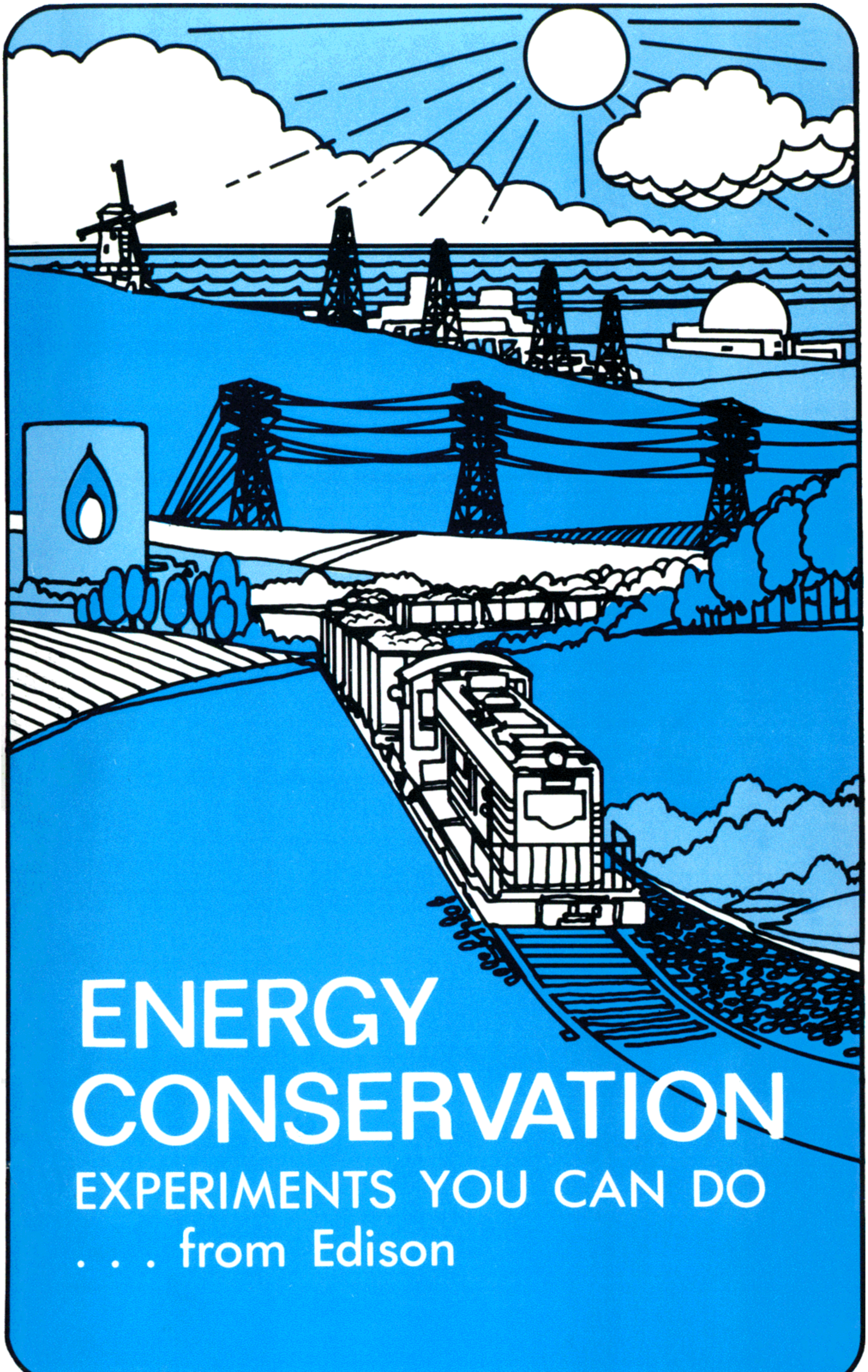


ENERGY CONSERVATION

EXPERIMENTS YOU CAN DO

. . . from Edison

OF THOMAS ALVA EDISON

He has led no armies into battle . . . He has conquered no countries . . . yet he wields a power the magnitude of which no warrior ever dreamed . . . this democratic, kindly, modest man has bestowed upon the human race blessings instead of bondage, service instead of serfdom, construction instead of conquest . . . he is humanity's friend.

Arthur J. Palmer

ENERGY CONSERVATION

EXPERIMENTS YOU CAN DO
. . . from Edison

INTO THE SECOND CENTURY OF LIGHT

A PUBLICATION OF THE
THOMAS ALVA EDISON FOUNDATION
21000 WEST TEN MILE ROAD
SOUTHFIELD, MICHIGAN 48075

ADVANCING SCIENCE, TECHNOLOGY AND ENGINEERING EDUCATION

TO THE YOUNG PEOPLE OF AMERICA

One of the great opportunities available to young people today is to develop the interest and skills that will help business and government, by working together, find better ways and means for meeting the rapidly increasing demands, world-wide, for more and more energy.

The first order of business, however, is to make certain that today's immediate energy needs are satisfied. To do that, it is essential that all of us make a concerted effort to conserve the limited energy supply now available.

To that end, we are pleased to make this booklet on energy conservation experiments available. It is our hope that it will bring about a better understanding of how energy can be conserved immediately . . . and that it will inspire the youth of this generation to use their inherent imagination, resourcefulness and ingenuity for problem solving in the same way that Thomas A. Edison brought his genius to bear on his and future generations. The many fruits of his labor and dedication have long benefited the daily lives of all of us.

A growing population throughout the world today is determined to live better in a better environment. But this desire can only be fulfilled when energy sources are safely developed and the end product is adequately distributed.

And herein lies a great opportunity for young people who accept the challenge in our current dilemma and realize that a mere redistribution of existing energy is not the answer . . . and that a permanent solution to our energy crisis cannot be legislated. The solution, rather, lies within those who have the determination to be creative and imaginative and who know that our American ability to persevere has always been nurtured by personal involvement.

CONTENTS

BE AN ENERGY "WASTE WATCHER"

Why must we conserve energy? That's a good question . . . and the answer is very simple: By conserving energy today, we are helping to make sure that we will have enough energy in the years ahead.

How can you help? That's another good question . . . and the answer may surprise you: You can become an energy waste-watcher!

Once you know what to look for, you can make valuable energy-saving suggestions to your friends and your parents.

You see, it is very easy to waste energy. Most of us waste energy every day. We may not do it on purpose. . . but we do it, nevertheless!

Have you ever walked out of a room without switching off the light? Well, leaving a light on unnecessarily wastes energy. A 100-watt light bulb, for example, wastes about one fluid ounce of oil (or about $1\frac{1}{3}$ ounces of coal) for every hour it operates unnecessarily. That much fuel — oil or coal — was burned at the power station to generate the electricity that kept the bulb lit.

An ounce of oil may not sound like much, but just think of all the light bulbs carelessly left glowing on your block. . . or in your home town. . . or in your state. . . or in our country. In no time at all, those "little" ounces add up to thousands of gallons.

Some experts believe that we waste ¼ of the energy we use! That is a huge amount of oil, coal, and natural gas each year.

We really can't afford to waste *any* oil, coal, or natural gas. These are precious natural resources that took *hundreds of millions* of years to create. They are truly irreplaceable! Once we use up the limited supplies that nature has provided us, we simply won't have any more.

A FEW THINGS WASTE WATCHERS SHOULD KNOW

To a scientist, "energy" is a very special thing. It is *the ability to do mechanical work or to produce a change in temperature* (to heat or cool). If you think about it, you'll realize that all of our familiar uses of energy fall into these two categories. For example:

- we produce light by heating the filament of a light bulb to make it glow brightly
- we wash clothes by swishing them around in a tubful of water (this takes mechanical work)
- we heat our home in winter by first heating air *or* water, and then by blowing warm air into each room or circulating the warm water through radiators

Much of the energy we use every day is in the form of *electrical energy.* As you probably know, in most parts of the country, electricity is produced by generating plants that burn coal or fuel oil. Thus, by conserving electricity you are actually conserving coal or oil.

