DOCUMENT RESUME

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ABSTRACT

Presented is a science activities in energy package which includes 14 activities relating to energy conservation. Activities are simple, concrete experiments for fourth, fifth and sixth grades, which illustrate principles and problems relating to energy. Each activity is outlined on a simple card which is introduced by a question. A teacher's supplement is included. (SL)

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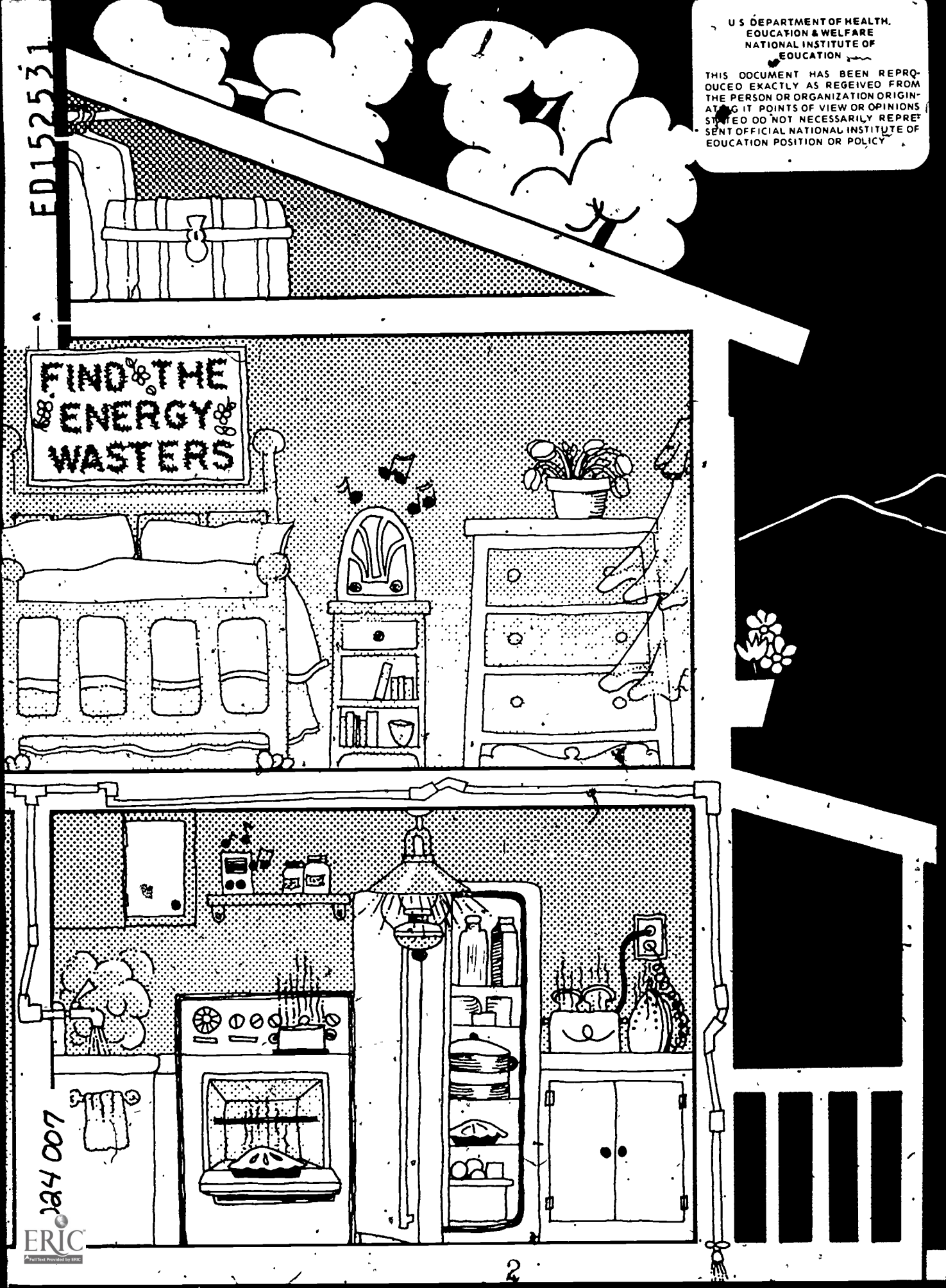

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Science Activities in Energy is a series of simple, concrete, revealing experiments that was developed by the American Museum of Atomic Energy especially for fourth, fifth, and sixth graders but can be just as useful in community programs.

The purpose of the series is to illustrate certain principles and problems related to various forms of energy and to their development, use, and conservation.

More important, it is an effort to help you and other teachers involve students directly in exploring intriguing questions—in making discoveries on their own.

You needn't be an expert in science to use this material. In fact, teachers shouldn't be expected to know the "right" answer to every question posed. What's more, many of the activities involve not just science but art, economics, arithmetic, reading, and other skills and disciplines as well—and need not be used in sequence.

Each unit in the series forms a coherent program of instruction on a single topic: solar energy, electricity, conservation, and the like.

Most activities in the series can be completed in the classroom with materials readily available in any community: pots and pans, paper cups, water, salt, thermometers, and cardboard boxes. A few require purchases from local or national suppliers.

Each project is introduced as a question: How much warmer do objects get in the sun than in the shade? What is the best color to paint a house to keep it cool in the summer? Which stores solar energy better—water or rock?

At the outset of an experiment, try to get your students to predict outcomes, even when they have no experience to justify their projections. Urge them to make a guess. They'll become more interested, feel more involved, if they do.

In order to answer each question, a student (or the class as a group) follows instructions on an activity card that lead him or her through a specific experiment.

This kind of direct student participation leads easily to other related questions—some suggested on the activity cards themselves, others generated by the students and their teacher—and to further exploration by the experimenters on their own.

The American Museum of Atomic Energy has purposely used metric measurements throughout the experiments, believing that this would be part of the learning process for many young people and for some adults as well.

Because the activities are outlined on single cards, you can easily photocopy them for distribution or project them on a screen or wall.

As the developers of the series, we are anxious to learn how you and your students use the materials, what variations you develop, and any results you find extraordinary. Please let us know your reactions to the materials, and feel free to ask for more information on any energy-related topic.

CONSERVATION

It's cheaper to save a barrel of oil than to produce an additional barrel. One projection indicates that turning all thermostats in the United States down two degrees in winter and raising them two degrees in summer could save more than half a million barrels of oil a day by 1980.

Dwindling of existing resources—coal, petroleum, natural gas—and excessive financial and environmental costs of developing new sources of energy are twin problems facing the U.S. and some other nations of the world. Together they make conservation—the careful use of currently available resources—essential.

Conservation has more immediate results than new resource development, too. It takes five years to bring a new coal mine to full production, six to seven years for a new oil field, and eight to ten years for a nuclear power plant. In 1975, with six percent of the world's population, the United States consumed about one-third of the world's energy. On a per capita basis, West Germany used 20 percent of the gasoline the U.S. did, and Sweden half of the total energy of the U.S. All three countries had comparable standards of living.

Personal use of energy in this country—home heating, lighting, air-conditioning, cooking, refrigeration, and transportation—accounts for 37 percent of the country's energy use.

The experiments in this series on conservation all are related to such personal uses: means of effecting fuel economy in cars, insulation and other forms of home temperature regulation, and food preparation and storage. Among other things, they show how individuals can help reduce waste in the use of energy while maintaining a high standard of living.

The series, **Science Activities in Energy**, was developed by the Oak Ridge Associated Universities under contract from the U.S. Department of Energy, with assistance from teachers and staff from the Lawrence Hall of Science, Berkeley, California. This publication was prepared as an account of work sponsored by the United States Government. Neither the United States nor the U.S. Department of Energy, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

