Hands-On Minds-On Science Explorations

Grades 3-5

Physical Science & Energy

Hands-On Minds-On Publications

By Beth R. Davis, Ed. S., NBCT

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Name________________________________ Date__________

Gravity

Problem Statement: When dropped at the same time, which item(s) in the materials list will drop to the ground first?

Materials: rubber ball, marble, toy car, bottle of water

Hypothesis: Tell which one(s) will reach the ground first.

Procedure:

Step 1: Weigh each item

Step 2: Drop each item off of the balcony at the same time

Step 3: Repeat for three trials

Results:

Tell which item(s) fell to the ground first.

Data Table

Items	Grams

Conclusion: Was your hypothesis supported?

Tell what you learned today that you did not already know.

Name______________________________________ Date_______________________

Inclined Planes & Energy

When you think of machines, you probably think of cars, trucks, or power tools. All these machines need motors to make them work. There are machines that do not need motors such as bottle openers, scissors, screws, wheels, or hammers. An **inclined plane** is a simple machine that helps you do work without moving. Suppose you want to put your bicycle in the back of a truck. You can use a board wide enough for your bicycle and long enough to reach from the ground to the bed of the truck on a gradual slope. If you used a longer board to make the inclined plane, you would need less force or effort to move your bicycle, but you would have to move it a longer distance. In this activity, you will find out if increasing the level of an inclined plane will make a toy car roll a farther distance. When you place a car at the top of an inclined plane, there is **potential energy** (stored energy) in the car. When the car is released, the energy is converted to **kinetic energy** (energy in motion). The farther above ground the inclined plane, the greater potential energy.

Problem Statement: Will increasing the height of an inclined plane make the car travel a farther distance?

Material: Toy car, Hot Wheel track, books

Hypothesis:

Procedure:

Step 1: Place two books on the ground. Place the Hot Wheel track on top of books.

Step 2: Place a car at the top of the track, be sure all four wheels are on the track.

Step 3: Release the car. Measure how many feet the car traveled.

Step 4: Record your data.

Step 5: Repeat steps 1-4, adding two books to the pile each time.

Controlling Variable	Independent Variable	Dependant Variable
Anything kept constant in the experiment is “controlled” so that is won’t affect the results of the experiment.	The thing that is changed to determine its effect on the result of the experiment.	What is changed in the experiment, the outcome or the results
		1. distance the car will travel.

Data Table

Number of books	Distance traveled Trial 1	Distance traveled Trial 2	Distance traveled Trial 3	Distance traveled Trial 4

Feet traveled	10							
	9							
	8							
	7							
	6							
	5							
	4							
	3							
	2							
	1							
	0							
		1		2		3		4

trial

Results: Use the data table or the graph to summarize your results. **Be sure to tell what you found out during the experiment regarding increasing the height of the inclined plane.**

When two books were used, the car traveled _________ feet.

Conclusion: Was your hypothesis supported? What did you learn in this experiment?

Give an example of another way an inclined plane can be used to make work easier.

Name______________________________________ Date_______________________

Inclined Planes & Energy (Answers)

When you think of machines, you probably think of cars, trucks, or power tools. All these machines need motors to make them work. There are machines that do not need motors such as bottle openers, scissors, screws, wheels, or hammers. An **inclined plane** is a simple machine that helps you do work without moving. Suppose you want to put your bicycle in the back of a truck. You can use a board wide enough for your bicycle and long enough to reach from the ground to the bed of the truck on a gradual slope. If you used a longer board to make the inclined plane, you would need less force or effort to move your bicycle, but you would have to move it a longer distance. In this activity, you will find out if increasing the level of an inclined plane will make a toy car roll a farther distance. When you place a car at the top of an inclined plane, there is **potential energy** (stored energy) in the car. When the car is released, the energy is converted to **kinetic energy** (energy in motion). The farther above ground the inclined plane, the greater potential energy.

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		1. distance the car will travel.

Data Table

Number of books	Distance traveled Trial 1	Distance traveled Trial 2	Distance traveled Trial 3	Distance traveled Trial 4

____

Distance in feet	18							
	16							
	14							
	12							
	10							
	8							
	6							
	4							
	2							
	0							
		1		2		3		4

Trial

Results: Use the data table or the graph to summarize your results. **Be sure to tell what you found out during the experiment regarding increasing the height of the inclined plane.**

When two books were used, the car traveled _________ feet.

