. Sprinkle a few beans on the top of the plastic. Hit the bowl with the spoon to create a sound. Hold it close to the plastic. Does anything happen?
3. Try replacing the beans with the rice. Try the pepper. Try making sounds with different pots, pans, instruments, etc. What happens?

Analysis and Conclusion

Were you able to see any movement? What was the difference between the beans, rice, and pepper? What was the difference between the sounds?

Real World Connection

Think about instruments and what you observed. Can you figure out how different instruments create sound?

These activities have been provided by The NEED Project.

For more information please visit www.NEED.org.