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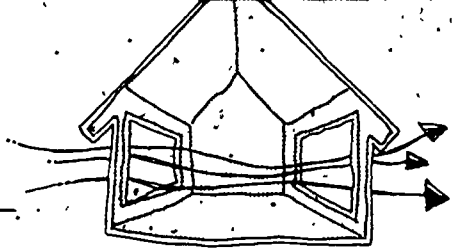
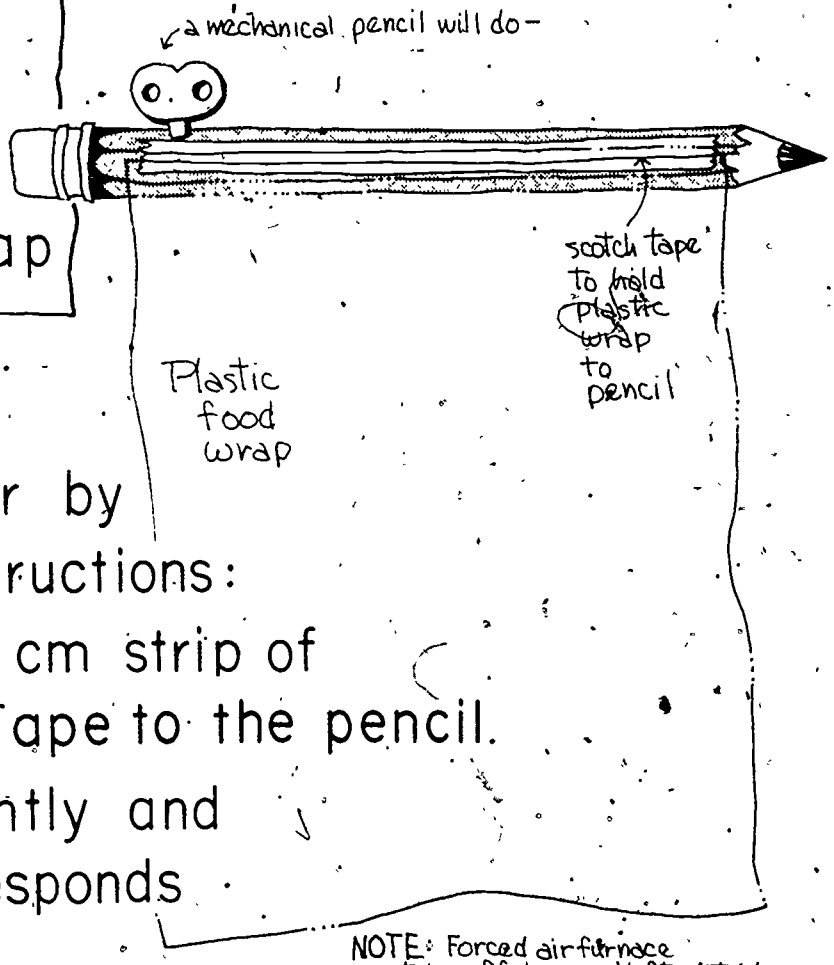
IS YOUR HOUSE DRAFTY?



MATERIALS:

- Pencil
- Scotch tape
- Plastic food wrap

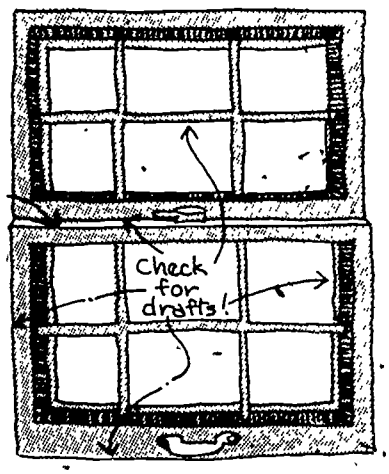


Make a draftometer by following these instructions:

Cut a 12 cm by 25 cm strip of plastic food wrap. Tape to the pencil.

Blow the plastic gently and see how freely it responds to air movement.

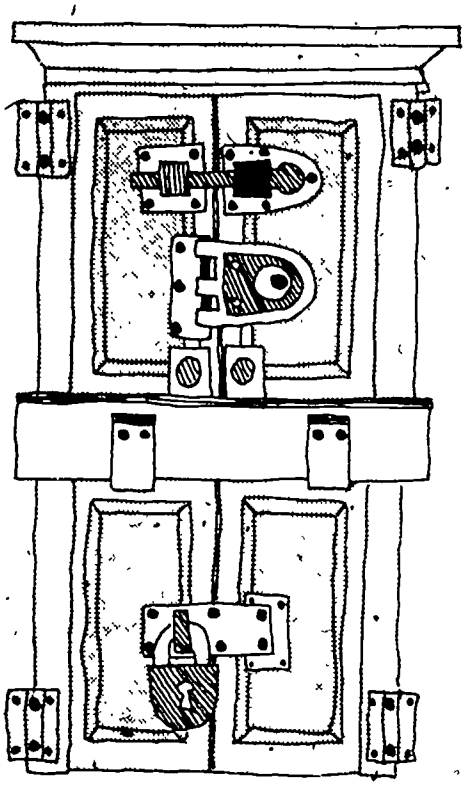
NOTE: Forced air furnace must be off to use draftometer!



Test your home for air leakage by holding the gadget near the edges of windows and doors.

Test your fireplace with the damper open and closed!

OTHER IDEAS TO EXPLORE:



Visit a hardware store and find out what is available to close air leaks around windows and doors.

Why are drafts energy wasters?

Look for dirt collected around doors and windows. What does it prove?

IS YOUR SCHOOL WASTING HEAT?

2

MATERIALS:

2 Thermometers
Draftometer
Plastic food wrap
Scotch tape
Pencil

A draftometer is a good idea!

scotch tape to hold plastic wrap in place

Test the temperature in several rooms in your school-for example, your classroom, cafeteria, library, hallway, office, gymnasium, etc.

Place 1 thermometer near the ceiling and one near the floor

Make a draftometer-

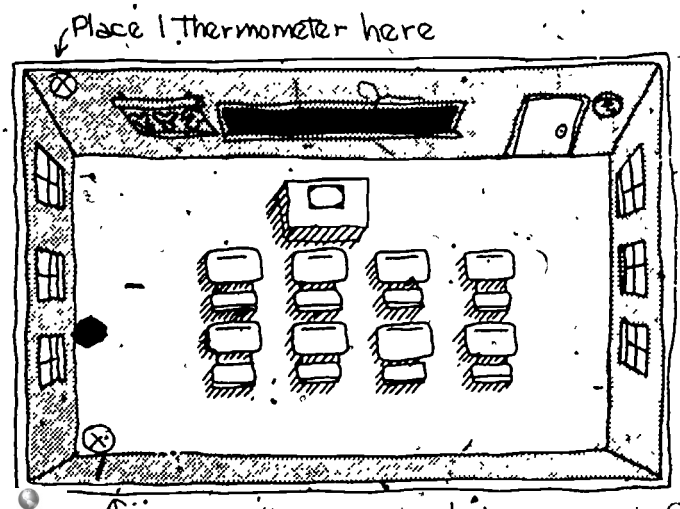
Cut a strip of plastic food wrap 12cm x 25 cm.
Tape to the pencil.

Blow gently and see how freely the plastic responds to air movement.

Use your draftometer to determine where there are drafts in the rooms.

Close doors and windows: are there still drafts?

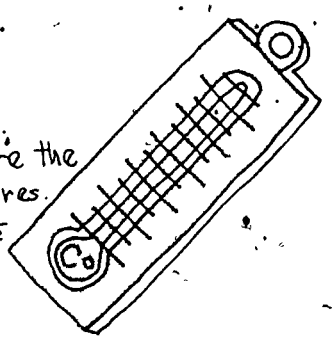
NOTE: Forced air furnace must be off to use draftometer!



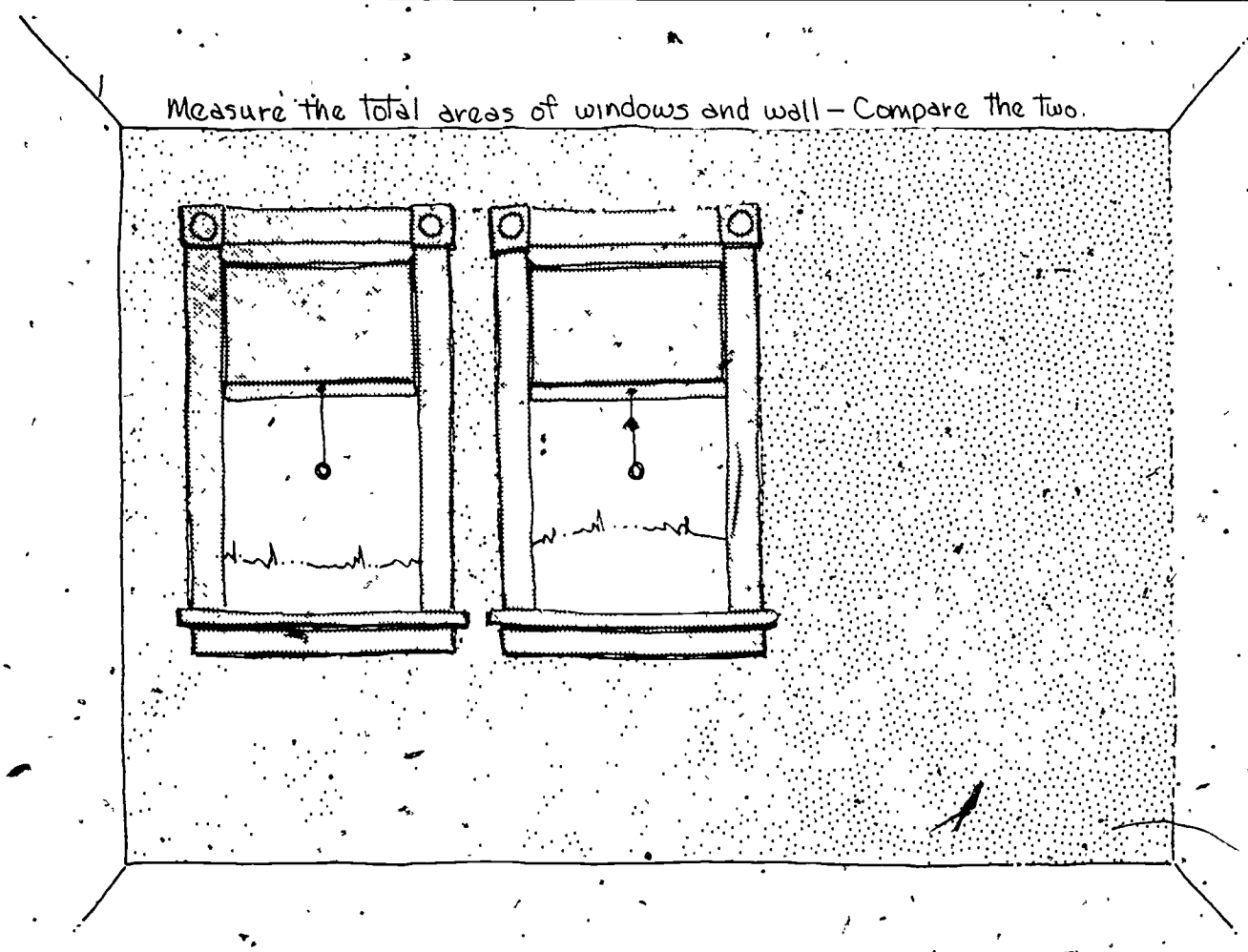
in each room and take temperature readings.