Conclusion: Was your hypothesis supported? What did you learn in this experiment?

Give an example of another way an inclined plane can be used to make work easier.

Name ________________________________ Date ______________________

STRUCTURES

Buildings need to be built on strong foundations so that they are safe for the people inside. Today you are going to build a structure using paper and tape that will support the weight of several books. You must follow several ground rules so that each structure has the same controls. A control is something that is the same for each experiment and does not change. There will also be several variables in the experiment. A variable is something that can change the outcome of an experiment.

Your task: Using six sheets of paper and 12 inches of tape, build a structure

that will support the most weight. The paper must be rolled in columns that are 8 1/2 inches high.

Draw a diagram showing how you will position your columns here:

Problem Statement: How many books do you predict your structure will hold?

Hypothesis:

Procedure: Tell how your group decided to make the structure:

Results:

Conclusion:

Tell what contributions you made to your group.

List the variables in this experiment:

List the controls in this experiment:

ABSTRACT

Name______________________________________ Date________________________

Make Mine Cold – Energy Transfer

BACKGROUND INFORMATION "Energy is the ability to do work." In other words, you can use energy to bring about certain changes in **systems** or their surroundings. The concept of adding salt to lower the freezing point of water or the melting point of ice is a difficult concept. Normally, water freezes when the temperature reaches about 32 degrees Fahrenheit (0 degrees Celsius). The addition of a foreign substance, such as salt, interferes with the formation of the ice crystals, and the freezing/melting point is lowered. When you mix salt with water you actually lower this freezing point. Salty water will still freeze, but the temperature has to be colder than it would for normal water. The exact freezing temperature of saltwater depends on the concentration of salt in the water. A 10% salt solution freezes at 20 degrees Fahrenheit and a 20% solution freezes at 2 degrees Fahrenheit. The more salt you add, the colder it must get before the water freezes. By lowering the temperature at which ice is frozen, we can create an **environment** in which the liquid freezer pop can get colder than 32 degrees Fahrenheit and freeze solid. The ice absorbs energy from the liquid freezer pop since the liquid freezer pop is warmer. (Conduction is the flow of heat through a substance from areas of higher temperature to areas of lower temperature.) This causes the liquid freezer pop to get cooler, because heat energy is being released from it. When the freezer pop has released enough heat energy, the liquid will undergo a **change of state** from a **liquid** to a **solid** or semi-solid state.

Problem Statement: How is energy transferred?

How long will it take to freeze a freezer pop in a cup of ice with rock salt?

MATERIALS : **Per pair of students** 1 6 inch long liquid freezer pop, 1 gallon bag filled with ice, 2 tablespoons of rock salt in a cup, 1 thermometer, paper towels

Procedure:

1. Place the freezer pop in a gallon zip lock bag. Fill the bag with ice.
2. Insert the thermometer into the bag of ice and note the starting temperature on the data sheet. **Caution: be careful placing the thermometer down into the ice so the thermometer does not break.**
3. Measure 4 tablespoons of rock salt and place it in the bag..
4. Close the bag and shake it vigorously.
5. Note the temperature of the ice once the pop is frozen and to record the ending temperature on the data table. C
6. Calculate the temperature difference and reflect on why there was a change in the temperature of the ice.

Data Table

Starting Temperature	Ending Temperature	Change in temperature

Results: How long did it take for the freezer pop to go from a liquid to a solid?

How did the properties of the freezer pops change?

What caused the freezer pops to change state?

Was there a change in the temperature of the ice?

Why did the temperature change occur?

Did the heat energy flow from the freezer pop to the ice or from the ice to the freezer pop?

When heat flows through a substance from an area of higher temperature to an area of lower temperature what it this is called?

Why is salt spread over icy roads in the north during the winter?

