WAVE POWER

TOPIC:

Renewable Sources of Energy

INTRODUCTION:

Most of our electricity is produced from sources of energy like oil and coal that will one day run out; burning oil and coal also produces acid rain and adds carbon dioxide to the atmosphere, encouraging the greenhouse effect. Much of the rest of our electricity needs are met by nuclear power plants that produce highly radioactive waste requiring long-term storage; this poses a further risk to the environment. There are other forms of electricity production, however, that do not use up valuable resources and that cause little or no damage to the environment. These alternative or renewable sources include wind, wave, and hydroelectric power. Waves are caused by winds blowing over the surface of the oceans. Research is now being carried out to find the best way of harnessing the kinetic energy of waves at sea in order to turn turbines and generate electrical energy. In this investigation you will build a model to show how waves can be used to produce electricity.

TIME NEEDED:

1 ½ hours

MATERIALS:

- length of balsa wood (from modeling stores), 24 in. x ½ in. x ½ in.
- balsa wood block, 3 in. x 1 in. x 1 in.
- balsa wood adhesive
- X-acto® knife
- metal file
- sandpaper
- small bar magnet, approximately 2.5 cm x 1 cm x 1 cm
- 50 ft. of plastic insulated bell wire
- masking tape
- 2 ring stands with clamps
- 2 long pins, approximately 10 cm long
- cardboard tube (*e.g.*, empty paper towel roll)
- galvanometer (*e.g.*, Multimeter®)
- dishpan

Safety Precautions

Please click on above link to view our safety guidelines.

PROCEDURE:

1. Using the knife, cut the length of balsa into three pieces: 12 in., 9 in., and 3 in. long.

figure 1

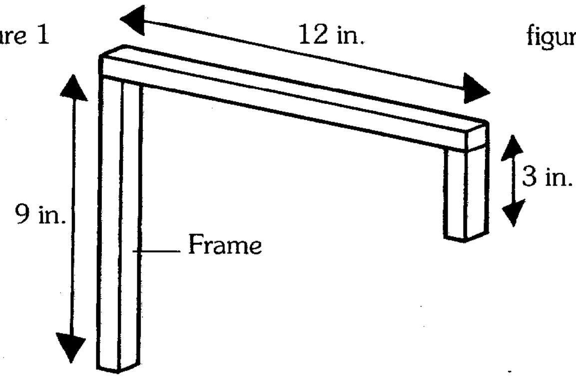
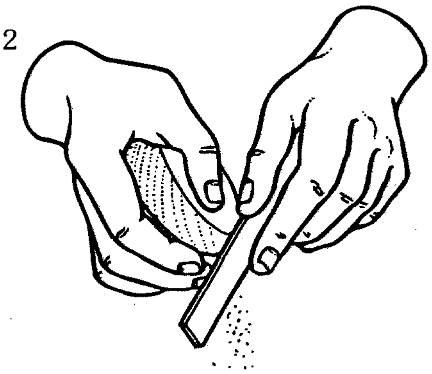


figure 2



2. Glue the three pieces together to make the wooden frame shown in figure 1, and put the frame to one side to dry.
3. Use the knife to cut the corners off the block of balsa. Use the file and sandpaper to smooth it into an egg shape (this is the float). (See figure 2.)
4. Cut a square shape, ½ in. x ½ in. x ½ in. deep, from the side of the balsa block. Use adhesive to glue together the 3-in. length of balsa and the float. (See figure 3.)
5. Use masking tape to attach the magnet to the end of the 9-in. piece of balsa. The magnet should stick out below the end of the wood by ¾ in. (See figure 4.)