Try other areas, too

Measure the rooms' temperatures. Check again in ½ hour!



OTHER IDEAS TO EXPLORE:



How much glass is there on the window side of your classroom? How much wall?

Feel the glass and the wall. Which carries heat better? Would you save energy if you had fewer windows?

How is your school situated with regard to the sun?

HOW MUCH DOES A BIMETALLIC STRIP WHEN IT'S HEATED OR COOLED?

3a

MATERIALS:

Try a strip of aluminum pie plate!

A bimetallic strip is 2 different metals bonded together: for example, copper and iron.

1 Piece of metal, 4cm or longer

1 Piece of bimetallic strip 4cm or longer

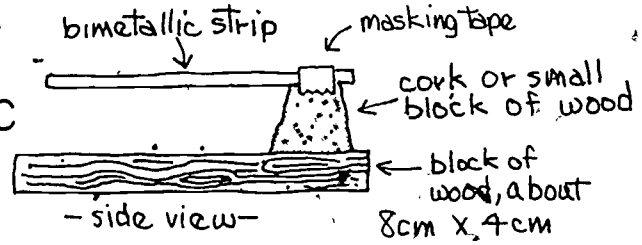
Masking tape, glue, candle, ice cubes

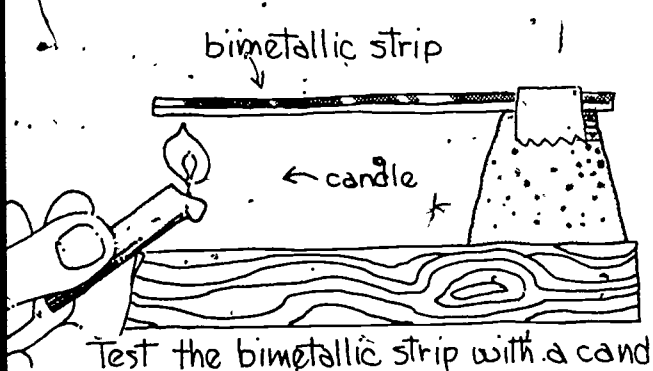
Large cork or small block of wood

Piece of wood about 8cm x 4cm

Buy bimetallic strips from the Discovery Shop, American Museum of Atomic Energy - See buying instructions on folder!

Glue the cork or small wood block to the large one. Attach the bimetallic strip to the top of the cork with masking tape.



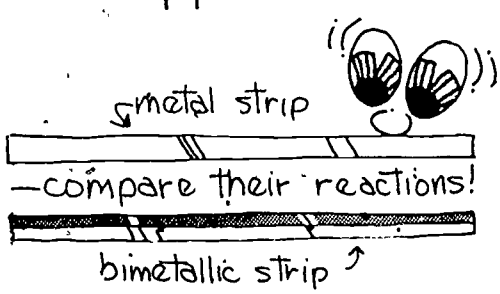


Test the bimetallic strip with a candle, then with an ice cube.

Place the candle under the end of the strip. What happens?

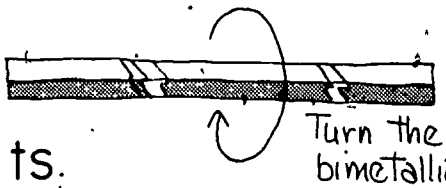
Remove the candle and put the ice cube in its place. What happens now?

Repeat both experiments using the metal strip. Does it react in the same way?

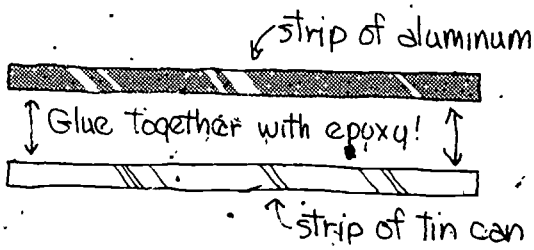


OTHER IDEAS TO EXPLORE:

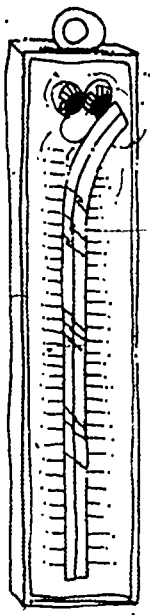
Turn the bimetallic strip over. Repeat the experiments. Does the same thing happen?



Try making your own bimetallic strip. Use epoxy glue to bond two different kinds of metal, such as a strip from an aluminum pie plate and one from a tin can.



Can you make a thermometer from your bimetallic strip?



HOW CAN YOU TEST YOUR HOMEMADE THERMOSTAT ?

3b

MATERIALS:

- Bimetallic strip from Activity 3a
- 1 Flashlight battery
- 1 Flashlight bulb, 1 D cell
- Copper connecting wire
- Masking tape, finishing nail

Start with the gadget you made in activity 3a: use bimetallic strip.

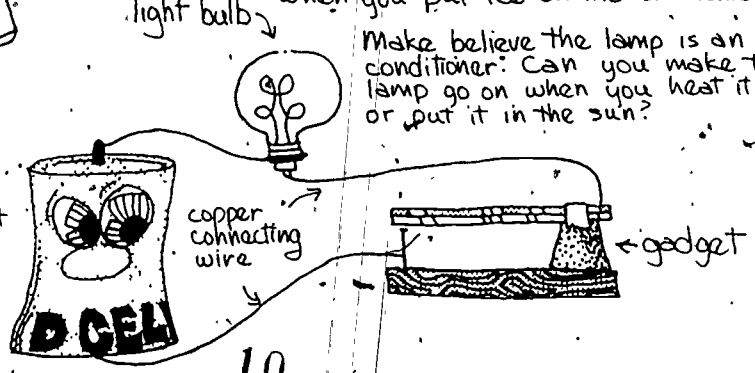
Now hammer the nail to the end of the piece of wood under the free end of the bimetallic strip.

Wire like this:

Push the bimetallic strip to the nail—the light should go on.

Make believe the lamp is a heater. Can you make the lamp go on automatically when you put ice on the bimetallic strip?

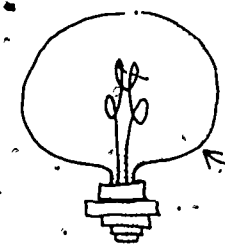
Make believe the lamp is an air conditioner. Can you make the lamp go on when you heat it gently or put it in the sun?



Can you adjust the height of the nail so that the lamp goes on when the temperature of the room reaches 21°C and goes off at 19°C?

OTHER IDEAS TO EXPLORE:

Look inside a blinking bulb as it flashes on and off. Notice the bimetallic strip that bends outward and switches the bulb off after it has heated up.

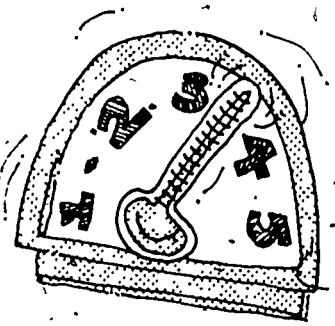


Can you find the bimetallic strip in a blinking bulb?

Look for ice cream bags that have one side made of paper and the other of aluminum foil. Would a strip of this material behave like a bimetallic strip?

HOW HIGH WILL THE TEMPERATURE RISE IN A CLOSED BOX HEATED FOR 5 MINUTES?