Name______________________________________ Date________________________

Make Mine Cold – Energy Transfer (Answers)

BACKGROUND INFORMATION "Energy is the ability to do work." In other words, you can use energy to bring about certain changes in **systems** or their surroundings. The concept of adding salt to lower the freezing point of water or the melting point of ice is a difficult concept. Normally, water freezes when the temperature reaches about 32 degrees Fahrenheit (0 degrees Celsius). The addition of a foreign substance, such as salt, interferes with the formation of the ice crystals, and the freezing/melting point is lowered. When you mix salt with water you actually lower this freezing point. Salty water will still freeze, but the temperature has to be colder than it would for normal water. The exact freezing temperature of saltwater depends on the concentration of salt in the water. A 10% salt solution freezes at 20 degrees Fahrenheit and a 20% solution freezes at 2 degrees Fahrenheit. The more salt you add, the colder it must get before the water freezes. By lowering the temperature at which ice is frozen, we can create an **environment** in which the liquid freezer pop can get colder than 32 degrees Fahrenheit and freeze solid. The ice absorbs energy from the liquid freezer pop since the liquid freezer pop is warmer. (Conduction is the flow of heat through a substance from areas of higher temperature to areas of lower temperature.) This causes the liquid freezer pop to get cooler, because heat energy is being released from it. When the freezer pop has released enough heat energy, the liquid will undergo a **change of state** from a **liquid** to a **solid** or semi-solid state.

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Data Table

Starting Temperature	Ending Temperature	Change in temperature

Results: How long did it take for the freezer pop to go from a liquid to a solid?

How did the properties of the freezer pops change?

(The freezer pops changed from a liquid to a solid or semi-solid state.)

What caused the freezer pops to change state?

(Energy must be taken away from a liquid to make it a solid. As the ice melted, it absorbed heat energy from the warmer liquid pop, which then became cooler and nearly frozen.)

Was there a change in the temperature of the ice?

(The temperature of the icy water began to decrease. When salt comes into contact with ice, the freezing point of the ice is lowered.)

Why did the temperature change occur?

(The addition of a foreign substance, such as salt, interferes with the formation of the ice crystals and lowers the freezing point of water and the melting point of ice. Water will normally freeze at 32 degrees Fahrenheit [0 degrees Celsius]. Salt lowers the freezing point and causes the ice to start melting.)

Did the heat energy flow from the freezer pop to the ice or from the ice to the freezer pop? **(Heat energy flowed from the freezer pop to the ice. The freezer pop was warmer and released heat energy to the cooler ice.**

When heat flows through a substance from an area of higher temperature to an area of lower temperature what it this is called?

conduction.

Why is salt spread over icy roads in the north during the winter.

(Putting salt on ice makes the ice melt, because the salt lowers the melting temperature causing the ice to melt more quickly.

Name_________________________________ Date__________________

The Heat Is On- Solar Energy

BACKGROUND INFORMATION: **Light** is a form of **energy** that travels at very high speeds. Light can pass through air, water, glass, and many other materials. Light can easily pass through materials that are transparent, like clear window panes. Some materials, such as opaque objects, do not permit light to pass through them. Opaque objects are usually **solid** materials, such as books or wooden blocks. Light that hits an opaque object is blocked. A shadow is then formed in the shape of the object blocking the light. Transparent, translucent, and opaque objects can all create shadows. An opaque object casts a shadow that looks totally dark because it blocks all of the light rays falling on it; no light passes directly behind the object. A transparent or translucent object casts a lighter shadow because it blocks only some of the light rays falling onto it. Ultraviolet light is a form of radiation which is not visible to the human eye. It's in an invisible part of the "electromagnetic spectrum".

Radiated energy, or radiation, is given off by many objects: a light bulb, a crackling fire, and stars are some examples of objects which emit radiation. The type of radiation being emitted depends on the temperature of the object. A coal glowing red in a barbecue is cooler than our Sun, which appears yellow, which is cooler still than some stars which appear bright white.

Forms of energy include: **mechanical**, energy of position and motion; **electrical**, energy of moving electrons; **chemical**, energy stored in chemical bonds; **thermal,** heat energy - the energy of moving and vibrating molecules; **nuclear**, energy contained in the nuclei of atoms; and **radiant,** energy that travels in waves like sunlight

Problem Statement: How does light interact with objects?

Use the overhead projector to make shadows. Explain why you were able to see the shadow on the wall.

Photosensitive beads are used in this activity. Photosensitive beads work because the bead is coated with a thin film of a chemical that is changed by the ultraviolet rays that are absorbed from the **sun.** You can see this change when the color of the bead changes from white to a color.

The following colors might appear on the beads; red, purple, blue, yellow, and orange. Predict what color the beads will turn.