A gallon of oil, or a pound of coal, or a cubic foot of natural gas contains a certain amount of energy. To know how much, you have to understand how energy is measured. One very popular measure is the *British Thermal Unit* (or BTU, for short).

One British Thermal Unit (one BTU) is the amount of energy required to increase the temperature of one pound of water by one degree Fahrenheit.

If you were to burn a one-pound piece of coal, you would release about 13,500 BTU's of heat energy. Similarly, burning a gallon of crude oil will yield about 140,000 BTU's, and burning a cubic foot of natural gas gives about 1,000 BTU's.

Electrical energy is usually measured in watt-hours, but the BTU can also be used: one watt-hour is equivalent to 3.413 BTU's.

WHERE DOES COAL COME FROM?

You may have heard coal described as a mineral. This isn't true. Coal is really an organic material composed of the remains of trees and other plants that lived hundreds of millions of years ago, during a time when the earth had a warm and moist climate.

When the plants died, they fell into boggy water. There they turned into a spongy substance called peat, Eventually, these peat deposits were covered by sediment, and subjected to huge pressures. In time, the peat dried and hardened to become coal.

Coal is our most abundant *fossil* fuel (so-called because coal is fossilized plant matter).

WHERE DOES OIL AND NATURAL GAS COME FROM?

Many millions of years ago, the seas covered portions of the Earth that are now dry land. These prehistoric oceans were inhabited by countless tiny animals and plants. As these living things died, they sank to the sea floor. There they mixed with sand and mud to create marine sediment.

In time, the layers of sediment were covered with more sand and mud, and eventually, by rock. Ages of heat and pressure — along with the decomposition of the dead plants and animals — changed the organic material into crude oil.

Like coal, crude oil is a *fossil* fuel (because it was made from once-living matter). Chemically speaking, crude oil is a blend of *hydrocarbon* compounds (compounds composed of hydrogen and carbon atoms). Thus, many people refer to fuel oil, gasoline, and kerosene as hydrocarbon fuels.

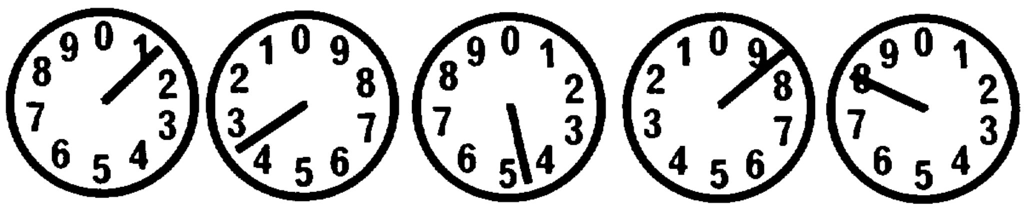
Some of the hydrocarbon compounds in crude oil are light-weight gases. If the underground pressure above a pool of oil is not too great, these gases may leave the crude oil and collect in a pocket above it. This is where *natural* gas comes from. Natural gas is a blend of light-weight hydrocarbon gases.

HOW TO READ YOUR ELECTRIC METER

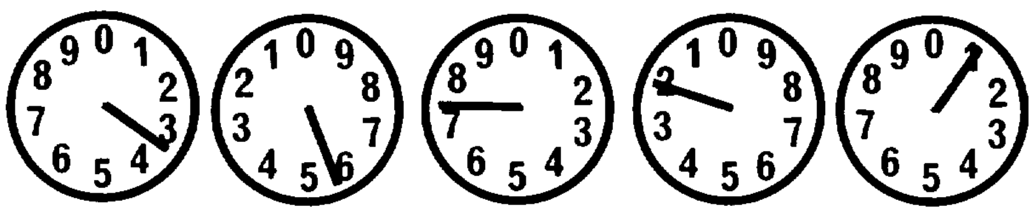
Your electric meter has an important job to do... it measures how much electrical energy is consumed by the many electric lights and electrical appliances in your home. You should learn how to "read" your meter so that you can keep track of how much electrical energy you and your family use each day. Then, you will be able to monitor the effectiveness of your energy-conservation efforts.

On most electric meters (probably yours too) the dials are organized from right to left: the rightmost dial indicates kilowatt-hours, the next dial tens of kilowatt-hours, the next dial hundreds of kilowatt-hours, and so on. Reading the dials can be tricky — this is because some of the dials read clockwise, while others read counterclockwise.

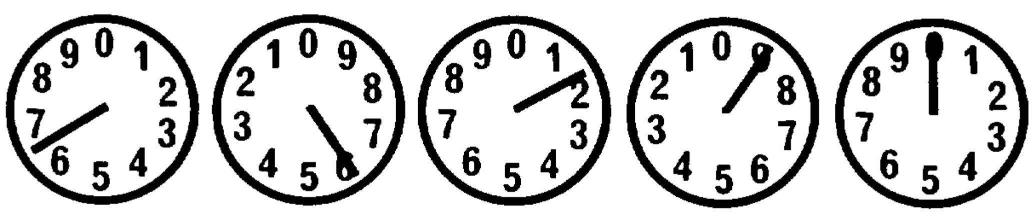
The illustrations on this page show three sets of meter dials, along with their corresponding readings. Study the sketches carefully; be sure you understand how the readings were made.



READING = 13488



READING = 35721



READING = 66190

Your electric meter is much like the odometer in your family car. . . it gives a total — cumulative — reading of electrical energy consumption. To find out how much energy you used during a given period of time (say one day, or one week) you must compare readings made at the beginning and end of the period.

For example, suppose that your meter reads 13478 on Monday morning and 13488 on Tuesday morning. This means that your home consumed:

$$\begin{array}{r} 13488 \\ -\ 13478 \\ \hline 10 \end{array}$$ kilowatt-hours

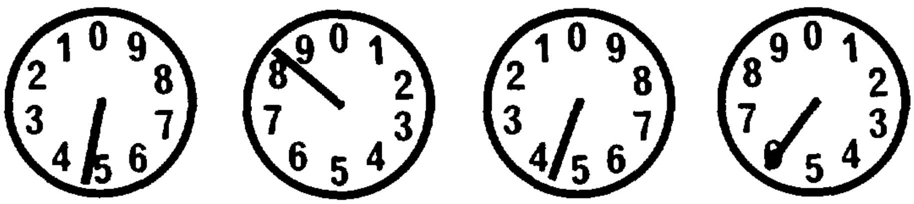
during the 24-hour period from Monday morning to Tuesday morning. You can perform similiar comparisons for a month, or a week, or even a year.

HOW TO READ YOUR GAS METER

Once you can read your electric meter, you can also read your gas meter . . . the dials are organized much the same way.

Note that the smallest quantity of gas measured by most gas meters is 100 cubic feet. The markings on the rightmost dial each represent 100 cubic-feet; thus, the rightmost needle goes around once for every 1000 cubic-feet of gas consumed.

Your gas meter, too, is a total — or cumulative — reading instrument. And so, to measure gas consumption during a given time period you must compare readings taken at the beginning and end of the period. For example, if your meter reads 4786 on one Sunday morning, and 4846 the following Sunday morning, you have consumed:



READING=4846

4846
- 4786

60 “units” of gas

during the week. Since each “unit” equals 100-cubic-feet of gas, you have consumed:

60 X 100 = 6,000 cubic-feet of gas.

HEATING AND AIR CONDITIONING

Here’s an interesting fact: A typical American family uses more energy to heat their home in winter than for any other purpose except powering their automobile. “Space heating” (that’s the technical term) uses up just over one-fourth of an average family’s total energy budget. That’s well over 100,000,000 BTU’s! It’s equivalent to over 800 gallons of oil, or 100,000 cubic feet of natural gas.

The experiments in this chapter will teach you a lot about keeping heat where we want it. . . which, after all, is the secret of conserving energy used for space heating. You see, during the winter, we want to keep heat inside our homes: the better job we do, the less fuel we have to burn.

If your home is air conditioned, the same thing is true. . . in reverse! During the hot summer months, the idea is to keep the heat outside. By doing this, you cut down on the energy needed to power your air conditioner.

EXPERIMENT 1:

HOW DOES INSULATION WORK?

THINGS YOU NEED: A small water glass. An inexpensive "fish tank" thermometer. A cardboard box (find one made out of corrugated cardboard; it should be just big enough to hold the water glass). A handful of cotton balls (you can buy these at any drug store).

During the winter, the insulation in your home's walls *slows down* the movement of heat from inside to the cold outdoors. To understand how insulation works, you must first study how quickly heat will flow from a warm object to cold air when no insulation is present.

Fill the glass with water that is at room temperature (about 70°F); use your thermometer to measure the exact temperature. Put the thermometer into the glass, then place the glass inside your refrigerator. Check the water temperature every five minutes.

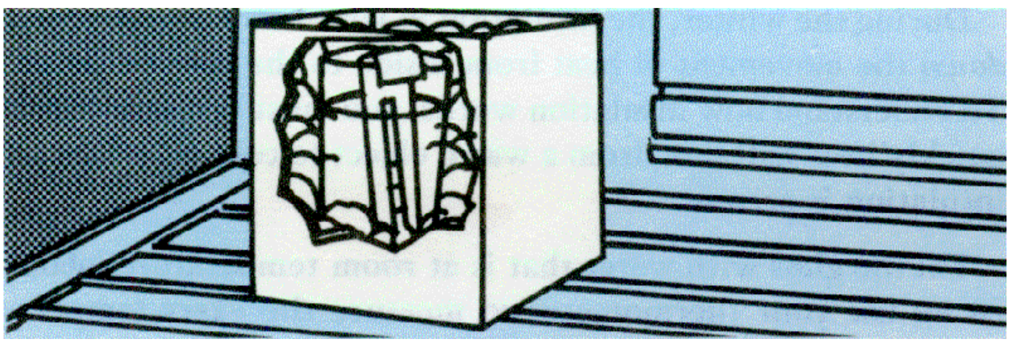
You will find that the water temperature drops quickly. . .probably three or four degrees every five minutes. The reason, of course, is that heat is flowing out of the relatively warm mass of water and into the relatively cold surrounding air inside the refrigerator.

Now, let's add some insulation. Here's how: First, refill the glass with water at room temperature. Then, place a layer of cotton balls inside the bottom of the cardboard box, and rest the glass atop the layer of cotton. Finally, pack the empty space between the glass and the sides of the box with cotton balls. Now repeat what you did above.

You'll find that the temperature will drop much less quickly, now. . . maybe only a degree or so every five minutes. The cotton insulation is slowing down the loss of heat from the mass of water in the glass.

The insulation in your home's walls is not made of cotton (it is probably made out of fiberglass), but it works much the same way.

You may be surprised to learn that many homes are poorly insulated — they have too little insulation (or maybe none at all!) in their walls and ceilings to effectively slow down the movement of heat from inside to outside. Because of this, their owners must burn more fuel in order to stay warm. This is a major cause of energy wastage.



EXPERIMENT 2:

HOW DOES WEATHERSTRIPPING WORK?

THINGS YOU NEED: All of the materials from Experiment 1. A sharp, small-bladed knife or a single-edged razor blade. Some heavy paper tape (the kind used to seal packages).

Weatherstripping around windows and doors, and caulking in cracks and crevices, both do the same job: they stop the "leakage" of cold air into your home during the winter. In technical terms, this leakage is called *infiltration*. . . and it isn't all bad: some infiltration is desirable because it brings fresh air into your home. But, too much infiltration can rob your home of heat, and waste energy.

For this experiment, we'll use the cardboard box from Experiment 1, but without the insulating cotton balls.

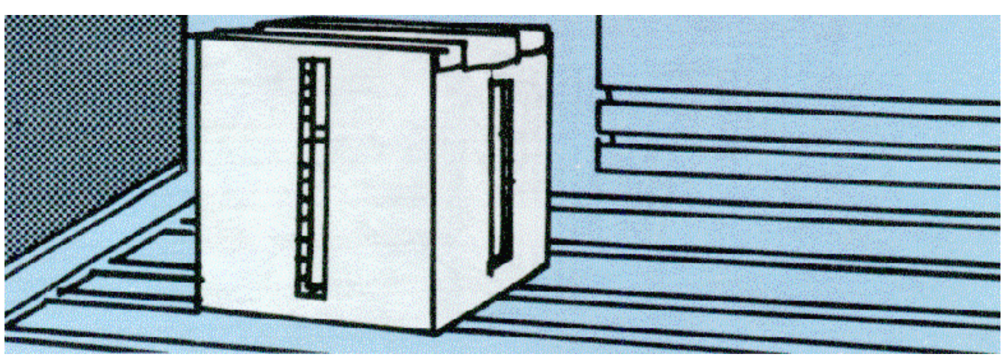
As before, fill the glass with water at room temperature, and place it in the box. Now, put some tape over the top of the box... leave a small opening large enough for the thermometer. Finally, place the thermometer in the glass, and put the box into your refrigerator.

The temperature will drop a bit faster than before (although not as fast as you may think!) because the insulation now consists only of the cardboard box walls and the air trapped inside the box. Make a note of how long it takes for the temperature to decrease by 5° F. Check the temperature every three minutes.

Now, let's add some infiltration. Peel off the tape carefully, and remove the glass. Then, cut a long "slot" (about l/8-inch wide) in each side of the box. The sketch on this page shows you where to cut.

OK, let's see what effect infiltration has. Perform exactly the same experiment as you did above: tape a glassful of room-temperature water into the box, and put the box into your refrigerator. You will find that the water temperature drops considerably faster.

Does this experiment cause you to wonder if your home has "too much" infiltration? Later in this chapter, we'll build a "draftometer" to help you find out. As a rule of thumb, any crack or opening or crevice that you can see provides "too much" infiltration, and should be weatherstripped or caulked. On the other hand, infiltration through microscopic pores in the building material, around nail holes, through lock keyholes, etc., is considered to be "normal."



EXPERIMENT 3:

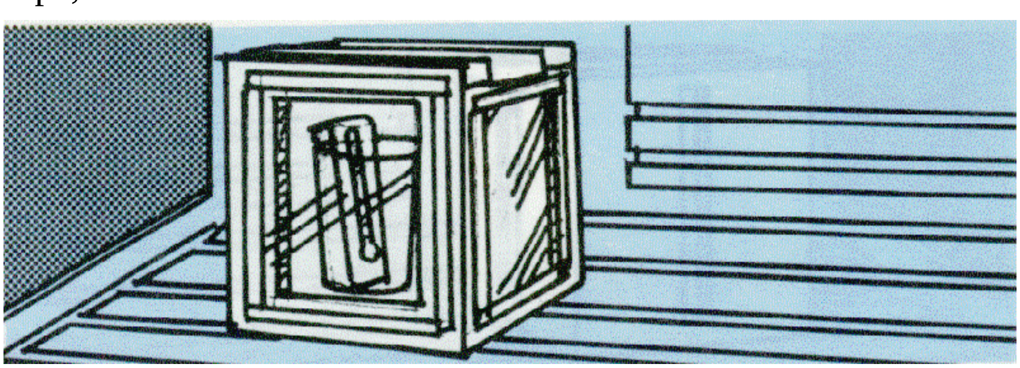
HOW DO STORM WINDOWS WORK?

THINGS YOU NEED: All of the materials from Experiment 2. Some plastic food wrap. A roll of cellophane tape.

A pane of ordinary window glass is not a very good insulator. That's why the many windows in your home *may* be letting a surprising quantity of heat "slip" through. Let's suppose the outside temperature is a chilly 20° F, and that you keep your thermostat set at 70° F. If your home has 200 square feet of ordinary glass windows (a typical value), over 11,000 BTU's of heat will pass through these windows every hour. Your heating system will burn three gallons of oil (or 400 cubic-feet of natural gas) every day to replace this lost heat!

Storm windows (or double-pane "insulated" windows) can cut this heat loss in half. Storm windows are installed over your regular windows — they trap an insulating layer of air between the two layers of glass.

This experiment demonstrates how storm windows work. Use the cardboard box from the previous experiments. Carefully cut four large "windows" in the sides of the box... the sketch on this page shows you where to put the windows. Now, tape a piece of plastic food wrap over each opening from *the inside of the box*. These pieces of plastic film represent ordinary single-pane windows. Use your cellophane tape, here.