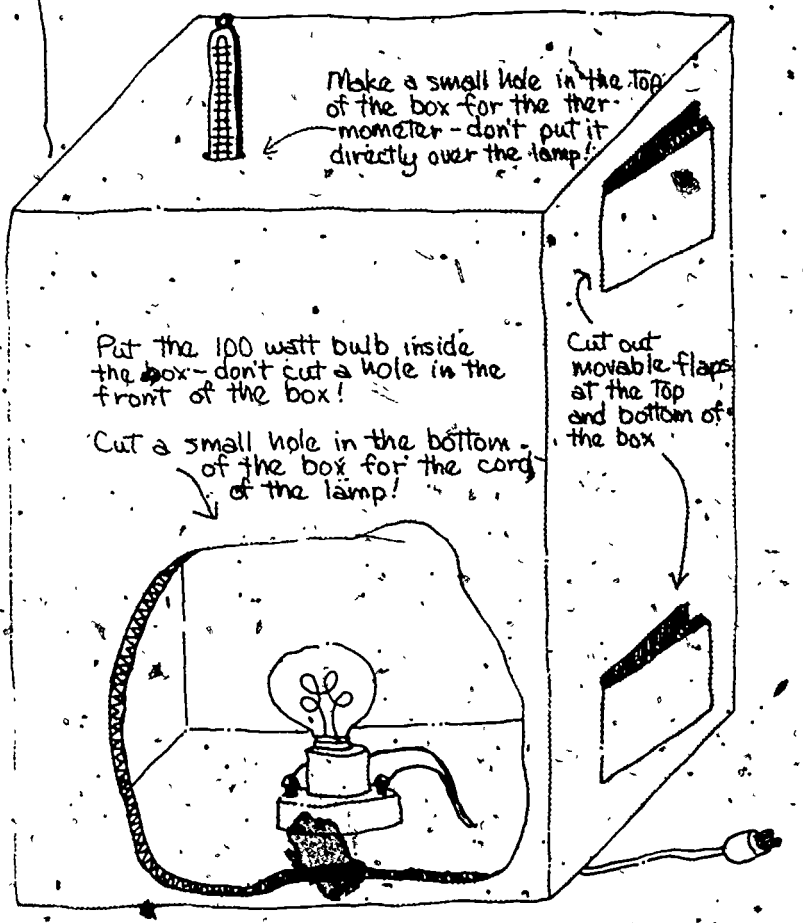
4



MATERIALS:

- Tall cardboard box
- 100 Watt bulb in ceramic socket
- Thermometer
- Watch, knife

Do this first:



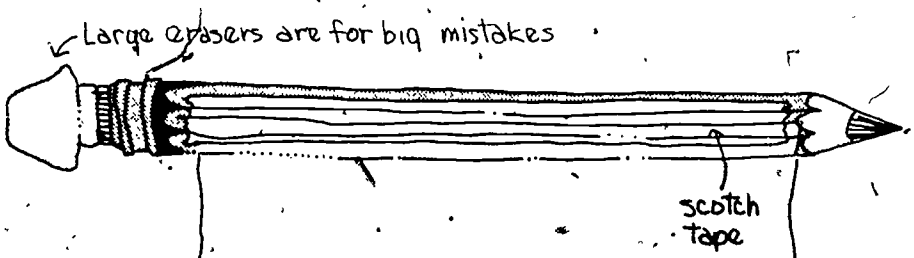
TEMPERATURE READINGS					
	1 min.	2 min.	3 min.	4 min.	5 min.
Both flaps closed					
Top open, bottom closed					
Bottom open, top closed					
Both flaps open					

Then, fill in the temperature readings with the flaps open and closed: compare the results!

OTHER IDEAS TO EXPLORE:

Use the draftometer during your experiments to see where air goes in and out.

Make a draftometer like this.



Make a draftometer -

Cut a strip of plastic food wrap 12cm x 25cm.

Tape to a pencil.

Blow gently and see how freely the plastic responds to air movement.

NOTE: Forced air furnace must be off to use draftometer!

Do you see any connection between this experiment and the ventilation of your own home?

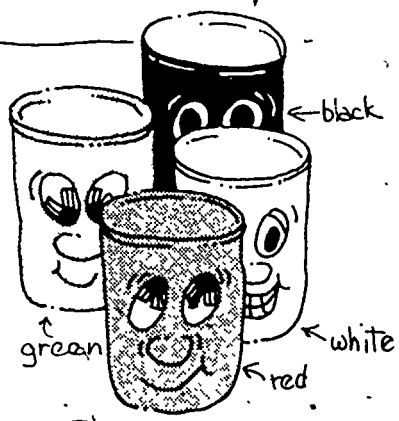
WHICH COLOR HOLDS HEAT LONGEST?

5

MATERIALS:

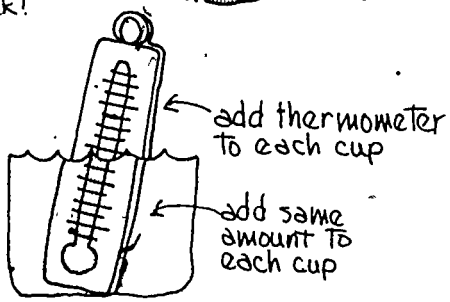
- 4 Juice cans
- Poster paint: white, black, green, and red
- Hot water, close to boiling
- 4 Thermometers, food colors

Paint each cup a different color; then fill each cup with the same amount of hot water.

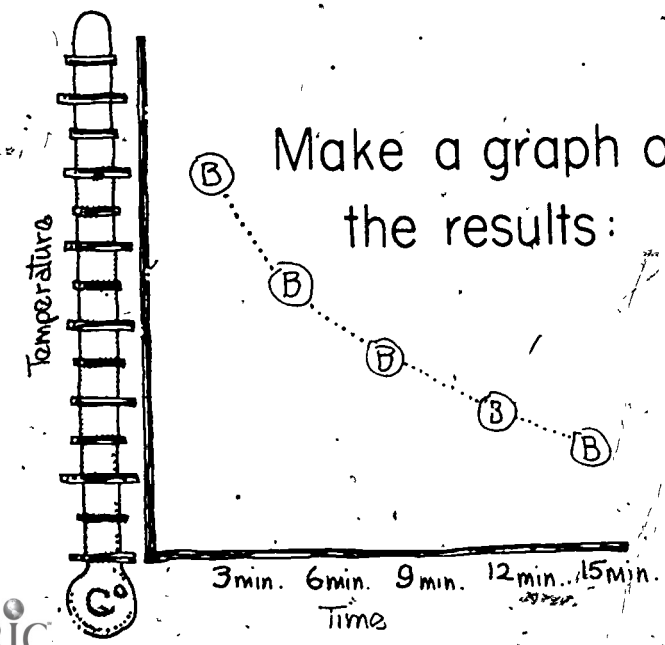


Add food color to the hot water: Add drops of all the colors together to get black!

Put a thermometer in each cup. Record the temperature every 3 minutes until the water cools.



Make a graph of the results:



Which COLOR held heat best?

OTHER IDEAS TO EXPLORE:

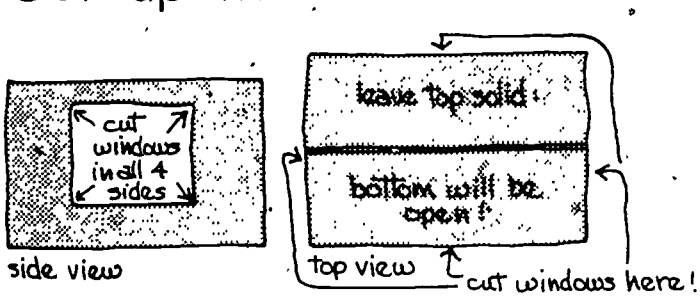
What is the best color to paint a house to keep it warm in winter?

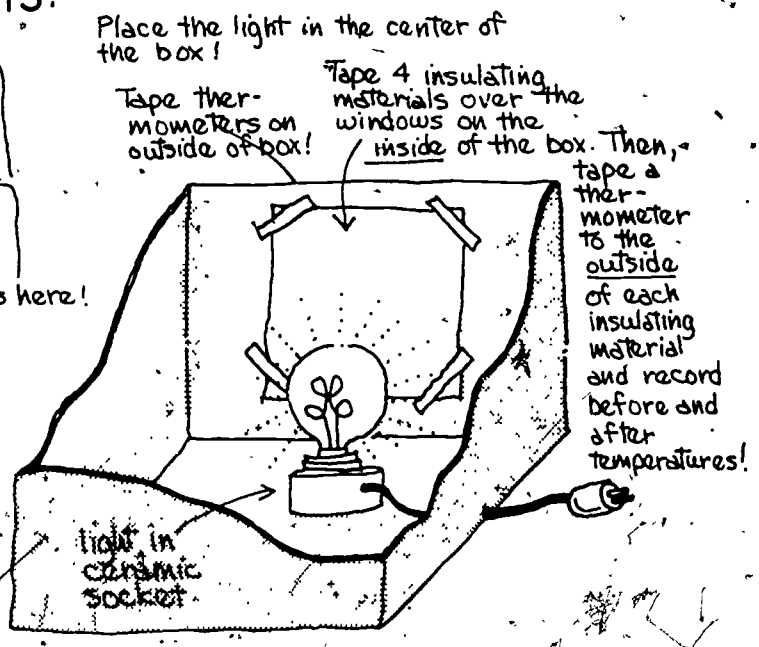
WHAT'S THE BEST INSULATOR? 6

MATERIALS:

100 Watt bulb in ceramic socket – see drawing
A variety of insulating and non-insulating materials such as wood, aluminum foil, fiberglass (3" or 4"), glass, metal, newspaper, heavy cloth, etc.
4 Thermometers, cardboard box, watch
Masking tape