Go outside. Shield the UV beads from the sun, then expose the bead to the sunlight.

	Bead 1	Bead 2	Bead 3	Bead 4	Bead 5	Bead 6	Bead 7	Bead 8	Bead 9	Bead 10
Hypothesis										
Results										

How long did it take from the time the beads were exposed until the color appeared?

How many beads did you guess correctly? __________

What percentage does that number represent? _______%

Why did the color change when they were exposed to the sun?

What form of energy was used in this color changing experiment? Explain why.

Using the heat sensitive paper, create friction by rubbing your finger on the paper. Explain what happened and what type of energy this represents.

The sun is a renewable energy resource. A simple solar oven is made by painting a box black. The box is lined with aluminum foil and covered with a piece of glass or plastic. **Explain why the cooker is painted black** and the **role of the aluminum foil** and the **glass** plays in the operation of the solar over.

Tell something you learned in the lab today that you did not already know, or explain your favorite part of the lab period.

Name_________________________________ Date_____________________

Light Benders

BACKGROUND INFORMATION: A swimming pool appears shallower than it really is. A pencil in a glass of water appears bent. These effects are caused by the change in the speed of **light** and the change in the direction of light when it passes from one material to another. These effects are due to the **refraction** (bending) of light. Refraction occurs when light enters a medium, like oil or water, at a slant (at any angle other than a right angle). Each time the light enters or leaves one clear substance and travels diagonally into another, the slanted light beam penetrates the next clear substance at a slightly different angle. This gives the illusion that the object is broken or bent. The degree of refraction depends on the type of material. Light slows down when it enters a more viscous (slower-flowing) medium and speeds up when it leaves the medium. The difference in speed at surfaces also causes light to bend. Refraction may also make objects in liquids appear closer and/or bigger than they really are. Light is refracted, or bent, as it passes through a prism, a transparent object with flat faces that refracts light. A prism breaks visible, white light, into a spectrum, a light arrangement separated according to wave length, frequency and **energy**. Color is the way the human eye perceives various wavelengths of light. If the wavelengths are in the visible portion of the family of wavelengths and all the same kind, a color of the spectrum is seen: red, orange, yellow, green, blue, indigo, or violet (ROY G BIV). A mixture of visible light wavelengths produces other colors such as brown, purple, olive green, etc.

Problem Statement

What happens when light travels from one material to another?

Material: flashlight, comb, tape, shoebox, sheet of white paper, prism

Procedure:

1. Tape a comb over the semicircle on the front of the box.
2. Place a white sheet of paper under the box and place a flashlight under the box. Turn on the flashlight.
3. Position the prism on the white paper about 5 cm inches away from the comb.
4. Illustrate what you see in box 1.
5. Move the prism three inches to the right of the center and illustrate what you see in box 2.
6. Move the prism three inches to the left of the center and illustrate what you see in box 3.

Box 1	Box 2	Box 3

Write your observations here:

Here is what happened: Light is refracted, or bent, as it passes through a prism. A prism breaks visible, white light, into a spectrum, a light arrangement separated according to wave length, frequency and energy. Color is the way the human eye perceives various wavelengths of light. If the wavelengths are in the visible portion of the family of wavelengths and all the same kind, a color of the spectrum is seen: red, orange, yellow, green, blue, indigo, or violet. When light passes through a prism, each wavelength, or color, is bent at a different angle. This is because the color of light is an indication of its energy; blue light is more powerful than red light, so it bends more than red light. Green light, in the middle of the spectrum, refracts at a greater angle than red light, but at a lesser angle than blue light.

Think about the colors of the rainbow. Compare how the colors are arranged in the prism to how they are arranged in a rainbow.

What may have caused the rainbows to appear?

Bend white light by shining a light onto a mirror submerged in water. Tilt the mirror so that reflected light strikes a white surface. ***What do you see on the white surface?***

Place a pencil in a clear plastic cup of water. Explain what you see.

Write an abstract about this experiment

Name__________________________________ Date______________________

Light Benders (answers)

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10. Illustrate what you see in box 1.
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Box 1	Box 2	Box 3

Write your observations here:

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Think about the colors of the rainbow. Compare how the colors are arranged in the prism to how they are arranged in a rainbow.

(they are arranged in the same order)

What may have caused the rainbows to appear?