You know what to do now. That's right — fill your glass with water at room temperature, tape it into the box, place your thermometer into the water, and put the whole works into your refrigerator. Read the thermometer every three minutes or so, and note how quickly the temperature drops.

OK, let's add "storm windows." Tape (again with cellophane tape) four more pieces of plastic wrap over the box openings. . . this time *from the outside* of the box. It is important that both inside and outside "windows" be taut so that there is a uniform, thin layer of air trapped between them.

Now, repeat the experiment. You will find that the water temperature drops *slightly* less quickly. The difference is small (although noticeable) because our imitation storm windows don't work as well as the real thing.

EXPERIMENT 4:

BUILD A "DRAFTOMETER"

THINGS YOU NEED: Some plastic food wrap. A 10 inch length of ¼-inch diameter wood dowel. One foot of "one by two" lumber cut into two six-inch lengths. A few thumbtacks. Wood glue.

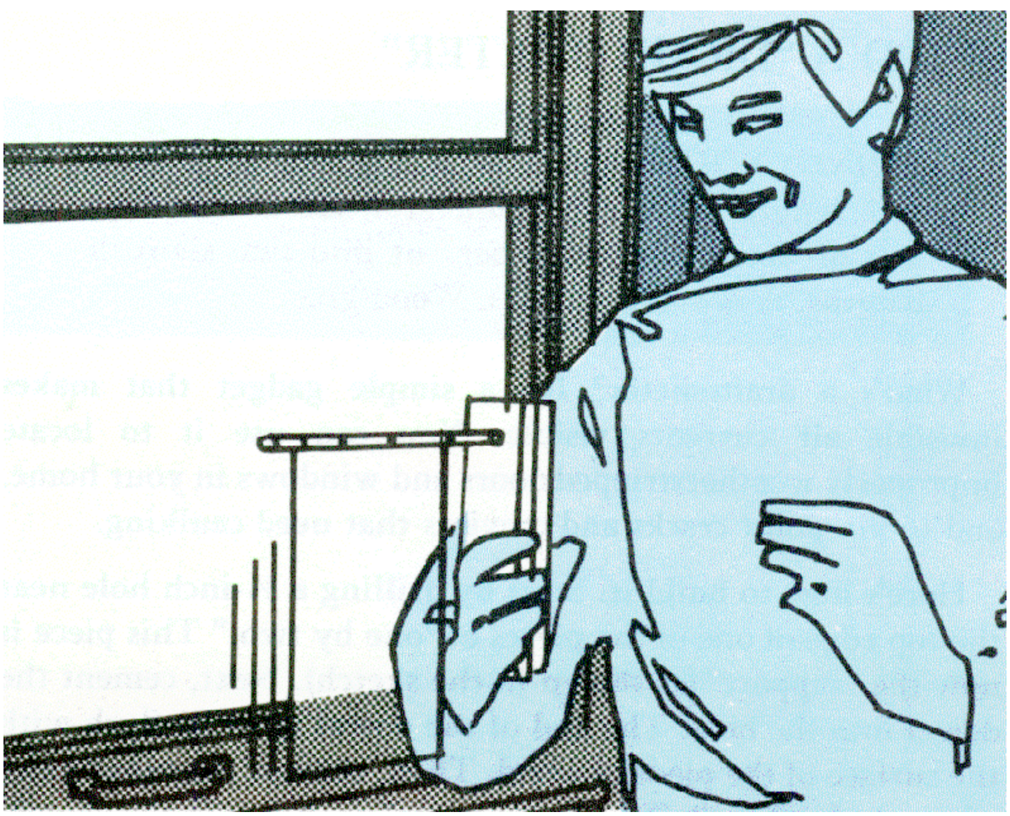
What's a draftometer? It's a simple gadget that makes invisible air currents visible. You can use it to locate improperly weatherstripped doors and windows in your home, and to pin-point cracks and crevices that need caulking.

Here's how to build it: Start by drilling a ¼-inch hole near the top edge of one of the pieces of "one by two." This piece is now the "support" (as shown in the sketch). Next, cement the dowel into the hole. The end of the dowel must be flush with the surface of the piece of wood. Then, cement the other piece of wood (the "handle") to the "support" as shown in the sketch.

Now, cut a 5-inch by 10-inch strip of plastic food wrap (you will need a sharp pair of scissors to do a neat job). Carefully wrap one end of the strip around the end of the wood dowel, then "windup" the strip on the dowel until only four-inches or so of the strip is flapping free. Push two or three thumbtacks into the dowel — through the plastic wrap — to hold the wrap in place.

The thin, lightweight plastic wrap acts like a "sail". . . it will respond to the gentlest breeze by bending out of shape. You can blow at it from two or three feet away and make it move.

To detect excessive *infiltration* (as described in Experiment 2) hold your draftometer near the edges of windows and doors, near passage-holes for pipes and ducts, and close to caulked seams. The piece of wrap *should* remain motionless (provided, of course, your hand is steady!). Noticeable movement signals poor weatherstripping and/or caulking. Tell your mother or father.



EXPERIMENT 5:

LET THE SUN HELP HEAT YOUR HOUSE

THINGS YOU NEED: A cardboard box (an old shoe box is fine). A “fish tank” thermometer (from Experiment 1). Some plastic food wrap (“Handi Wrap” or something similar). A roll of cellophane tape. An old piece of cloth.

Energy from the sun is free! That’s why it makes good sense to use as much of it as we can, as often as we can. How do we use the sun’s energy? By letting it stream through our windows.

To prove the point, build a cardboard “house.” Take your shoebox and tape a piece of plastic wrap across the open top. The plastic sheet should be smooth and wrinkle-free.

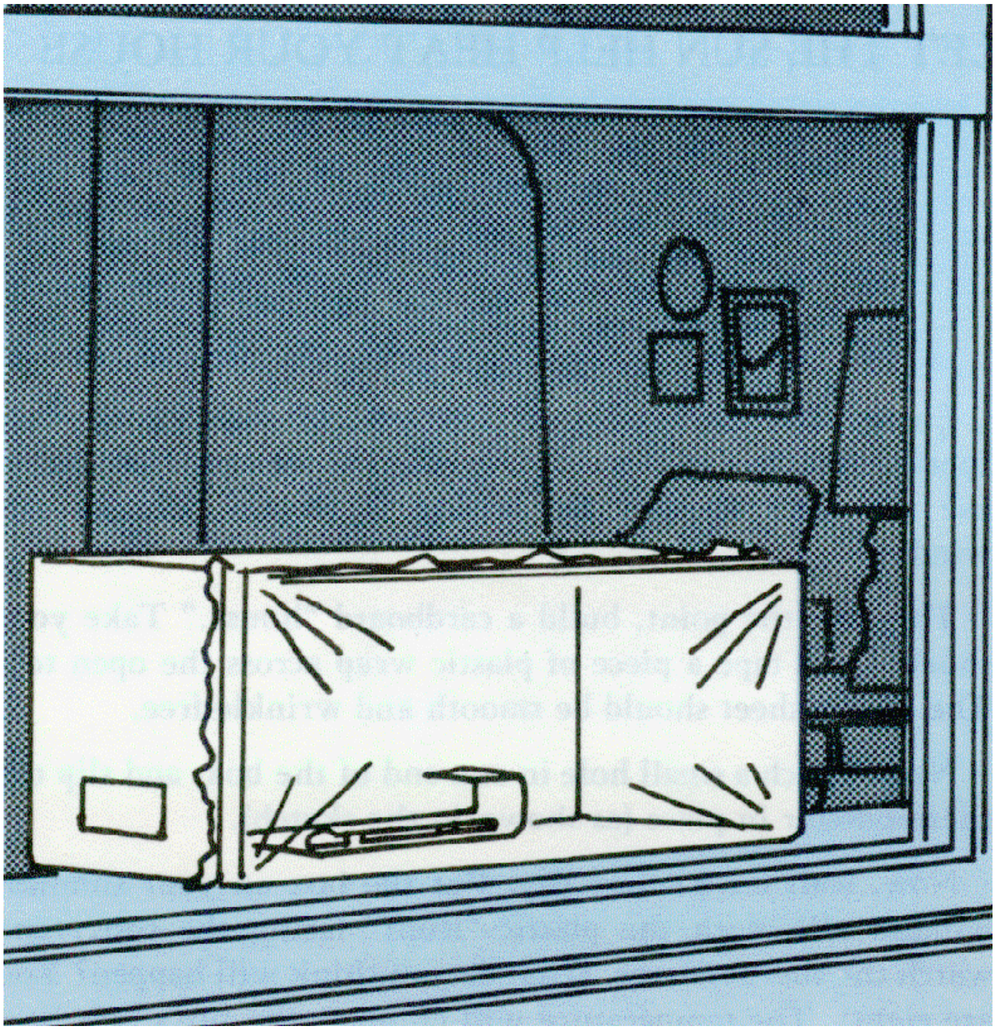
Next, punch a small hole in one end of the box, and slip the thermometer in place (as shown in the sketch).

Now, wait for a sunny day. Put the box on your sunniest window sill, with the plastic “front” facing the sun. . . and watch the thermometer. What do you think will happen? You are right! The temperature will climb as the sun’s rays heat the air inside the box.

OK, let’s repeat the experiment. But, this time, put your piece of cloth over the plastic “window” to simulate a window curtain or a shade. What do you think will happen now? Right again! The temperature will climb very slowly (or not at all!).

In the same way, the sun can help heat your home in winter. When the sun is shining, completely open curtains, raise shades and venetian blinds, and pull back draperies.

BUT, on a cloudy day (and at night, too), close curtains and draperies: they add insulation to windows and help reduce heat flow outside.



HOT WATER

Making water hot takes energy . . . lots of it. A typical family uses 15-20 million BTU's of energy each year to heat water for washing everything from hands *to* dishes. It takes about 168 gallons of fuel oil, or 19,900 cubic feet of natural gas, or 4,500 kilowatt-hours of electricity to do the job.

The two experiments in this chapter have an important fact in common: they both show us how we may have been wasting energy *unexpectedly.*

EXPERIMENT 6:

SHOULD YOU SHOWER OR TAKE A BATH?

THINGS YOU NEED: Your bathtub. A yardstick. A bar of soap (optional).

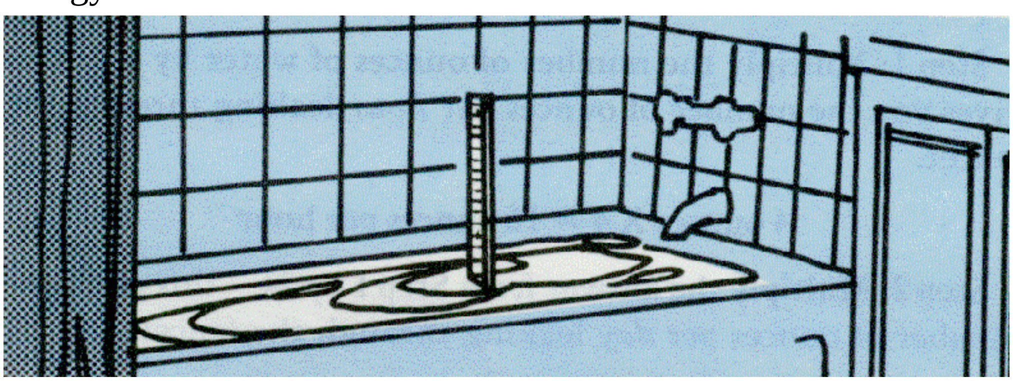
Here's a surprising fact: If people who took baths took showers instead, we'd save a lot of energy. This experiment demonstrates what we mean.

Start by taking a bath. Fill your bathtub with water (adjusted to the temperature you like best) as usual, but before you step in, use your yardstick to measure the depth of water in the tub.

Next, take a shower (better wait till you really need one!). Before you begin, though, do something unusual: close the bathtub drain so that the shower water will collect in the tub. When you are finished (take your time!), measure the depth of water that has collected. Compare this reading with the bath water depth.

You will find that your shower used substantially less water . . . probably less than half as much! A lot of this water is hot water.

As a rule of thumb, figure that it takes an ounce of oil (or a cubic foot of gas, or ¼-kilowatt-hour of electricity) to heat a gallon of water. So you can see that showering saves lots of energy.



EXPERIMENT 7:

A LITTLE DRIP MEANS A BIG ENERGY WASTE

THINGS YOU NEED: An 8-ounce glass or plastic graduated measuring cup. A pencil and some paper. A leaky faucet (optional). A clock.

Drip. . . drip. . . drip. . . goes the leaky faucet. Each drop of water is tiny, but add all the drops together and we end up with *thousands* of gallons of water dripping from the faucet each year. If hot water is dripping down the drain, we are wasting more than clean water. . . we are throwing away the energy used to heat the water.

Here's an experiment that shows you how serious the problem is. If you have a leaky faucet, use it. Otherwise, adjust your kitchen sink faucet (cold water, please) to produce a steady drip. . . drip. . . drip.

Simply place the measuring cup underneath the dripping faucet, and collect 15-minutes worth of drip. You might, for example, collect 4 ounces of water in 15 minutes.

Now we have to do some arithmetic to find out how much energy was wasted. Get your pencil and paper (and your thinking cap). We'll use the 4-ounce figure in the example below:

Step 1: Multiply the number of ounces of water by 4 — this gives you the number of ounces per hour leaking through the faucet.

4 ounces X 4 = 16 ounces per hour

Step 2: Multiply the answer from Step 1 by 24— this gives the number of ounces per *day* leaking through the faucet.

16 ounces per hour X 24 = 384 ounces per day

Step 3: Multiply the answer from Step 2 by 365 — this gives the number of ounces per year leaking through the faucet.

384 ounces per day X 365 = 140,160 ounces per year

Step 4: Divide the answer from Step 3 by 128 — this gives the number of *gallons per year* leaking through the faucet.

140,160 ounces per year ÷ 128 = 1095 gallons per year

That's a lot of water! And it took a lot of energy to make it hot. You can figure out approximately how much oil, or gas, or electricity was wasted by doing the following calculations:

For an oil fired hot water beater: Divide the answer from Step 4 by 110 — this gives the approximate *number* of gallons of oil wasted.

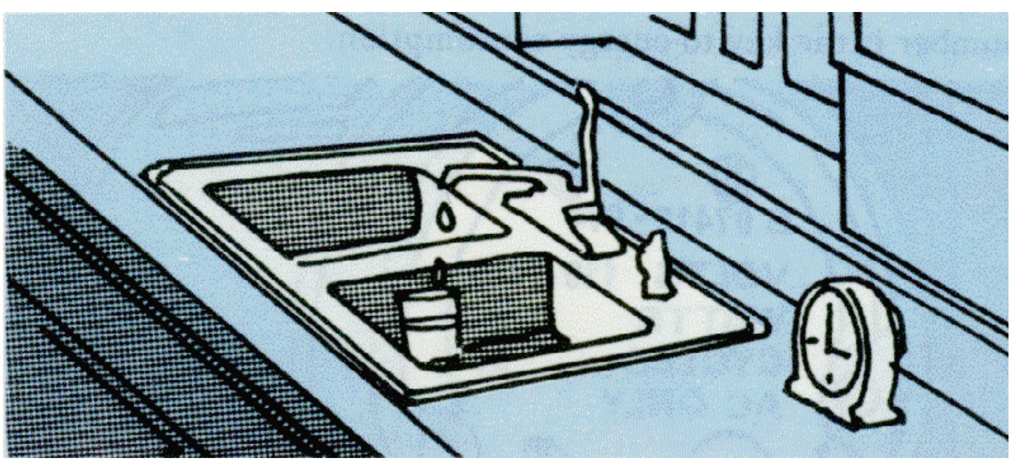
1095 ÷ 110 = 9.95 gallons of oil *per year.*

For a gas-fired hot water beater: Multiply the answer from Step 4 by 1.2 — this gives the approximate number of cubic feet of gas.

1095 X 1.2 = 1,314 cubic feet of gas *per year*

For an electric hot water heater: Multiply the answer from Step 4 by 0.25 — this gives the approximate number of kilowatt-hours of electricity wasted.

1095 X 0.25 = 274 kilowatt-hours *per year*



APPLIANCES AND LIGHTING

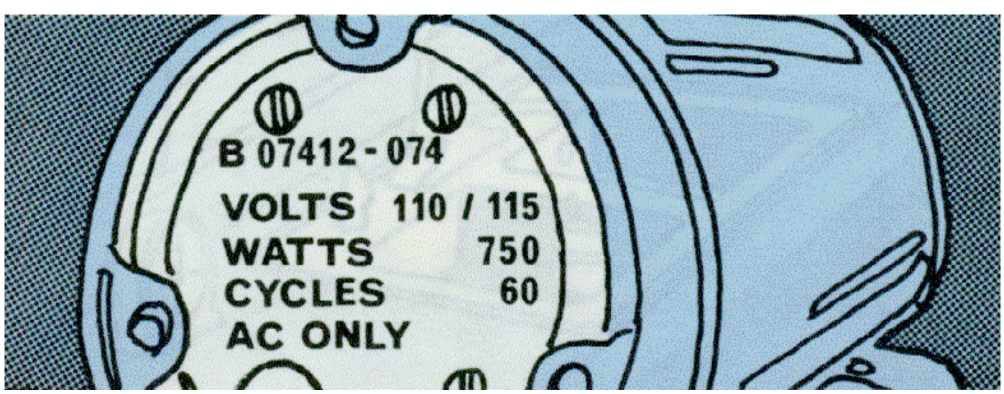
The next chance you get, go on a "scavenger hunt" around your home for things that use energy. You'll probably find several dozen electric lights (don't forget the bulb inside your refrigerator!), a dozen or more different appliances (refrigerator, TV, toaster, washing machine, etc.), a few electric clocks, a stereo, and maybe even an electric toothbrush.

It has been estimated that a well-equipped home consumes over 35,000,000 BTU's of energy each year keeping these "energy eaters" well fed.

A lot of this energy is wasted energy! That's bad news. But here's the good news: It's easy to conserve much of the energy we are wasting.

Here are four experiments that will turn you into an energy-saving expert. But, before you begin, let's spend a few moments discussing how you can determine how much energy each of the electrical appliances in your home uses. It's really very easy. All you have to do, is to look on the back or bottom of the appliance to find the electrical "ratings" information. Probably, you will see a group of numbers pretty much like the numbers in the sketch on this page.

Ignore all the numbers *except* the wattage rating. . . this number is the key to energy consumption.



Once you have an appliance’s wattage rating, consult the table on the next page. It tells you how much electrical energy (measured in kilowatt-hours) the appliance consumes during *one hour* of operation. And, the table tells you approximately how much oil or coal was burned at your power station to produce this amount of electrical energy.

Be sure you ask your mother for permission before you turn over her kitchen appliances, and don’t try to move big appliances without your dad’s help.

ELECTRICAL APPLIANCE ENERGY TABLE

Appliance Wattage Rating	Kilowatt-Hours of Energy Used Per Hour	Ounces of Oil Burned Per Hour	Ounces of Coal Burned Per Hour
10	l/100	l/10	13/100
25	l/40	l/4	33/100 (or l/3)
40	l/25	2/5	l/2
60	3/50	3/5	4/5
100	l/10	1	l-1/3
150	3/20	l-1/2	2
200	l/5	2	2-2/3
300	3/10	3	4
500	l/2	5	6-2/3
750	3/4	7-l/2	10
1000	1	10	13-l/3
1500	l-1/2	15	20
2000	2	20	26-2/3
5000	5	50	66-2/3

EXPERIMENT 8:

DOES YOUR CLOTHES DRYER WASTE ENERGY?

THINGS YOU NEED: About one hour of spare time on washing day. A clock.

The heart of a clothes dryer is a source of hot air. . . wet clothes tumble through the hot air and are dried. It takes many thousands of BTU's of energy per hour to heat the air — and so, we should never run a clothes drier unnecessarily.

Unhappily, many people do just that. They set the dryer's timer for longer than is necessary, and the machine rumbles on long after the clothes inside are completely dry.

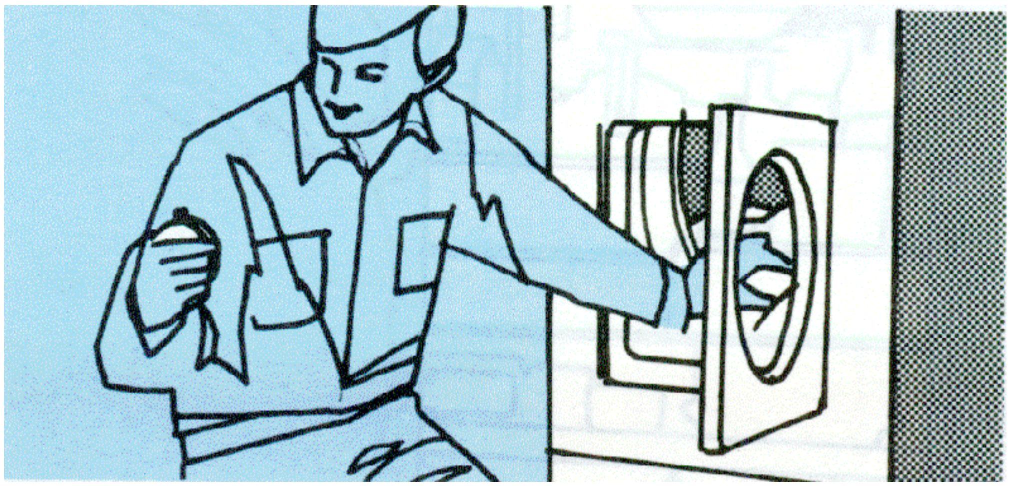
This simple experiment will tell the tale. Start by getting permission. Learn how to restart the machine after you stop it by opening the door. Now you are ready to begin.

The next time there is a load of clothes in the dryer, pull up a comfortable chair and start watching the clock. After fifteen minutes goes by, open the dryer door, *wait* for the drum to stop turning, then feel the clothes (careful. . . they will be hot). They will probably still be damp. Close the door, and restart the dryer.

Do this again every five minutes *until* the clothes feel dry to your touch. Look at the timer and see how much longer the dryer was set to run. If your dryer is electric, you can figure that every wasted minute burned up about 4/5-ounce of oil (or one ounce of coal) back at the power company. If your dryer runs on gas, figure that every wasted minute burns about l/10 cubic feet of gas.

Here are two other energy-saving tips for dryers:

- Make sure the lint filter is cleaned out every time the dryer is used
- Don't dry "half loads" — fill up the machine before using it



EXPERIMENT 9:

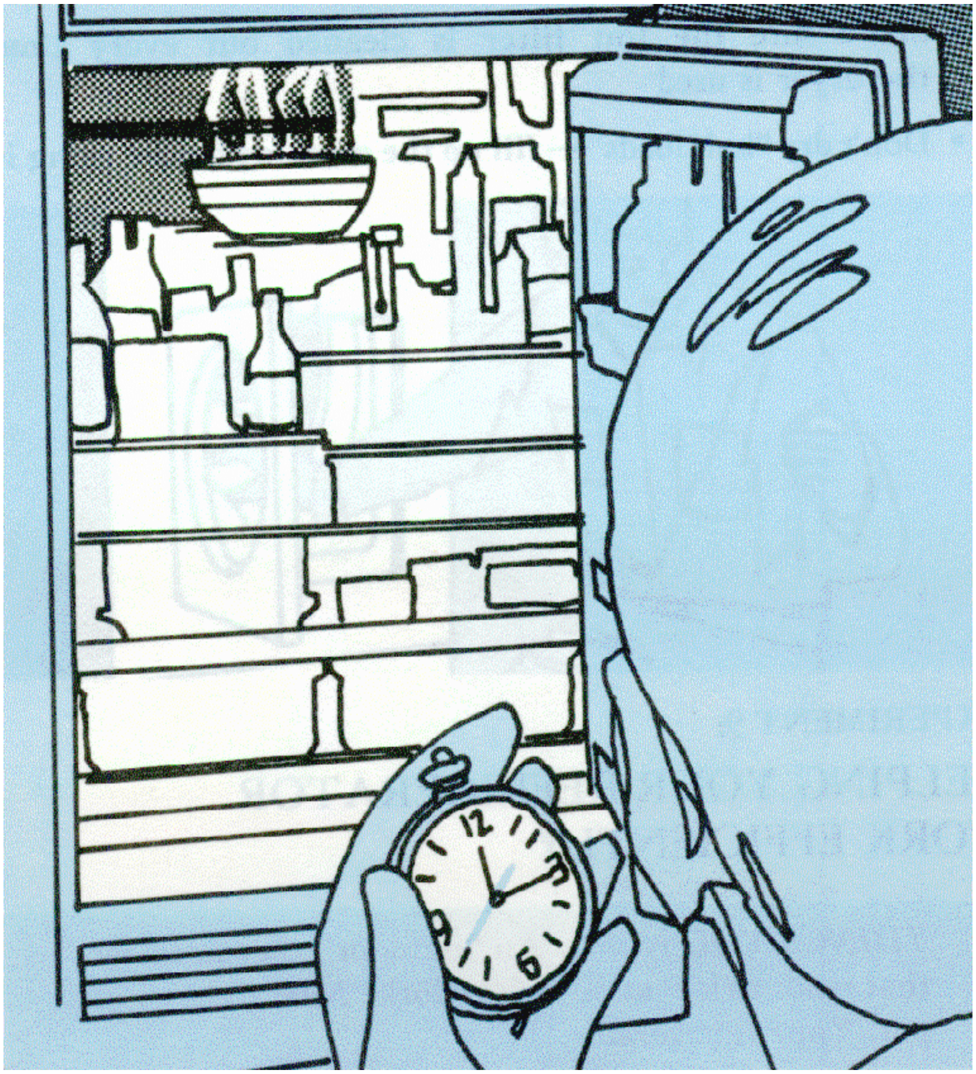
HELPING YOUR REFRIGERATOR WORK EFFICIENTLY

THINGS YOU NEED: An "outdoor" thermometer that reads as low as 30° F. A clock. A large bowl or pot. Your refrigerator.

Two ways we all make our refrigerators work harder (and thus use more energy) are:

1. Putting warm (often steaming) things in the refrigerator
2. Opening the refrigerator door more times than absolutely necessary

This simple experiment will show you how significant these everyday "mistakes" are. Before you begin, though, be sure to get permission. And pay close attention to the instructions — if you are careless you could spoil some food.



Now we can start. Put your thermometer inside the refrigerator, close the door, and wait about 15 minutes for the thermometer to reach the inside temperature. Open the door (and, working as quickly as you can) read the inside temperature. It will probably be about 40° F.

Then, unplug the refrigerator's power cord from the wall outlet. Make sure that no one opens the door for exactly 15 minutes. Finally, open the door and take a temperature reading. You will find that the temperature hardly changed.

Plug the refrigerator back in (its motor will probably come on) and wait another 15 minutes (the thermometer should be back inside).

Now, unplug the refrigerator again, and repeat the experiment. . . but with one difference. Every five minutes open the door for about 30 seconds. When you check the thermometer after 15 minutes, what do you think you will see? That's right! The temperature has risen by several degrees.

Can you explain why? Right again! Opening the door two or three times let in warm air. Usually, of course, your refrigerator automatically switches on when this happens. But we have unplugged it to prevent the machinery from working.

Plug the refrigerator back in as before, and wait about 30 minutes before you continue. In the meantime, fill your bowl or pot with hot water from your kitchen faucet.

When you are ready, unplug the refrigerator, and place the bowl of water inside (it will start "steaming" immediately). Close the door. Come back in 15 minutes and take a temperature reading.

The temperature will have risen several degrees; can you explain why? I am sure that you can!

Do you have any conclusions? Yep. . . it makes sense *not* to put hot things inside a refrigerator, and *not* to open the door often.

One more point: The coils on the back of your refrigerator are designed to transfer heat from the coolant liquid inside to the outside air. To do their job, they must be clean: soot, grease, dust, dirt, and lint all act as insulators, and prevent heat transfer. Consequently, your refrigerator motor works harder — and consumes more energy — to cool the inside contents.

Inspect the coils of your refrigerator (they are called *condenser* coils) and vacuum out any dust or dirt you find. Make it a habit to repeat the cleaning every three months or so.

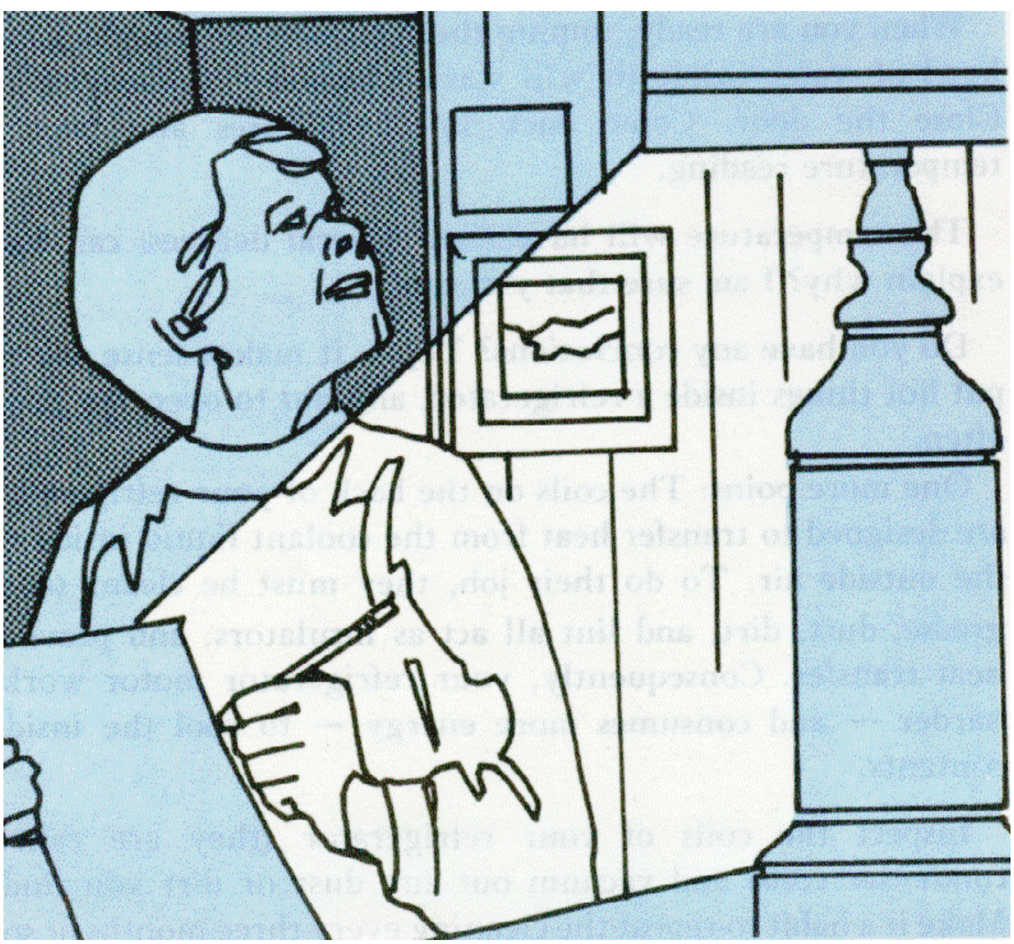
EXPERIMENT 10:

CHECKLIST FOR ENERGY — EFFICIENT LIGHTING

THINGS YOU NEED: A yardstick or tape measure. Pencil and paper.

How much energy is used to light your home? Probably, about 2000 kilowatt-hours of electrical energy each year. Your local electric power plant burns about 150 gallons of oil (or over ¾ ton of coal) to generate the electricity.