Set up the box like this:

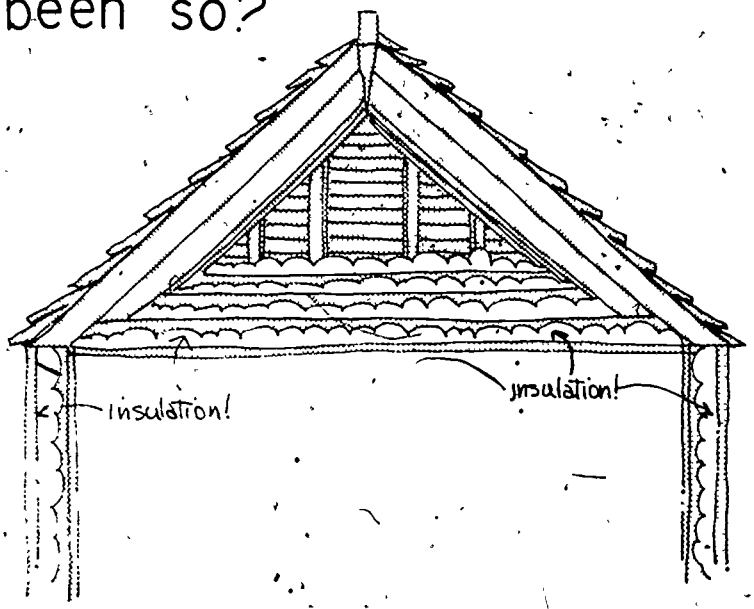




Turn the lamp on for 5 minutes. Record the rise in temperature for each material.

How much better is the best insulator compared to the worst? Record your results.

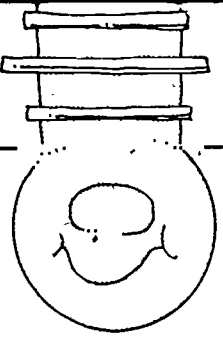
Why is full insulation now required in new houses? Why hasn't this always been so?



material:	TEMPERATURE before	after
wood		
aluminum foil		
fiberglass		
glass		
metal		
newspaper		
cloth		

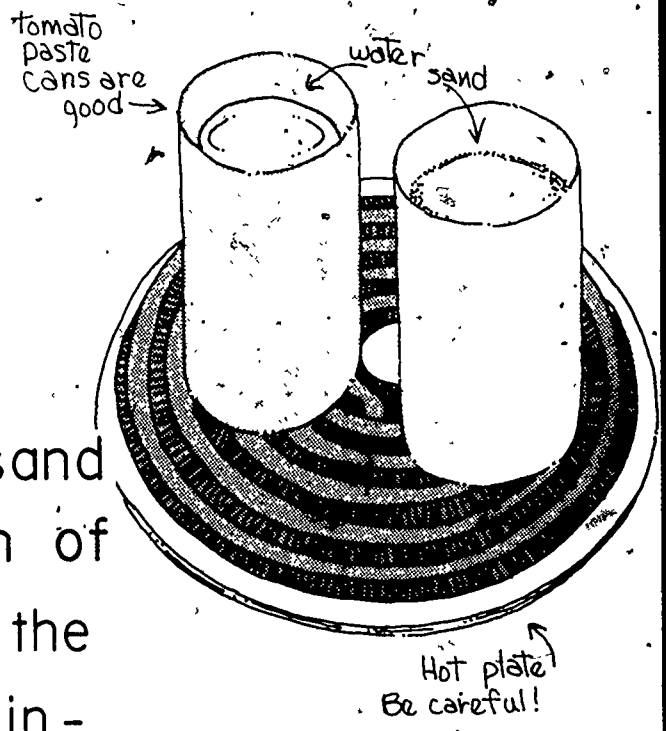
Use a chart like this to record your results!

WHICH GETS WARMER FASTER?



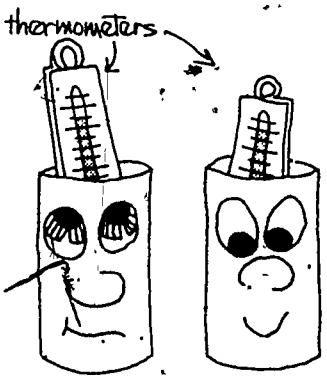
MATERIALS:

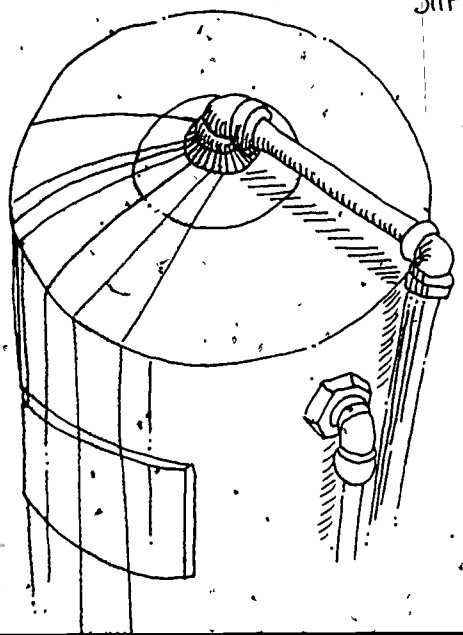
- 2 Small tin cans
- 2 Thermometers
- Hot plate
- Water
- Sand
- Spoon



Put water in one can and sand in the other to within 3 cm of the top. Place the cans on the hot plate, and heat for 2 minutes. Remove the cans from the hot plate. Stir them, and measure their temperatures with the thermometers.

Stir before taking temperatures!

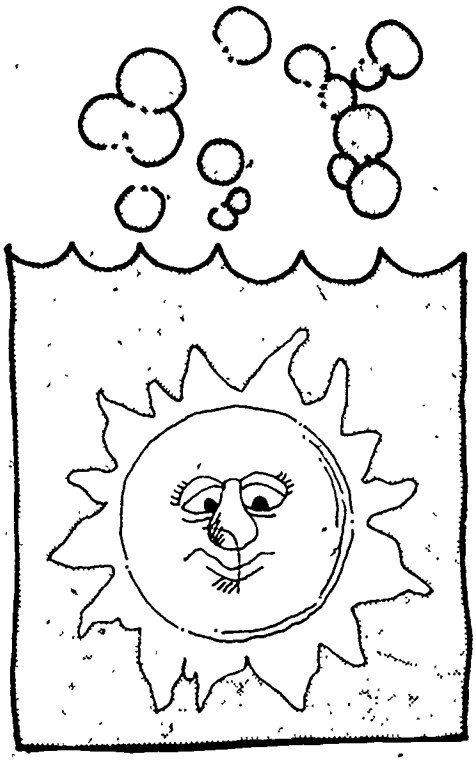




What does this experiment tell you about the energy required to heat the water in your home ?

OTHER IDEAS TO EXPLORE:

Would a solar water heater make sense where you live?



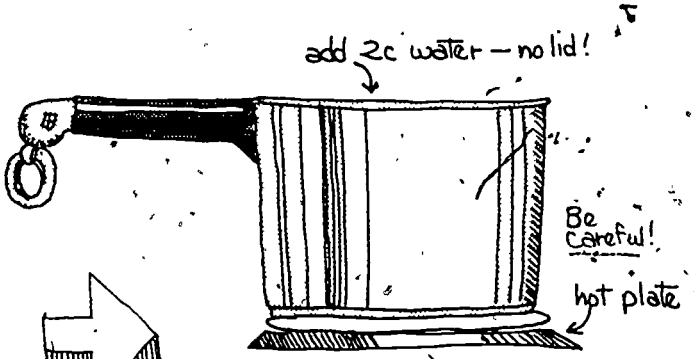
HOW MUCH ENERGY CAN BE SAVED BY BOILING WATER IN A COVERED PAN ?

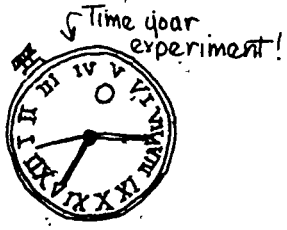
8

MATERIALS:

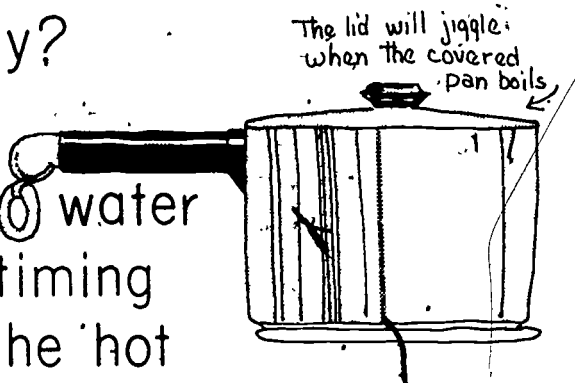
- Hot plate
- Pan with lid
- Watch
- Water
- Styrofoam cups

Heat up the hot plate. Then, do this:





Start timing when you place the pan on the hot plate. How long does it take for the water to boil vigorously?