(When conditions are right, water in the air, such as raindrops, can act as prisms and refract the sunlight as it passes through, causing the light to separate into the spectrum of colors.)

Bend white light by shining a light onto a mirror submerged in water. Tilt the mirror so that reflected light strikes a white surface. ***What do you see on the white surface?***

the light is reflected onto the white paper

Place a pencil in a clear plastic cup of water. Explain what you see.

The pencil appears to be bent. It is the light that is bending.

Write an abstract about this experiment

Name______________________________ Date__________________________

CHANGING FORMS OF ENERGY:

BALL BOUNCING EXPERIMENT

Energy can be changed from potential energy (energy at rest) to kinetic energy (energy in motion). An example can be seen in bouncing a ball. When you hold a ball in the air, before you drop it, the ball has stored energy. When the ball is dropped, it is energy in motion. In this activity, you will predict whether the height of the drop will affect the height of the bounce.

Problem Statement: Will the height of the drop affect the height of the bounce?

Hypothesis: What is your prediction?

Materials: Graph paper, meterstick, tape, colored markers, ping pong ball

Procedure:

1. Tape 5 sheets of graph paper on the wall, one on top of the other from the floor up.
2. Tape the meterstick on the side of the paper and mark the paper every ten centimeters from the bottom to the top of the paper.
3. Hold the ball at the 50cm line and drop the ball. Mark the height of the bounce. Repeat for a total of 4 trials.
4. Hold the ball at the 75cm line and drop the ball. Mark the height of the bounce. Repeat for a total of 4 trials.
5. Hold the ball at the 100cm line and drop the ball. Mark the height of the bounce. Repeat for a total of 4 trials.
6. Use a difference color marker or colored pencil to plot the points on the graph.

Data Table

height of drop	bounce height trial 1	bounce height trial 2	bounce height trial 3	bounce height trial 4	bounce height total	bounce height average
50 cm					/4	cm
75 cm					/4	cm
100 cm					/4	cm

Ball Bounce Graph

42							
40							
38							
36							
34							
32							
30							
28							
26							
24							
22							
20							
18							
16							
14							
12							
10							
8							
6							
4							
2							
0							
	trial 1		trial 2		trial 3		trial 4

KEY: Choose a color for each height. Make a dot on the line for each one______50cm _______75cm 100cm____

Results: Using the data table, summarize your results.

1. Name 5 forms of kinetic energy:

1.	4.
2.	5.
3.	

2. Name 2 forms of potential energy:

1.	2.

3. Define energy:

4. What is the difference between potential and kinetic energy?

5. In the ball dropping experiment, tell when potential and kinetic energy was being used.

6. If you toss a ball in the air, at what point does it have the most potential energy?

Name____ Date__________________________

ROCKET BALLOONS

There are two kinds of mechanical **energy – kinetic and potential.** Potential energy is energy an object has because of its position or shape. Kinetic energy is the energy an object has because it is moving. The greater the speed and the mass of an object, the greater its kinetic energy. When the rocket balloon has been inflated and the neck is being pinched closed, the balloon has potential energy (stored energy). When the rocket balloon is released and moves along the track, the potential energy is transformed to kinetic energy (energy of motion). Newton's three laws of motion can be used to explain the movement of all objects in the universe. Newton's Third Law states, "For every action, there is an equal but opposite reaction." Newton's Third Law says that when one object exerts a force on a second object, the second object exerts a force back that is equal in size but opposite in direction. All forces act in pairs. In this activity, when the air inside the balloon escapes, it pushes the balloon forward - an equal and opposite reaction.

Problem Statement: What happens to an inflated rocket balloon when the air is released?

Materials:

4 balloons of various sizes/shapes, cellophane or masking tape, 1 metric measuring tape, 10 meters of fishing line or string coiled around an index card

Procedure:

1. Cut 10 m of fishing line and wrap it around a ruler. Tape the line to the ruler.
2. Slip a straw onto one end of the line. Extend the fishing line out and have a second student hold the opposite end of the line some distance away.
3. Have a third student select a balloon, blow it up, and pinch the end closed while the fourth student tapes the balloon to the straw. Be sure the balloon is taped to the straw and not to the line itself.
4. Predict how far they think the balloon will travel when released.
5. As the two students are holding the line taut and about shoulder height, the student who is pinching the balloon closed should release it when the "GO" signal is given.
5. One student should measure the distance the balloon traveled and share it with the team so that they can record it on the data sheet.