With this much energy "going up in light," it makes good sense to learn to use lighting efficiently. This simple lighting checklist will give you a head start. Walk through your home –



with pencil and paper in hand — and see how well the lights in your home stack up. Tell your parents about your findings.

• Are bulbs and lampshades free of dust and dirt that block light transmission? Dirty bulbs and shades waste the light produced inside the bulbs. As a result, you may turn on two lights when only one is really necessary.

• Are lampshades *translucent* (so light can pass through them) rather than solid? It doesn't make sense to use energy to produce light, and then block the light with a solid lampshade.

• Are ceilings and walls light-colored? Light colors reflect more light than dark colors, and so fewer lamps (or lower-wattage bulbs) can be used to light the room.

• Are "non critical" lighting levels in your home kept as low as possible? As a rule of thumb, one watt of lighting per square foot of floor area is adequate for general room and hallway lighting. Use your yardstick or tape measure to make measurements. Of course, "critical" tasks (such as reading, sewing, building model airplanes, and doing your homework) require more light.

• Does every member of your family turn off lights after he or she leaves a room? Not doing this is just an out-and-out waste of valuable energy!

By the way, you may hear some people say that they *purposely* leave lights on. These people mistakenly believe that the sudden surge of electricity that flows through a light bulb when it is turned on represents a lot of energy. They think that keeping the bulb lit — and thereby avoiding starting surges — somehow saves energy.

They are wrong! A light bulb consumes less energy during its starting surge than during a *single second* of normal operation.

Always turn lights off when they are unnecessary, even for a few seconds.

ENERGY SOURCES OF THE FUTURE

All around the world, in hundreds of different laboratories, thousands of scientists are searching for new sources of energy. Someday soon, we may know how to harness the power of the winds and tides, or to tame the amazing process called *nuclear fusion* (the mechanism that generates the sun's energy), or to capture the energy from the sun that falls on the earth.

The last experiment in this book is meant to give you a glimpse of the future. It is a simple device that puts the sun's rays to work.

EXPERIMENT 11:

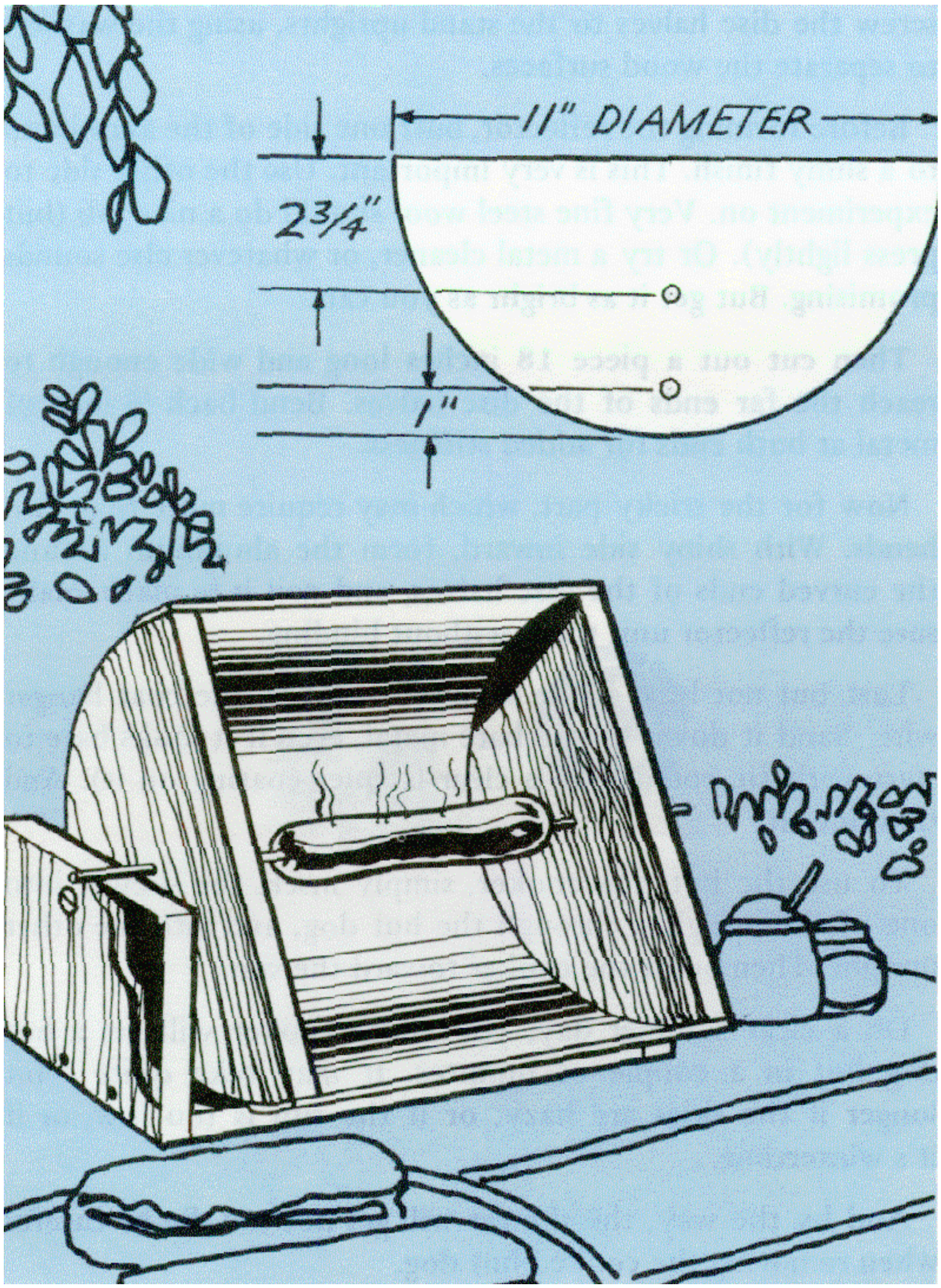
A SUN-POWERED HOT DOG COOKER

THINGS YOU NEED: Four feet of "one by six" lumber. A sheet of aluminum 12 inches by 18 inches (ask for "aluminum valley" at lumber yards or hardware stores). Two wood screws at least 1¼ inches long and two washers to fit the screws. A 14-inch length of wire from a coat hanger. Some long and short nails.

Start by cutting the wood as follows: Three pieces 11 inches long and two pieces 5 inches long.

On two of the 11-inch pieces, inscribe a semi-circle having a diameter of 11 inches. As carefully as you can, cut out these disc halves with a coping saw. Finish the cut edges with a file.

Drill holes in the disc halves as shown in the sketch. The center holes should be sized so that the coat hanger wire slides in and out easily. The lower holes should be sized SO that the screws fit snugly.



Next comes the support stand. In each short piece of wood, drill a hole one inch from either cut end and halfway between the sides. Make the hole slightly larger than the diameter of the wood screws. Then nail the short pieces to the ends of the remaining piece of wood to complete the stand. Finally, screw the disc halves to the stand uprights, using the washers to separate the wood surfaces.

Before forming the reflector, buff one side of the aluminum to a shiny finish. This is very important. Use the other side to experiment on. Very fine steel wool should do a nice job (but press lightly). Or try a metal cleaner, or whatever else sounds promising. But get it as bright as you can.

Then cut out a piece 18 inches long and wide enough to reach the far ends of the disc halves. Bend back ½ inch of metal at both ends for added stiffness.

Now for the tricky part, which may require more than two hands. With shiny side inward, form the aluminum around the curved ends of the disc halves, and nail it in place. Make sure the reflector unit turns without binding.

Last but not least is the skewer – that is, the coat hanger wire. Sand it down to the bare metal, even if it looks bare to start with (it could have a clear lacquer coating on it). And that does it.

To use the hot dog cooker, simply insert the skewer into one of the uprights, through the hot dog, and into the other upright. Then point the cooker toward the sun.

On a clear summer day, your solar cooker will get a hot dog hot in a couple of minutes. It may take quite a bit longer if the skies are hazy, or if the sun is too low, or if it's wintertime.

And by the way, the skewer will get hot too. So be careful when removing the cooked hot dog.

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