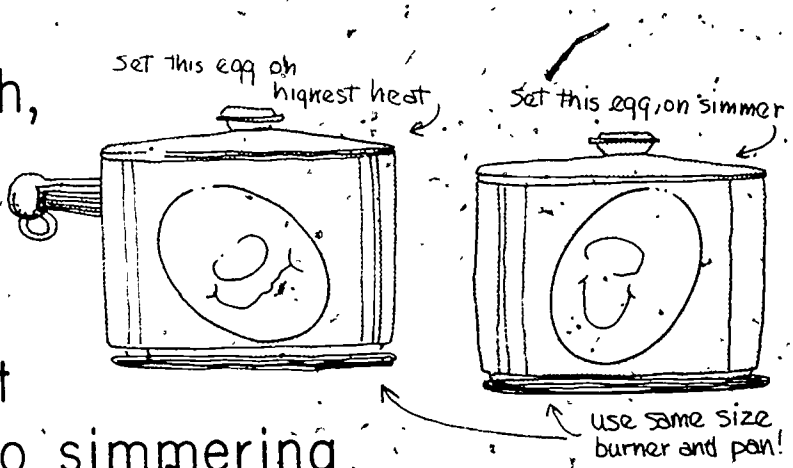


Empty the pan and let it cool. Add 2 more cups of water and cover the pan. Begin timing again when you put it on the hot plate. How long does it take for it to boil? Did covering the pan save energy?

OTHER IDEAS TO EXPLORE:

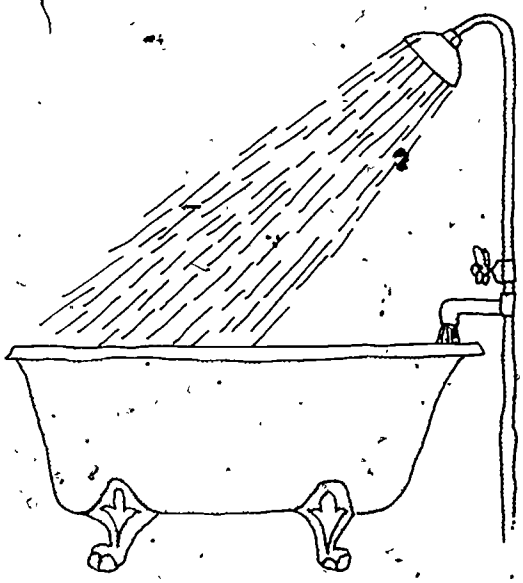
Bring 2 pans of water to a boil.

Place an egg in each, and put each one on the same size burner on a stove. Set one burner to the highest heat and the other to simmering.



Time them for 3 minutes, then pour the water out of both at the same time.

Is one egg more cooked than the other?



Which uses more water, a shower or a tub?

How much more?

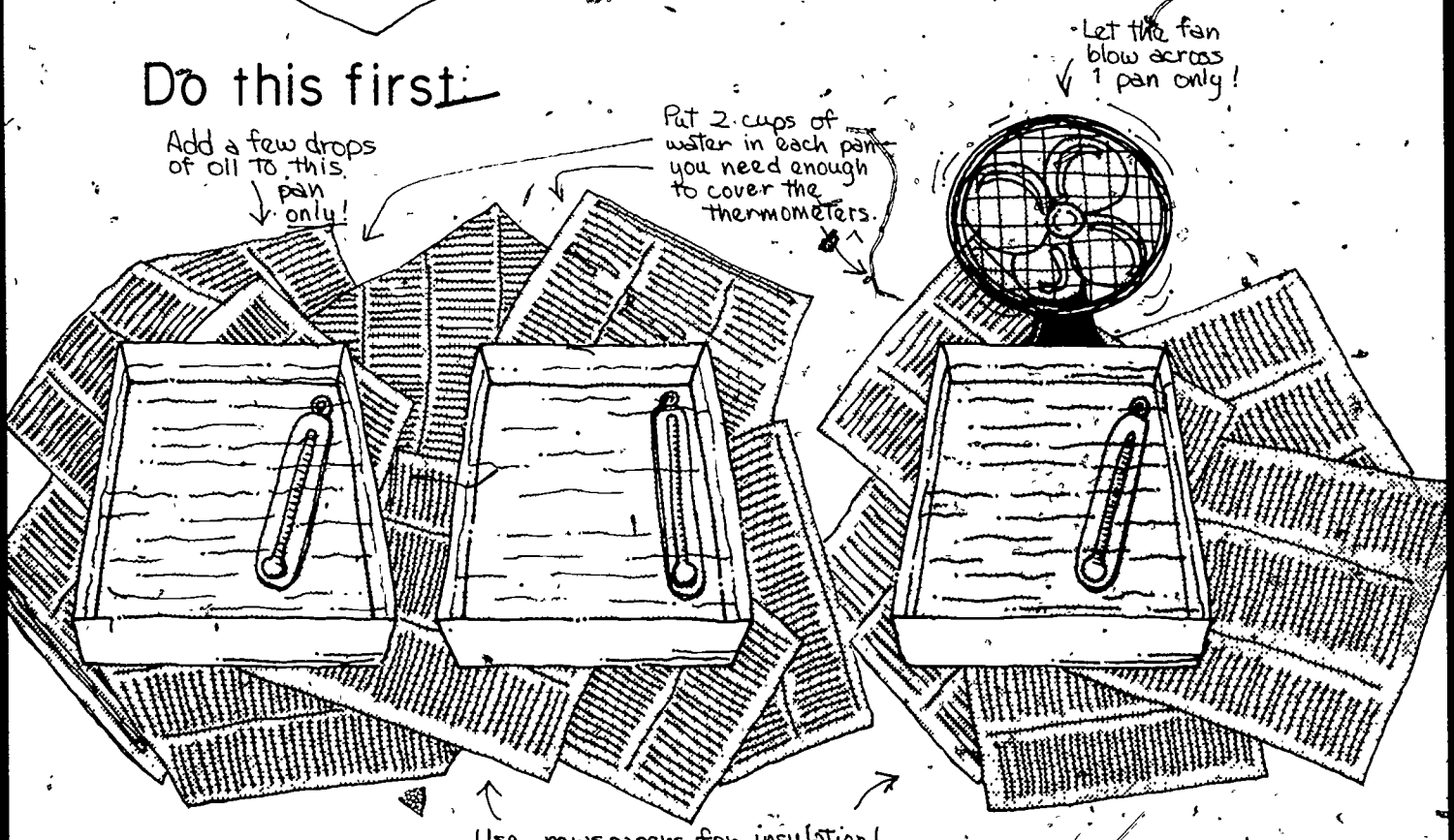
HOW MUCH WATER GET IF YOU SPEED UP THE EVAPORATION PROCESS?

9

MATERIALS:

3 Flat pans, fan, newspapers
Edible oil, warm water 40°-50°C
3 Thermometers

Do this first

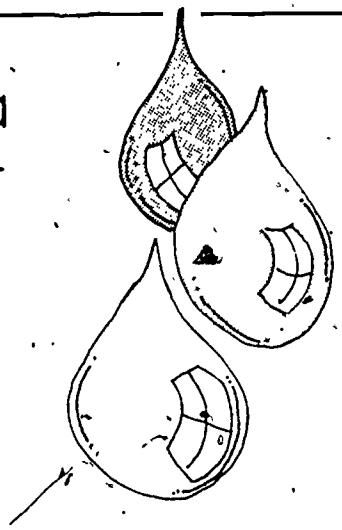


	TEMPERATURE				
	2 min.	4 min.	6 min.	8 min.	10 min.
PAN #1					
PAN #2					
PAN #3					

Which is coolest? What is the purpose of the oil? How much liquid is left in each pan?

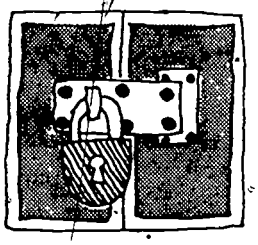
OTHER IDEAS TO EXPLORE:

How could you use this idea to keep things cool on a hot or humid day?



CAN YOU MAKE A CONTAINER THAT WILL KEEP AN ICE CUBE FOR 3 HOURS OR LONGER ?

10

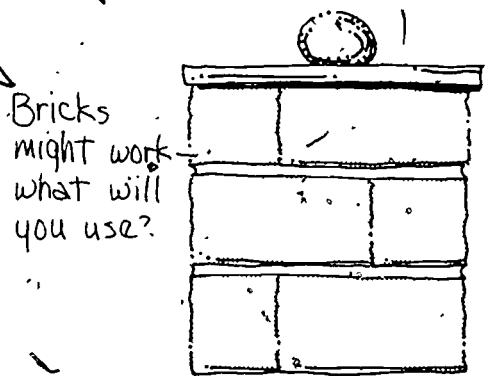


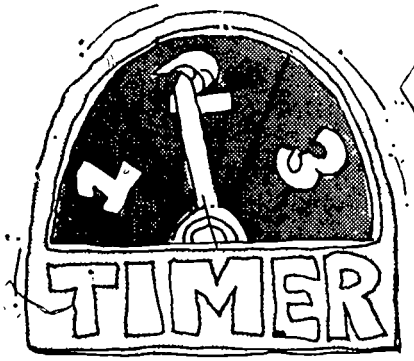
MATERIALS:

Uniformly-sized ice cubes
Assortment of materials to make ice-cube boxes and various types of insulating materials
Bring anything you want to try from home!

Build a container large enough to hold 1 ice cube.

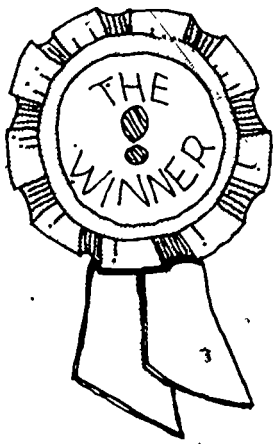
You're on your own here!





After 3 hours, open the containers.

Reward the winning container!



HOW MUCH BETTER IS A THERMOS AT KEEPING LIQUIDS HOT THAN OTHER CONTAINERS?

11

MATERIALS: Use a wide-mouthed and a narrow-mouthed thermos, if available!

2 different thermos jugs
Tin can, newspapers
Glass jar, hot and cold water
Plastic pitcher, measuring cup
Styrofoam cup, thermometer

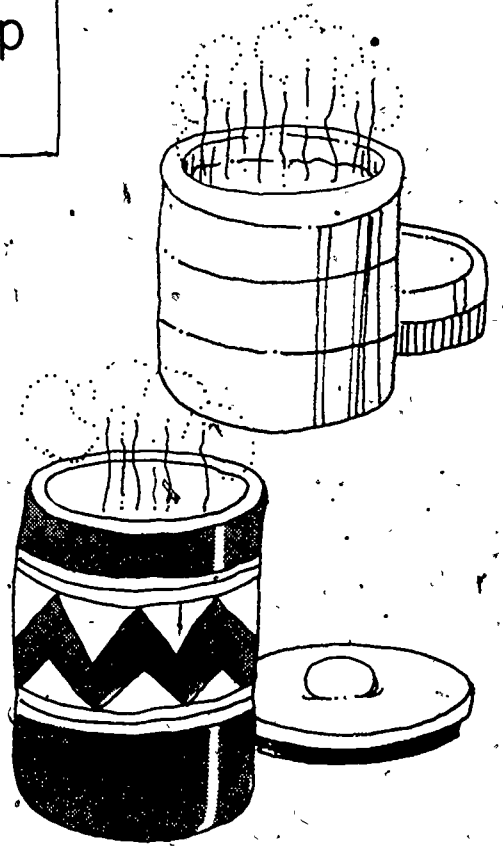
Fill each container with the same amount of hot water. Measure the temperature of each.

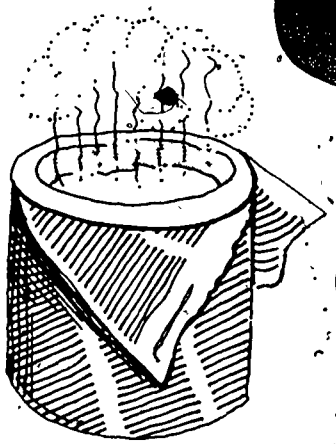
Check the temperature again in 1/2 hour.

Which is hottest?

Now try the experiment again after wrapping newspaper around each container.

Fill the 2 thermos jugs with the same amount of hot water. Fill the tin can, glass jar, plastic pitcher, and styrofoam cup, too!





Compare the temperature of the various containers after 1/2 hour.

OTHER IDEAS TO EXPLORE:

Repeat both experiments using cold water.

Compare the results to those you got with hot water.

ITEM:	HOT WATER		COLD WATER	
	orig. temp	temp. in ½ hr.	orig. temp.	temp in ½ hr.
A →				
B →				
C →				
D →				
E →				
F →				

which seems easier to conserve:

HEAT or COLD ?

HOW HUMID OR DRY IS THE AIR IN YOUR ROOM?

12

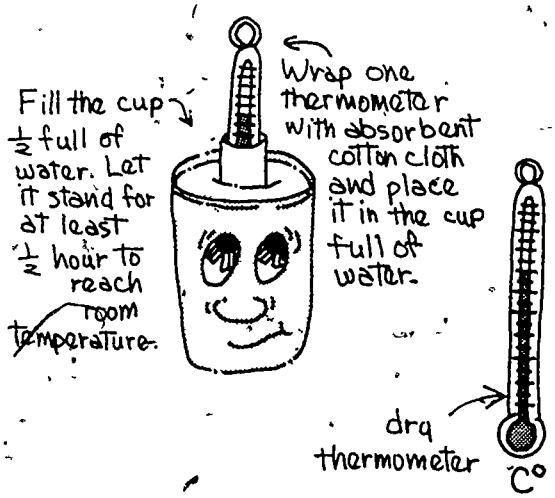
MATERIALS:

2 Thermometers
Absorbent cotton cloth, about 4cm by 2cm
Styrofoam cup

Make a hygrometer

An instrument for measuring humidity!

to measure the amount of water in the atmosphere in your room.



Find the relative humidity from the table below

RELATIVE HUMIDITY CHART

Difference (°C) Between Dry Bulb and Wet Bulb Temperatures

(°C) Dry-Bulb Temperature	1	2	3	4	5	6	7	8	9	10
-4	77	55	33	12						
-2	79	60	40	22						
0	81	64	46	29	13					
2	84	68	52	37	22	7				
4	85	71	57	43	29	16				
6	86	73	60	48	35	24	11			
8	87	75	63	51	40	29	19	8		
10	88	77	66	55	44	34	24	15	6	
12	89	78	68	58	48	39	29	21	12	
14	90	79	70	60	51	42	34	26	18	10
16	90	81	71	63	54	46	38	30	23	15
18	91	82	73	65	57	49	41	34	27	20
20	91	83	74	66	59	51	44	37	31	24
22	92	83	76	68	61	54	47	40	34	28
24	92	84	77	69	62	56	49	43	37	31
26	92	85	78	71	64	58	51	46	40	34
28	93	85	78	72	65	59	53	48	42	37
30	93	86	79	73	67	61	55	50	44	39
32	93	86	80	74	68	62	57	51	46	41
34	93	87	81	75	69	63	58	53	48	43
36	94	87	81	75	70	64	59	54	50	45

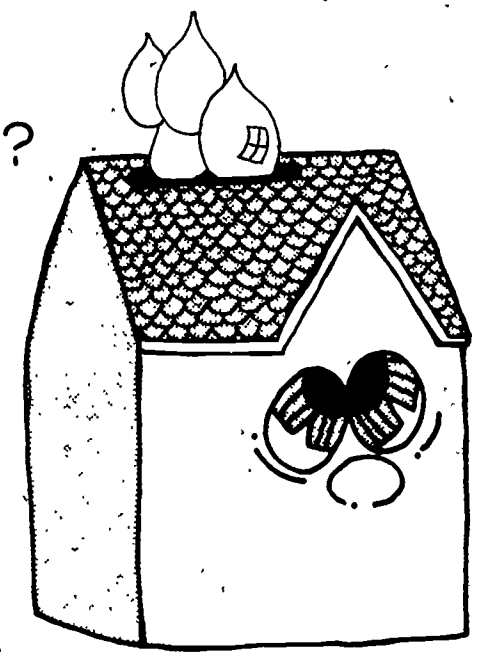
Record the temperature of each thermometer. Fan each one for 1 minute and record the temperatures again.

OTHER IDEAS TO EXPLORE:

Changing the humidity may actually make you more comfortable than raising or lowering the temperature. Why?

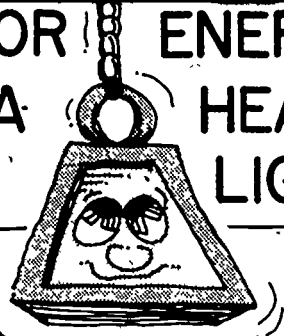
How can you change the humidity level of your classroom ?

How about your room at home ?

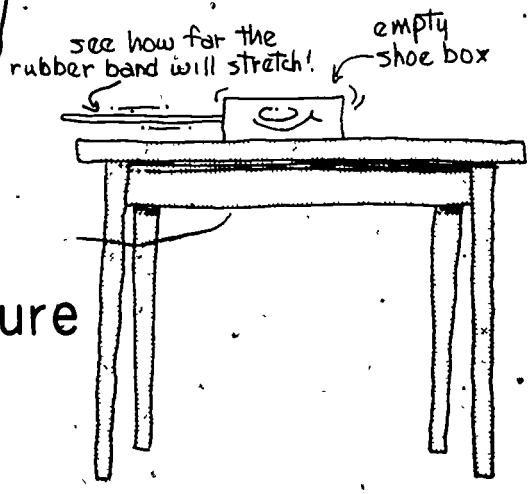


HOW MUCH MORE FORCE OR ENERGY DOES IT TAKE TO MOVE A HEAVY OBJECT COMPARED TO A LIGHT ONE?

13

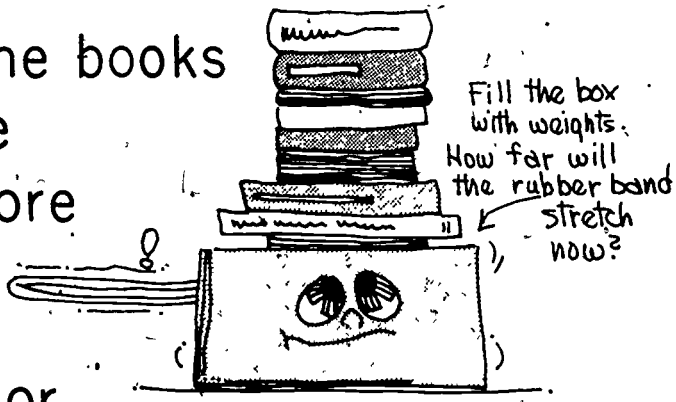


MATERIALS:
- Shoe boxes
- Pencils
- Heavy weights or books
- Rubber band assortment

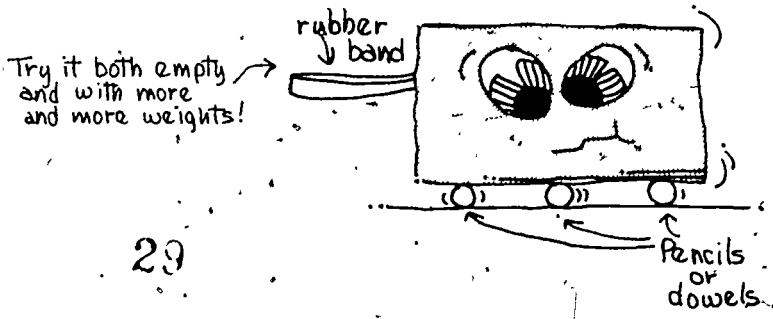


Attach the rubber band to the shoe box so that it can be pulled along a table top. Measure how long the rubber band will stretch with the box empty.

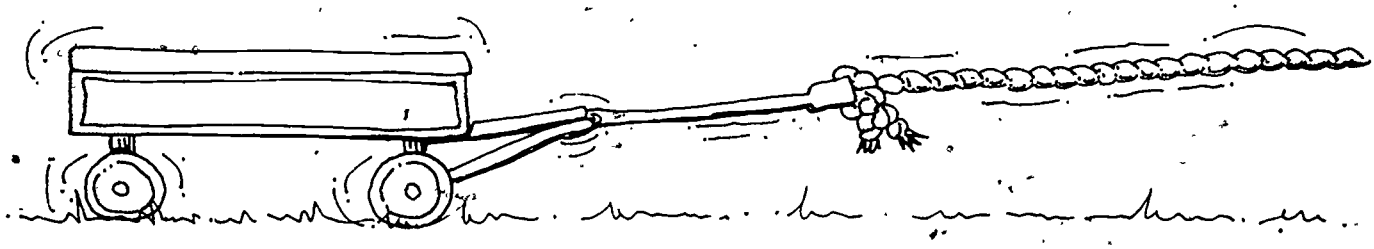
Now fill the box with some books or weights and repeat the experiment. Add even more weights.



Put some round pencils or dowels under the box - try pulling it now.

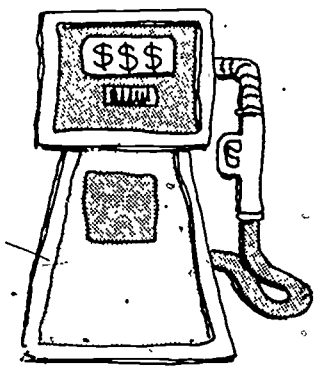


OTHER IDEAS TO EXPLORE:

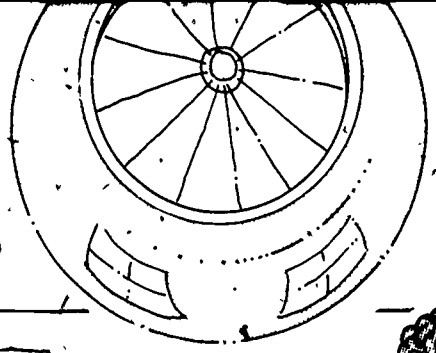


Try pulling an empty wagon with a rope. Then try pulling it while someone sits in it. Is there much difference?

Why do heavy cars use more gasoline than light cars?



WILL YOUR BICYCLE COAST TWICE AS FAR IF YOUR TIRES HAVE TWICE THE PRESSURE?

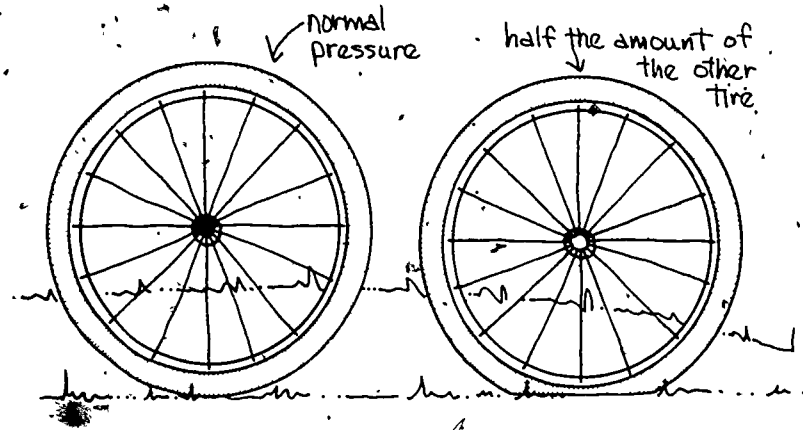


14

MATERIALS:
2 Bicycles, similar type
1 Tire pressure gauge

Inflate one bicycle's tires to normal pressure and another to half that amount.

Have 2 students of similar weight ride side by side at the same speed. When they reach a selected line on the ground, they should coast the rest of the way. Compare how far each goes.



Is it important to check the tire pressure on your bicycle?

How about your family car?

1. Is your house drafty?

This simple draftometer shows how air (and hence heat and cold) moves through even the smallest of spaces in a home or other building. The warm air in a house will be pushed upward and out by the cold air that comes in. Increasing the temperature in a house with many small holes or leaks will only speed up the waste of fuel used to heat the house.

2. Is your school wasting heat?

Public buildings can waste a great deal of heat. Many are kept too warm in the winter and too cool in the summer. You can check your school to see how well heat is being conserved and whether temperatures in different parts of the school are suited to their activities. (E.g., hallways do not have to be as warm as classrooms.)

3a. How much does a bimetallic strip bend when its heated or cooled?

The human body is easily fooled when it comes to measuring temperature. A thermostat is an objective way to keep the temperature in a house constant and therefore to prevent waste of heat. Most materials expand when they are heated. However, they do not expand the same amount. When two different metals are bonded together they bend when they are heated or cooled—and a crude thermometer is thereby created. (Bimetallic strips for this experiment are available from The Discovery Shop, American Museum of Atomic Energy, P.O. Box 117, Oak Ridge, TN, 37830. The cost for 10 strips weighing a total of one-fourth pound is $4.50, plus $.50 postage. 10 strips will make 80 thermostats.)

3b. How can you test your homemade thermostat?

By adding a nail to a bimetallic strip in the experiment and connecting it to a "D" cell and flashlight bulb, as shown in the experiment, the homemade thermometer becomes a homemade thermostat. The lamp can be considered the furnace or air conditioner.

4. How high will the temperature rise in a closed box heated for 5 minutes?

The effect of ventilation on a home's interior temperature is easily demonstrated in this simple cardboard-box-house experiment.

5. Which color holds heat longest?

The color of the roof and walls of a house can be very important in determining the amount of heat and air-conditioning the house will use.

6. What's the best insulator?

The proper insulation can conserve significant amounts of heat—and hence energy. All insulation materials are not equally effective, as this experiment demonstrates.

7. Which gets warmer faster?

The amount of energy required to heat water, and the impact on energy conservation of using hot water sparingly, is indicated through this experiment.

8. How much energy can be saved by boiling water in a covered pan?

Uncovered pans of water waste heat.

9. How much cooler does water get if you speed up the evaporation process?

A great deal of heat is lost when water evaporates.

10. Can you make a container that will keep an ice cube for 3 hours or longer?

A contest or game to see who can discover the best way of preventing heat from coming into a box, this experiment demonstrates the relative effectiveness of various kinds of building and insulating materials.

11. How much better is a thermos at keeping liquids hot than other containers?

Commercially available insulating materials are not all equally effective.

12. How humid or dry is the air in your room?

The humidity or amount of water in the air is as important as air temperature in determining how warm or cool we feel. One's comfort can be accommodated and much energy can be saved by adjusting the humidity in a building without significantly changing the temperature.

13. How much more force or energy does it take to move a heavy object compared to a light one?

It takes energy to move objects, and the heavier the object the more energy required. Heavy cars consequently use more energy (fuel) than light ones.

14. Will your bicycle coast twice as far if your tires have twice the pressure?

Because friction makes machines harder to move, bikes and cars require more energy to move if their tires are soft than if they are properly inflated.