Data Table:

Trial 1	___________**meters**
Trial 2	___________ **meters**
Trial 3	___________ **meters**
Trial 4	___________ **meters**
Trial 5	___________ **meters**
Trial 6	___________ **meters**
Trial 7	___________ **meters**
Trial 8	___________ **meters**
Total	

Average meters:________

Graph the data:
Rocket Balloon Graph

Meters traveled

13															
12															
11															
10															
9															
8															
7															
6															
5															
4															
3															
2															
1															
0															
	Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		Trial 7		Trial 8

TRIAL

Results: Summarize the results, be sure to tell the average number of feet that the balloon traveled.

What caused the rocket balloon to move along the tracks?

When did an energy transformation occur during the activity?

How did balloon size affect the flight?

What other variables may have affected the distance the balloons traveled

Think about how launching a rocket balloon is similar to popping a kernel of popcorn. The small amount of water in the starch inside the hull turns to steam, which builds up pressure, and POP! If there is no lid, the popcorn will shoot into the air just as the balloon shoots along the track.

Name____ Date___________________________

ROCKET BALLOONS (answers)

There are two kinds of mechanical **energy – kinetic and potential.** Potential energy is energy an object has because of its position or shape. Kinetic energy is the energy an object has because it is moving. The greater the speed and the mass of an object, the greater its kinetic energy. When the rocket balloon has been inflated and the neck is being pinched closed, the balloon has potential energy (stored energy). When the rocket balloon is released and moves along the track, the potential energy is transformed to kinetic energy (energy of motion). Newton's three laws of motion can be used to explain the movement of all objects in the universe. Newton's Third Law states, "For every action, there is an equal but opposite reaction." Newton's Third Law says that when one object exerts a force on a second object, the second object exerts a force back that is equal in size but opposite in direction. All forces act in pairs. In this activity, when the air inside the balloon escapes, it pushes the balloon forward - an equal and opposite reaction.

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Data Table:

Trial 1	___________**meters**
Trial 2	___________ **meters**
Trial 3	___________ **meters**
Trial 4	___________ **meters**
Trial 5	___________ **meters**
Trial 6	___________ **meters**
Trial 7	___________ **meters**
Trial 8	___________ **meters**
Total	

Average meters:_________

Graph the data:

Rocket Balloon Graph

	13															
	12															
	11															
	10															
#	9															
Of	8															
	7															
M	6															
E	5															
T	4															
E	3															
R	2															
s	1															
		Trial 1		Trial 2		Trial 3		Trial 4		Trial 5		Trial 6		Trial 7		Trial 8

TRIAL

Results: Summarize the results, be sure to tell the average number of meters that the balloon traveled.

The average distance traveled was ________ meters.

What caused the rocket balloon to move along the tracks?

The air inside the balloon was released pushing the rocket forward- equal and opposite reaction.

When did an energy transformation occur during the activity?

Potential energy was converted to kinetic energy when the neck of the balloon was opened and the air was released.

How did balloon size affect the flight?

The more air in the balloon, the greater distance it traveled.

What other variables may have affected the distance the balloons traveled

Size of balloon, tightness of rope, how it was taped, etc.

Think about how launching a rocket balloon is similar to popping a kernel of popcorn. The small amount of water in the starch inside the hull turns to steam, which builds up pressure, and POP! If there is no lid, the popcorn will shoot into the air just as the balloon shoots along the track.

NAME____________________________ DATE_______

TYPES OF ENERGY & SOLAR COOKING

BACKGROUND INFORMATION: Energy is available in two forms. **Potential Energy** is the stored energy found in such resources as coal, wood, and oil. **Kinetic energy** is found is such sources as heat light, sound, and motion. When potential energy is converted to kinetic energy, such as burning fuel to power a car, unwanted chemicals are released in the air. This is one of the causes of air pollution. Many of the resources used to produce kinetic energy are fossil fuels or non-renewable resources. This means they were formed over millions of years ago and when they are used up, there will be no more. One type of energy that does not cause air pollution and is renewable is solar energy. Solar energy uses energy from the sun. Some homes have solar panels that collect and store the sun's energy for later use.

PROBLEM STATEMENT: How long will it take for chocolate to melt on a marshmallow in a solar cooker?

MATERIALS: solar cooker, thermometer or probe, marshmallows, shaved chocolate, tape

HYPOTHESIS: (How long do you think it will take to melt the chocolate?)

PROCEDURE:

1. Set some marshmallows on a piece of foil in the bottom of the cooker
2. Place the thermometer or probe inside.
3. Cover with glass or plastic wrap to keep bugs out.
4. Record the temperature every 5 minutes.

TIME	TEMPERATURE

RESULTS:

CONCLUSION:

BUILDING A SOLAR SHOEBOX COOKER

MATERIALS: metal coat hanger or skewer, shoebox, aluminum foil, tape, plastic wrap, black paint, brushes

PROCEDURE:

1. Paint the outside of a shoebox black.
2. When the paint dries, line the inside with aluminum foil.
3. Place item to be cooked on a piece of foil.
4. Place a thermometer inside the box.
5. Cover the top with plastic wrap and tape closed.

6. Prop the cooker on another box so that it sits on an angle facing the sun.

MARSHMALLOW COOKING: Remove the skewer and push it through a few marshmallows. Top with chocolate shavings.

NACHOS & CHEESE: Place a small metal pan in the bottom of the cooker and remove the skewer. Put a layer of chips in the pan and top with cheese.

HOT DOGS: Place the hot dog on the skewer and place the cooker in direct sunlight.

SMORES: On a metal pan place a graham cracker. Lay two marshmallows on top. Place a Hershey bar on top of the marshmallows. Cook until chocolate it melted.

Name____ Date______________________

How does heat energy travel?

BACKGROUND INFORMATION: Heat is the name given to the **energy** that is transferred from one object to another by virtue of a difference in their temperatures. Whenever two samples of matter having different temperatures come into contact, energy is transferred from the one of higher temperature to the one of lower temperature until both have the same temperature. The flow of heat through a substance from areas of higher temperature to areas of lower temperature is called conduction. Conduction can be explained by the **kinetic energy** of **atoms** within the material. Heat causes the atoms to vibrate more rapidly. These atoms vibrate against nearby atoms, which do the same until the kinetic energy moves throughout the object. The faster the atoms vibrate, the warmer the object becomes. Metals, such as silver and copper, are best among common metals in conducting heat. The most efficient conductor of heat, to the last, being the least efficient conductor of heat are as follows: copper, gold, iron, glass, brick, water, nylon, wood (oak), concrete, wool, air.

MATERIALS Per group: 2 cans the same height, paper towels, clock or timer, matches, 2 sheets of heavy-duty aluminum, foil toothpicks, water (for fire extinguisher),1 piece of foil to wrap around the candle 1 votive candle 10 chocolate chips

SAFETY TIP: All loose clothing and hair should be secured, and students should wear safety goggles. Water should be available.

Think about how smores are made (Heat radiated from the campfire to a marshmallow held above it on a stick. The hot marshmallow was placed on a chocolate square that was on a Graham Cracker square. Through conduction, the chocolate was heated and melted.)

Procedure:

1. Fold one piece of foil in half four times. Bend the ends of the foil down about 2 centimeters and hook the ends over the tops of the two cans to create a bridge.
2. Evenly place five chocolate chips along the foil bridge.
3. Wrap foil around the candle to create a cylinder. Place the candle in the center under the bridge.
4. Predict the order in which you think the chips will melt. Draw a diagram showing the cans, foil bridge, and the chips. Number the chips on the diagram to show the predicted melting pattern.
5. Predict the total melting time of the chips and write that time on the data table. (Total melting time is the time needed for the last chip to start melting.)
6. One student will watch the clock and call out the time when group members report that the last chip has melted.
7. Light the candle and record the starting time. Observe the chips as they melt, paying attention to the order in which they melt and how their physical properties change. Continue to observe the chips until the last one is melted. Use a toothpick to gently touch the chips to check for melting.
8. Record the ending time on the data.
9. Fold the bridge over and do a second trial. This time put the flame to the left side of the bridge.

Draw a diagram of the two cans with the foil bridge. Be sure to draw the chocolate chips on the bridge and number them 1-5. Under each chip, write the starting and ending time to show when it melted.

HYPOTHESIS: Predict the order that the chips will melt for trial 1 and trial 2.

Trial 1 Trial 2

	Chip 1	Chip 2	Chip 3	Chip 4	Chip 5		Chip 1	Chip 2	Chip 3	Chip 4	Chip 5
hypothesis											
results											

Trial 1: Trial 2

	Chip 1	Chip 2	Chip 3	Chip 4	Chip 5		Chip 1	Chip 2	Chip 3	Chip 4	Chip 5
Start											
End											
Melt time											

How did the closeness to the flame affect the chips?

What caused the chocolate chips to melt?

The heat from the candle never touched the chocolate chips, so how did it heat them?

What melting pattern did you observe when the candle was in the middle?

What melting pattern did you observe when the candle was placed to the far left?

Why did those melting patterns occur?

Name____ Date______________________

How does heat energy travel? (Answers)

BACKGROUND INFORMATION: Heat is the name given to the **energy** that is transferred from one object to another by virtue of a difference in their temperatures. Whenever two samples of matter having different temperatures come into contact, energy is transferred from the one of higher temperature to the one of lower temperature until both have the same temperature. The flow of heat through a substance from areas of higher temperature to areas of lower temperature is called conduction. Conduction can be explained by the **kinetic energy** of **atoms** within the material. Heat causes the atoms to vibrate more rapidly. These atoms vibrate against nearby atoms, which do the same until the kinetic energy moves throughout the object. The faster the atoms vibrate, the warmer the object becomes. Metals, such as silver and copper, are best among common metals in conducting heat. The most efficient conductor of heat, to the last, being the least efficient conductor of heat are as follows: copper, gold, iron, glass, brick, water, nylon, wood (oak), concrete, wool, air.

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SAFETY TIP: All loose clothing and hair should be secured, and students should wear safety goggles. Water should be available.

Think about how smores are made (Heat radiated from the campfire to a marshmallow held above it on a stick. The hot marshmallow was placed on a chocolate square that was on a Graham Cracker square. Through conduction, the chocolate was heated and melted.)

Procedure:

1. Fold one piece of foil in half four times. Bend the ends of the foil down about 2 centimeters and hook the ends over the tops of the two cans to create a bridge.
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3. Wrap foil around the candle to create a cylinder. Place the candle in the center under the bridge.
4. Predict the order in which you think the chips will melt. Draw a diagram showing the cans, foil bridge, and the chips. Number the chips on the diagram to show the predicted melting pattern.
5. Predict the total melting time of the chips and write that time on the data table. (Total melting time is the time needed for the last chip to start melting.)
6. One student will watch the clock and call out the time when group members report that the last chip has melted.
7. Light the candle and record the starting time. Observe the chips as they melt, paying attention to the order in which they melt and how their physical properties change. Continue to observe the chips until the last one is melted. Use a toothpick to gently touch the chips to check for melting.
8. Record the ending time on the data.
9. Fold the bridge over and do a second trial. This time put the flame to the left side of the bridge.

Draw a diagram of the two cans with the foil bridge. Be sure to draw the chocolate chips on the bridge and number them 1-5. Under each chip, write the starting and ending time to show when it melted.

HYPOTHESIS: Predict the order that the chips will melt for trial 1 and trial 2.

Trial 1 Trial 2

	Chip 1	Chip 2	Chip 3	Chip 4	Chip 5		Chip 1	Chip 2	Chip 3	Chip 4	Chip 5
hypothesis											
results											

Trial 1: Trial 2

	Chip 1	Chip 2	Chip 3	Chip 4	Chip 5		Chip 1	Chip 2	Chip 3	Chip 4	Chip 5
Start											
End											
Melt time											

How did the closeness to the flame affect the chips?

(the closer to the flame, the faster it melted.)

What caused the chocolate chips to melt?

(heat energy from the candle)

The heat from the candle never touched the chocolate chips, so how did it heat them?

(Heat radiated from the candle to the foil. Vibrating atoms bumped other atoms and the heat energy traveled along the foil bridge by means of conduction.)

What melting pattern did you observe when the candle was in the middle?

The chip right above the flame melted first and then the two chips beside the middle one melted, followed by the outer two chips.)

What melting pattern did you observe when the candle was placed to the far left?

(The chip under the flame melted first and then the chips melted in order from left to right.)

Why did those melting patterns occur?

(Heat energy travels outward from the area closest to the heat source.)