figure 3

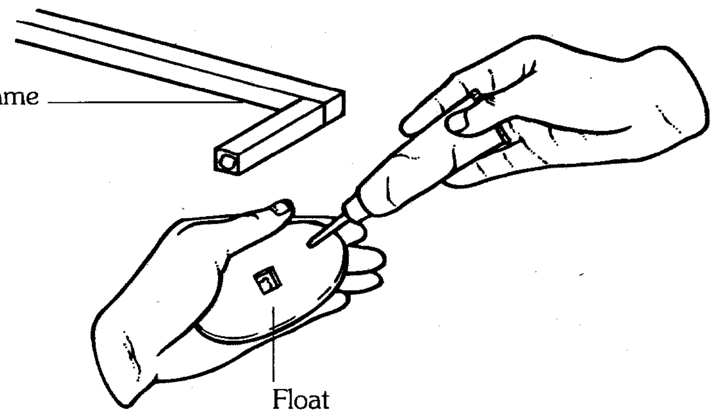
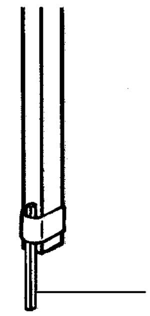
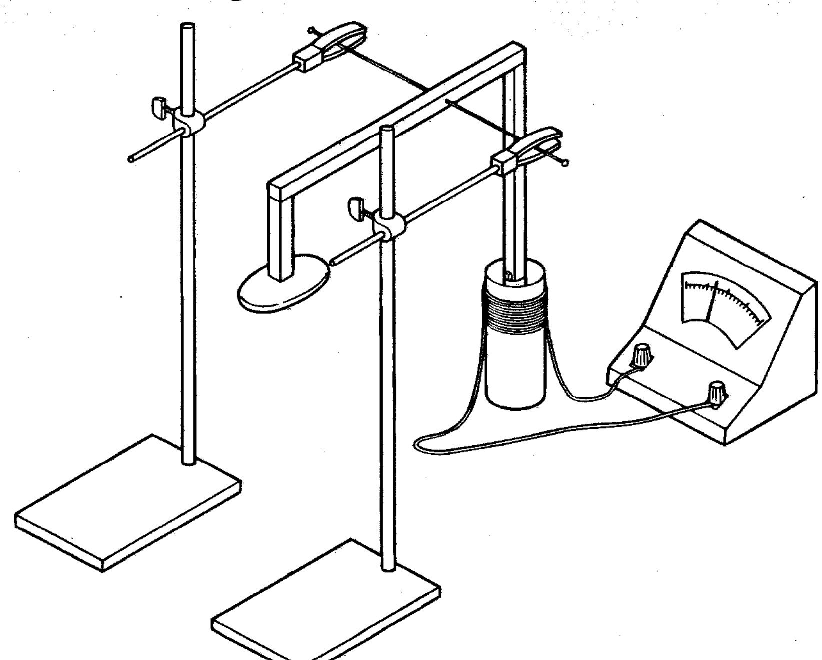


figure 4



6. Now try to balance the frame on your finger by resting the 12-in. bar lightly on one outstretched finger. When you find the balance point on the 12-in. bar, mark it by sticking the two pins into the balsa, one on each side, at this point.
7. Rest the pins on two clamps attached to the ring stands so that the frame swings backward and forward easily, with the tip of the magnet about 2.5 cm above the table.
8. Coil the wire around the cardboard tube to make a short, thick coil, about 2.5 cm long, of about 200 turns. Make sure the two ends of the wire, each about 15 cm long, are free of the coil.
9. Attach the free ends to the two terminals of the galvanometer. (See figure 5.)
10. Place the coil so that the magnet is able to move backward and forward inside it.

figure 5



11. Put the dishpan under the float. Add sufficient water so that the float is partially submerged.

12. Use your hand to make large waves in the water. The float should move freely backward and forward. Watch the galvanometer and note any response that it shows.

ANALYSIS:

1. What happened to the galvanometer needle when you made waves in the water? Why?
2. What type of energy do the waves in the bowl possess—kinetic or electrical?
3. What energy change has taken place here?
4. What is the function of a) the float and b) the magnet and coil?
5. Do some research. How do coal- and oil-fired power plants and nuclear power plants cause environmental damage?
6. Do more research. What other renewable forms of energy, apart from wave energy, are available?

OUR FINDINGS:

Click on above link to see what we found.

Our Findings

VII. ENERGY PROJECTS

7.002 Wave Power

1. The galvanometer needle moved when waves were made. This is because the waves produced in the water moved the float, which in turn moved the magnet inside the coil of wire. The movement of a magnet inside a coil of wire generates electricity. The movement of an electric current through the wire causes the galvanometer to move.
2. The waves possess kinetic energy.
3. Kinetic energy has been converted into electrical energy.
4. a) The function of the float is to move freely in response to the movement of the waves.

   b) The function of the magnet and coil is to generate electricity, transforming the kinetic energy of the float into electrical energy.
5. Coal- and oil-fired power plants use resources that are nonrenewable. They produce air pollution that causes acid rain, and they add carbon dioxide to the atmosphere, contributing to global warming through the enhanced greenhouse effect. Nuclear power plants produce waste that is highly radioactive and will remain so for many thousands of years. Accidents at nuclear power plants, such as that at Chernobyl in 1986, can release radiation into surrounding areas, causing death or long-term illness among local inhabitants and damaging wildlife.
6. Other renewable sources of energy include solar and wind power.

SPECIAL SAFETY NOTE TO EXPERIMENTERS

Each experiment includes a short list of special safety precautions that are relevant to that particular project. However, these do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note—The book assumes that you will read the safety precautions that follow, as well as those at the head of each experiment you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARE:
—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECT YOURSELF:
—Follow the directions step-by-step; do only one experiment at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USE EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Don't use your mouth to pipette; use a suction bulb
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not use reflected sunlight to illuminate your microscope
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

GOING ON FIELD TRIPS:
—Do not go on a field trip by yourself
—Tell a responsible adult where you are going and maintain that route
—Know the area and its potential hazards, such as poison plants, deep water, and rapids
—Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold)
—Bring along a first-aid kit
—Do not drink water or eat plants found in the wild
—Use the buddy system; do not do outdoor experiments alone

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES