WONDERS OF WATER

Teacher Guide

An inquiry based curriculum that introduces scientific concepts of electricity, water and hydropower to elementary students.

GRADE LEVEL

Elementary

SUBJECT AREAS

Science
Social Studies
Language Arts

NEED 2008-2009
Putting Energy into Education

NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

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NEED Mission Statement

The mission of the NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

Teacher Advisory Board Vision Statement

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

TABLE OF CONTENTS

WONDERS OF WATER was developed by the NEED Project with funding and technical support from the National Hydropower Association and the Hydro Research Foundation.

WONDERS OF WATER KIT: $300

Included in the Kit for Student Investigations
6 Wallpaper Pans
4 400ml Beakers
35 1” Styrofoam Balls
3 Bundles of Wooden Spoons
1 Spool of String
1 Box of Paperclips
1 Box of Pushpins
1 Hydropower Plant Poster

Included in the Kit for the Science of Electricity Demo
1 Large Round Bottle
1 Small Round Bottle
1 Spool of Magnet Wire
1 12” Wooden Dowel
1 15cm piece of plastic tubing
1 Bag of Wood Rectangles
4 Rectangular Magnets
1 Rubber Stopper
10 Wooden Spoons
1 Set of Alligator Clips
1 Voltmeter

Not Included in the Kit
Water
30 Styrofoam Cups
6 Permanent Fine-Point Markers
6 Bottles of Fast-drying Glue
6 Scissors
1 Sharp-pointed Scissors
6 Nails
6 2-liter soda bottles
6 Rulers
1 Large Bag of Paver’s Sand
6 Pencils
Towels

Correlations to National Science Content Standards

(Bolded standards are emphasized in the unit.)

UNIFYING CONCEPTS *(FOR ALL GRADE LEVELS)*

2. Evidence, Models, and Explanation

a. Evidence consists of observations and data on which to base scientific explanations. Using evidence to understand interactions allows individuals to predict changes in natural and designed systems.

b. Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have an explanatory power. Models help scientists and engineers understand how things work.

c. Scientific explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements. As students develop and as they understand more scientific concepts and processes, their explanations should become more sophisticated.

3. Change, Constancy, and Measurement

a. Although most things are in the process of change, some properties of objects and processes are characterized by constancy; for example, the speed of light, the charge of an electron, and the total mass plus energy of the universe.

b. Energy can be transferred and matter can be changed. Nevertheless, when measured, the sum of energy and matter in systems, and by extension in the universe, remains the same.

c. Changes can occur in the properties of materials, position of objects, motion, and form and function of systems. Interactions within and among systems result in change. Changes in systems can be quantified and measured. Mathematics is essential for accurately measuring change.

d. Different systems of measurement are used for different purposes. An important part of measurement is knowing when to use which system.

PRIMARY (K-4) STANDARD–A: SCIENCE AS INQUIRY

1. Abilities Necessary to do Scientific Inquiry

a. Ask a question about objects, organisms, and events in the environment.

b. Plan and conduct a simple investigation.

c. Employ simple equipment and tools to gather data and extend the senses.

d. Use data to construct a reasonable explanation.

e. Communicate investigations and explanations.

2. Understandings about Scientific Inquiry

a. Scientific investigations involve asking and answering a question and comparing the answer with what scientists already know.

b. Scientists use different kinds of investigations, which include describing objects, events, and organisms; classifying them; and doing a fair test (experimenting).

c. Simple instruments such as magnifiers, thermometers, and rulers provide more information than using only senses.

d. Scientists develop explanations using observations (evidence) and what they already know (scientific knowledge). Good explanations are based on investigations.

PRI–B: PHYSICAL SCIENCE

1. Properties of Objects and Materials

a. Objects have many observable properties, including size, weight, shape, color, temperature, and the ability to react with other substances. Those properties can be measured using tools such as rulers, balances, and thermometers.

b. Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made, and those properties can be used to separate or sort a group of objects or materials.

2. Position and Motion of Objects

a. The position of an object can be described by locating it relative to another object or the background.

b. An object's motion can be described by tracing and measuring its position over time.

c. The position and motion of objects can be changed by pushing or pulling. The size of the change is related to the strength of the push or pull.

PRI–D: EARTH AND SPACE SCIENCE

2. Objects in the Sky

a. The sun provides the light and heat necessary to maintain the temperature of the earth.

3. Changes in Earth and Sky

a. Weather changes from day to day and over the seasons.

b. Weather can be described by measurable quantities, such as temperature, wind direction and speed, and precipitation.

PRI–E: SCIENCE AND TECHNOLOGY

2. Understandings about Science and Technology

e. Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.

PRI–F: SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES

3. Types of Resources

a. Resources are things that we get from the living and nonliving environment to meet the needs and wants of a population.

b. Some resources are basic materials, such as air, water, and soil; some are produced from basic resources, such as food, fuel, and building materials; and some resources are nonmaterial, such as quiet places, beauty, security, and safety.

5. Science and Technology in Local Challenges

a. People keep inventing new ways of doing things, solving problems, and getting work done. New ideas and inventions often affect other people; sometimes the effects are good and sometimes they are bad. It is helpful to try to determine in advance how ideas and inventions will affect other people.

PRI–G: HISTORY AND NATURE OF SCIENCE

1. Science as a Human Endeavor

a. Science and technology have been practiced by people for a long time.

Teacher Guide

BACKGROUND

Wonders of Water is a kit-based unit that includes introductory background information on energy, electricity, electrical circuits, water, and hydropower with graphic organizers, hands-on activities, and language arts activities. The kit includes most of the materials to conduct the hands-on and inquiry-based activities as well as a class set of student guides.

CONCEPTS

Energy is the ability to do work or make a change.

We use many sources of energy to do work.

Energy sources can be renewable or nonrenewable.

We use many energy sources to generate electricity.

Water exists on earth in three states: solid, liquid, and gas.

Water moves between the atmosphere and the earth in a continuous cycle called the water cycle.

Water is pulled from higher places to lower places by the force of gravity—the force of attraction between all matter.

Water moves across the surface of the earth to form streams, rivers, lakes, and oceans.

The flow of water through the water cycle changes the earth.

People have built dams to control the flow of water in streams and rivers for many years.

Water has been used as an energy source for many years.

Moving water contains energy that can be used to generate electricity.

A hydropower dam uses the energy of moving water to generate electricity.

Hydropower has advantages and challenges.

TIME

Four weeks: 21 30-minute class periods to conduct all of the activities and evaluation.

PREPARATION

1. Become familiar with the Teacher and Student Guides. It is suggested that the teacher conduct the hands-on activities before assigning them to students.
2. Gather the materials needed to conduct the activities.
3. Assemble the Science of Electricity Turbine (pages 14-16) and practice operating it with the Voltmeter (page 17).
4. Make copies of the student pages if you do not want students writing in the Student Guides. Class sets of Student Guides may be purchased by calling NEED at 1-800-875-5029 or downloaded from www.need.org. It is suggested that students keep science notebooks during the unit and not write in the Student Guides.

DAY 1—INTRODUCTION TO ENERGY

Materials: Copies of Hydropower Survey (page 21)

Time: 30 minutes

Objectives

To activate students' prior knowledge about energy.

To stimulate student interest in energy.

1. Have the students take the Hydropower Survey as a pre-unit evaluation tool. The survey will also initiate some questions for the KWL charts.
2. Ask the students, "What do you think you know about energy?" Have the students make KWL Energy Charts in the Student Guide (page 20) or in their science notebooks and individually list what they know and would like to know about energy; then, have each student exchange his/her information with a classmate.
3. Facilitate a class discussion about what they know and want to know about energy. This is not the time to correct misconceptions but to make note of them.

DAY 2—FORMS OF ENERGY

Objectives

To understand that energy is the ability to do work or make a change.

To understand that there are many forms of energy.

Time: 30 minutes

Procedure

1. Have the students read about energy and forms of energy on pages 4-5 in the Student Guide, adding new information to their KWL Energy Charts.
2. Using page 21 in the Student Guide take the students on a tour around the school—inside and outside—to observe energy doing work and energy in different forms.
3. Have the students share with a partner or the class what they observed.

DAY 3—SOURCES OF ENERGY

Objective

To understand that we use many sources of energy to do work.

Time: 30 minutes

Procedure

1. Have the students read about sources of energy on the bottom of page 5 and all of page 6 in the Student Guide, adding new information to their KWL Energy Charts.
2. Facilitate a discussion of the major sources of energy we use today, renewable and nonrenewable, and the major tasks performed by the energy sources.
3. Have the students complete The Energy We Use graph on page 22 of the Student Guide. Review with the class.

DAY 4—INTRODUCTION TO ELECTRICITY

Objectives

To activate students' prior knowledge about electricity.

To understand that we use electricity for many different tasks.

Time: 30 minutes

Procedure

1. Ask the students, "What do you think you know about electricity?" Have the students make KWL Electricity Charts in the Student Guide (page 22) or in their science notebooks and individually list what they know and would like to know about electricity, then have each student exchange his/her information with a classmate.
2. Facilitate a class discussion about what they know and want to know about electricity. This is not the time to correct misconceptions, but you should make note of them.
3. Have the students investigate the classroom and note all of the ways electricity is being used.
4. For homework, have the students investigate their homes and make lists of the ways they use electricity.

DAY 5—LEARNING ABOUT ELECTRICITY

Objectives

To learn what electricity is.

To learn about the relationship between magnetism and electricity.

To learn how electricity is generated.

Time: 30 minutes

Procedure

1. Have the students read about electricity on pages 7-11 in the Student Guide.
2. Facilitate a discussion of atomic structure, electricity and magnetism, and electricity generation.
3. Have the students complete The Electricity We Use graph on page 23 of the Student Guide. Review with the class.

DAY 6—ELECTROMAGNETISM: SCIENCE OF ELECTRICITY MODEL DEMONSTRATION

*Materials: Science of Electricity Model,voltmeter, set of alligator clips, deep sink with faucet**

Objectives

To increase understanding of the relationship between electricity and magnetism.

To learn how a turbine generator produces electricity.

Time: 30 minutes

Procedure

1. Review the information learned about magnetism and electricity.
2. Show the students the voltmeter and explain that it measures electricity.
3. Show the students the Science of Electricity Model, pointing out the magnets and coils of copper wire.
4. Connect the model to the voltmeter using the alligator clips.
5. Demonstrate how the model works by spinning the turbine blades by hand.
6. Have students brainstorm other ways to spin the turbine.
7. Demonstrate how flowing water can spin the turbine by placing the model under a faucet. Vary the force of the water so that the students can see the different amounts of electricity produced on the voltmeter.
8. Have the students complete the Science of Electricity activity on page 24 of the Student Guide as an assessment of student understanding. Review essential knowledge with the class and correct any misconceptions that are apparent at this time.

DAY 7—INTRODUCTION TO WATER

Objectives

To activate students' prior knowledge about water.

To understand the states of matter.

To understand the water cycle.

Time: 30 minutes

Procedure

1. Ask the students, "What do you think you know about water?" Have the students make KWL Water & Energy Charts (page 25 of the Student Guide) or in their science notebooks and individually list what they know and would like to know about water, then have each student exchange his/her information with a classmate.
2. Facilitate a class discussion about what they know and want to know about water and the water cycle. This is not the time to correct misconceptions, but make note of them.
3. Have the students read about water's states of matter and the water cycle on pages 12-13 of the Student Guide, adding new information to their KWL Water Charts.
4. Have the students complete The Water Cycle Activity on page 26 of the Student Guide. Review essential knowledge with the class and correct any misconceptions that are apparent at this time.
5. *LANGUAGE ARTS EXTENSION:* Make copies of The Tale of Annie Soakley on page 18 of the Teacher Guide. Have the class read the story and illustrate the story and make a book for primary students.

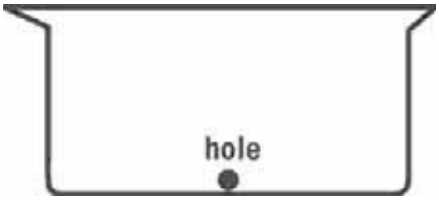
DAY 8—LAND AND WATER PART 1

Materials at each of six centers: 1 wallpaper pan as a stream table, 1 pitcher, 1 bag of fine sand, 1 nail*, 300 ml of water**

Objective

To understand that water changes the earth.

Time: 30-45 minutes



Preparation

1. Use the nail to make a hole at one end of the wallpaper pan near the bottom as shown in the diagram.

Procedure

1. Divide the students into six groups and assign each group to a center.
   When assigning students to groups, be cognizant of students' abilities to develop plans for their own investigations.
2. Review the Land & Water 1 procedure on page 27 of the Student Guide with the students. Instruct the students to write their hypotheses.
3. Instruct the students to proceed to their assigned centers and complete the activity, recording their observations on Land & Water 1 Observations on page 28 of the Student Guide.

DAY 9—LAND AND WATER PART 2

Materials at each of six centers: 1 wallpaper pan as a stream table, 1 pitcher, 1 bag of fine sand, 1 nail*, 300 ml of water**

Objective
To understand that water changes the earth.

Time: 30-45 minutes

1. Review the Land & Water 2 assignment on page 29 of the Student Guide with the students. Discuss variables and the scientific process with the students, as necessary.
2. Instruct each group to choose a variable and develop a plan for the investigation. Review each plan, suggest revisions as necessary, and approve each plan before allowing the investigations to begin. If any plans require additional materials, make sure those are available, such as rocks to place in the path of the water.
3. Have the students complete their investigations, recording their observations on the Land & Water 2 Observations sheet on page 30 of the Student Guide.
4. Have the groups share what they have learned with the class.

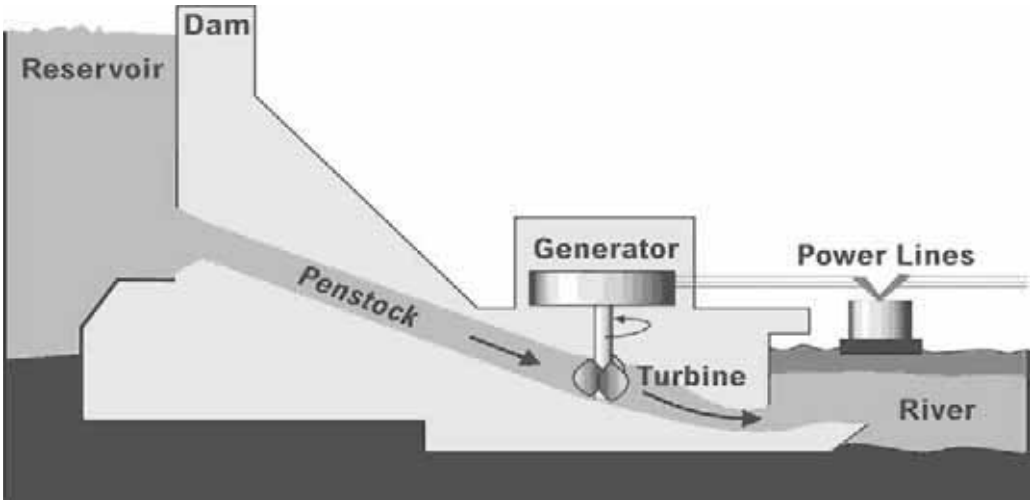
EXTENSION: Review both of the Land and Water Investigations. Ask students what they are still wondering about. Brainstorm questions with the class and have students conduct new investigations to answer their questions.

DAY 10—WATER AS AN ENERGY SOURCE

Objective
To understand that water is a source of energy.

Time: 30-45 minutes

Procedure
1. Have the students read about water as an energy source and hydropower dams on pages 14-15 of the Student Guide and add new information to their KWL Water Charts.
2. Use the Hydropower Plant Poster and facilitate a discussion of new learning and demonstrate the Science of Electricity Model again to reinforce understanding.
3. Have the students complete the Hydropower Plant activity on page 31 of the Student Guide as a way to build vocabulary. Review essential knowledge with the class and correct any misconceptions that are apparent at this time.



DAY 11—WATER CAN DO WORK

Materials for each student: 8 wood blades, 1 foam ball, 2 tall foam cups, 1 pencil, 1 30-cm piece of heavy duty thread, large paper clips, scissors*, tape*, fast-drying glue* , ruler*, source of water**

Objective

To understand that water can do work.

Time: 60 minutes

Preparation

Classroom Management: Have the students cut two wooden spoons in half creating four blades. Glue these blades to the foam balls the day before doing the first investigation. The first day should end with the students gluing additional blades onto the foam balls.

Procedure

1. Review the Moving Water Can Do Work and How Much Work Can Water Do? procedures on pages 32-33 of the Student Guide. Have the students write their predictions in their science notebooks.
2. Instruct the groups to go to their centers and complete the investigations, recording their observations in their science notebooks.
3. Have the students complete the Conclusions sections in their science notebooks with their groups.

DAY 12—FORCE OF WATER

Materials at each of six centers: 1 wallpaper pan, 1 large pushpin, 1 roll of duct tape, 1 2-liter bottle, 1 ruler*, 1 towel*, 1 marker*, source of water**

Objective

To understand how the height of water affects its force.

Time: 30 minutes

Preparation

1. Cover the holes in the wallpaper pans securely with duct tape on both the inside and outside of the pans so they will not leak.
2. Set up six centers with the materials listed.
3. Divide the students into six groups.

Procedure

1. Review the Height & Force of Water procedure on page 40 of the Student Guide with the students. Have the students write their predictions in their science notebooks.
2. Instruct the groups to go to their centers and complete their investigations and recording their data. Instruct the students to calculate the averages for each height and complete the Conclusion in their groups.
3. Have the students complete the Hydropower Plants on page 31 of the Student Guide as an assessment of student understanding. Review essential knowledge with the class and correct any misconceptions that are apparent at this time.

DAY 13—ADVANTAGES AND CHALLENGES OF HYDROPOWER

Objective

To understand the advantages and disadvantages of hydropower to generate electricity.

Time: 30 minutes

Procedure

1. Have the students read about the advantages and challenges of hydropower on page 16 of the Student Guide and add new information to their KWL Water Charts.

2. Have the students complete Advantages & Challenges on page 35 of the Student Guide.
3. Make copies of the story, They're Damming The River on pages 19-20 of the TeacherGuide. Have the students write a personal response to the story.

   LANGUAGE ARTS EXTENSION: Have the class illustrate the story and make a book for primary students.
4. Facilitate a discussion of the advantages and disadvantages of using hydropower to generate electricity and how all sources of energy have advantages and disadvantages—some cause air pollution, some are very expensive, some damage the earth when they are extracted. Use NEED's Energy Infobook as a resource.

DAY 14—FUTURE OF HYDROPOWER

Objective

To understand new technologies for increasing electricity generation at existing dams and some emerging technologies for capturing ocean energy.

Time: 30 minutes

Procedure

1. Have the students read about new technologies for generating hydropower on pages 17-19 of the Student Guide and add new information to their KWL Water Charts.
2. Have the students complete Future of Hydropower on page 36 of the Student Guide.
3. Facilitate a discussion of emerging technologies in hydropower.

EVALUATION

Materials: Copies of the Hydropower Survey

1. Have the students take the Hydropower Survey on page 21 as a post-unit evaluation.
2. Evaluate the unit with the students using the Evaluation Form on page 22 and return to NEED.

SURVEY ANSWER KEY

1. a 2. b 3. c 4. a 5. c 6. b 7. c 8. b 9. a 10. a

SCIENCE OF ELECTRICITY MODEL

Materials *(the materials marked with asterisks are not in the kit)*:

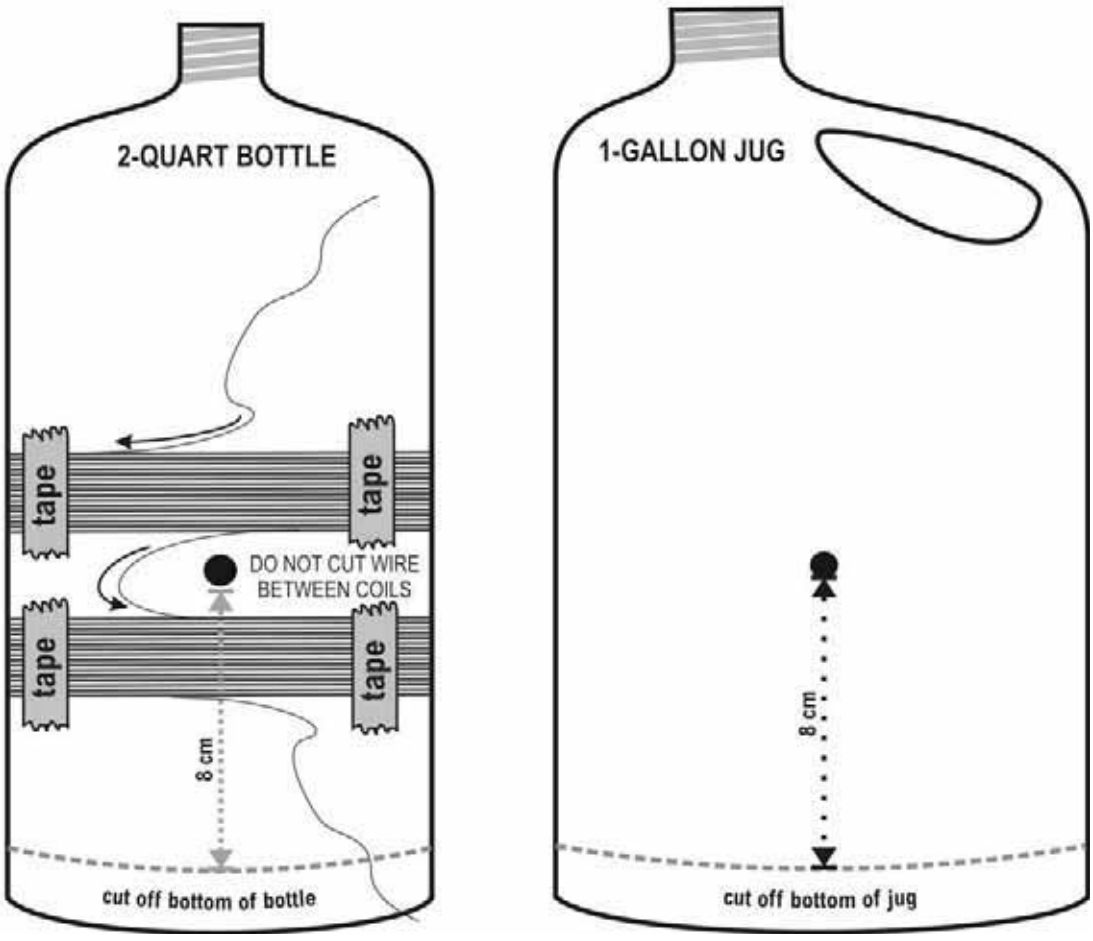
1 gallon plastic jug with handle
1 piece styrofoam (2 cm)
1 piece of plastic tubing (15 cm)
tape*
marker*
1 2-quart plastic bottle
8 wooden blades
4 pieces of wood for magnets
1 glue*
1 fine sandpaper*
1 wooden dowel (12")
4 rectangle magnets
1 sharp-pointed scissors*
1 nail*

Instructions for 2-quart Bottle:

1. Cut the bottom off the bottle.
2. Measure 8 cm from the bottom of the bottle and cut a hole big enough for the dowel to fit through easily with extra room.
3. Make another hole in the same location on the opposite side of the bottle.
4. Above the hole, wrap the wire 100 times around the bottle, leaving 10 cm of wire at the starting end.
5. Tape the coil of wire to the bottle, but DO NOT CUT IT from the spool.
6. Below the hole, wrap the wire in the OPPOSITE direction 100 times around the bottle.
7. Leave 10 cm of wire at the end in the same location as the extra wire above the hole and cut the wire.
8. Tape the coil of wire to the bottle, leaving the end free.
9. Use fine sandpaper to gently rub the coating from the ends of both wires to a distance of 1 centimeter.

Instructions for 1-gallon Jug:

1. Cut the bottom off the jug.
2. Measure 8 cm from the bottom of the jug and cut a hole big enough for the dowel with extra room.
3. Make another hole in the same location on the opposite side of the jug.



SCIENCE OF ELECTRICITY MAGNET ASSEMBLY

Diagram 1

Stacked Magnets End View

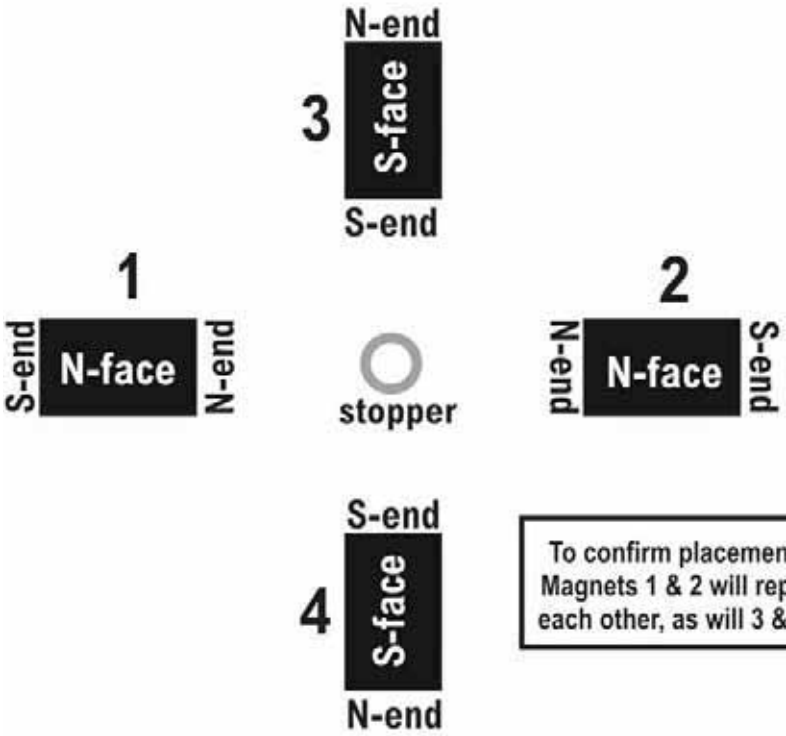
1. While stacked, mark one end of each of the stacked magnets with a permanent marker to indicate the N-end as shown in Diagram 1.

Diagram 2

Stacked Magnets Top View

2. Mark the top face of each stacked magnet with an N using a permanent marker in turn as you remove the magnets from the top one at a time and place around the tubing in the configuration below left. Make sure you place the magnets at a distance. The unmarked faces and ends of the magnets will indicate the S poles.

Diagram 3



OVERHEAD VIEWS OF MAGNET ASSEMBLY

To confirm placement, Magnets 1 & 2 will repel each other, as will 3 & 4.

Diagram 4

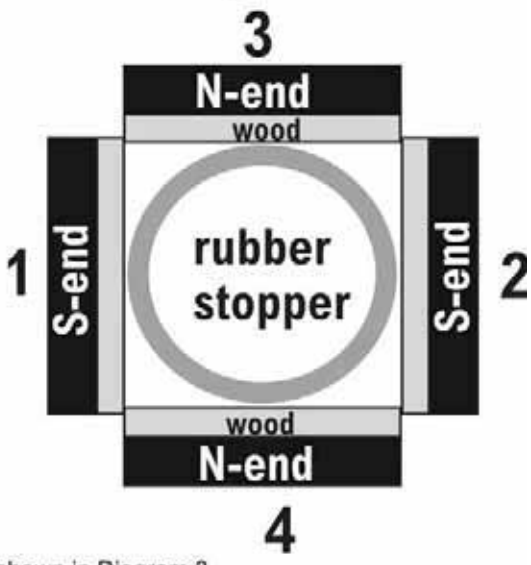


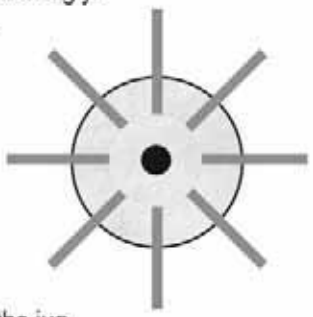
Diagram 5

3. Mark the magnets as explained in Steps 1 & 2 and place them in the configuration shown in Diagram 3.
4. Glue a piece of wood to the top faces of the magnets. Allow to dry. Remark the top N faces on the wood.
5. Place the dowel through the rubber stopper to stabilize the stopper. Hold the dowel and stopper upright.
6. Place a thick bead of glue the length of the magnet on the wood piece as shown in Diagram 5.
7. Lift the S-end of Magnet 1 to a vertical position and glue to the stopper, holding it firmly in place until the glue is set.
8. Glue Magnets 2, then 3, then 4 to the stopper one at a time following the same procedure. The finished magnet assembly should be configured as shown in Diagram 4.

SCIENCE OF ELECTRICITY MODEL ASSEMBLY

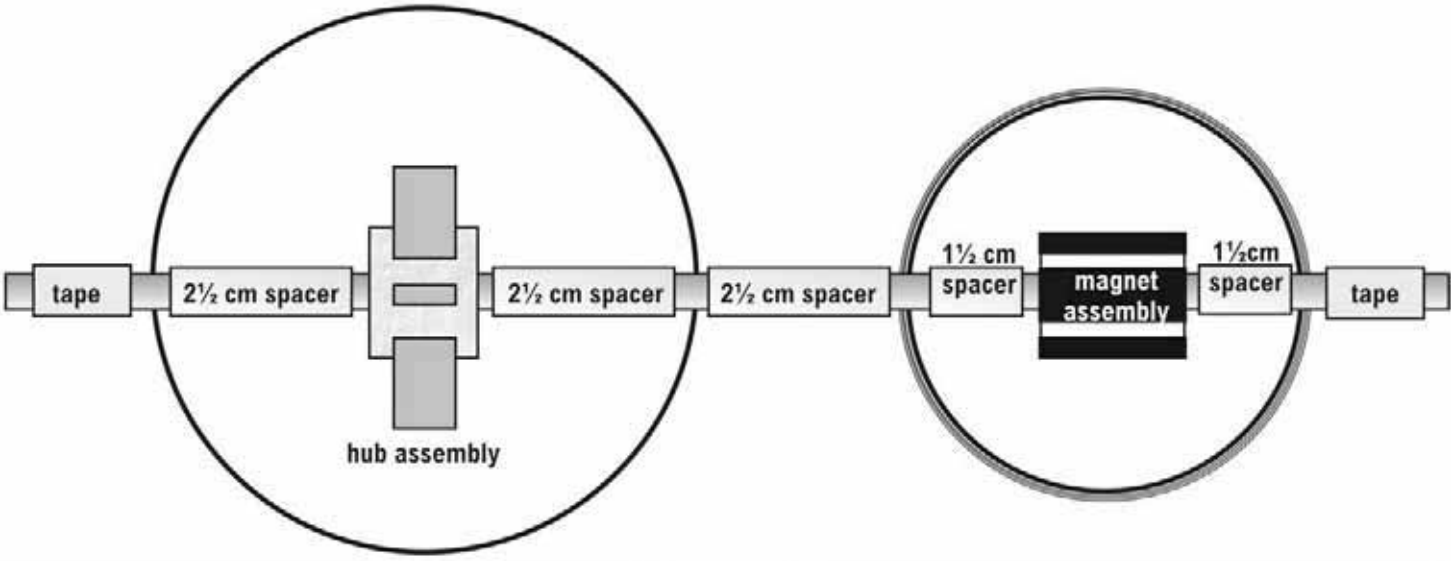
Instructions for Hub:

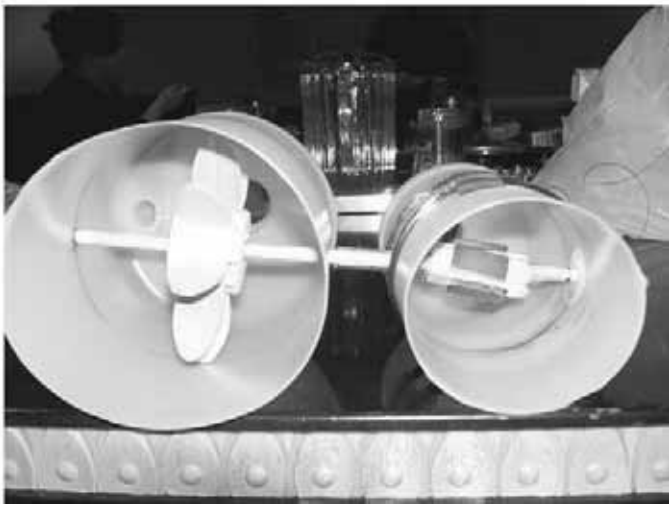
1. Cut a 2 cm piece of styrofoam for the hub.
2. Make a hole in the middle of the styrofoam with a nail. Insert the dowel into the hole and make sure it fits snugly.
3. Cut the blades in half and evenly space eight blades around the hub. Use glue to reinforce the blades.
4. Remove the hub from the dowel.



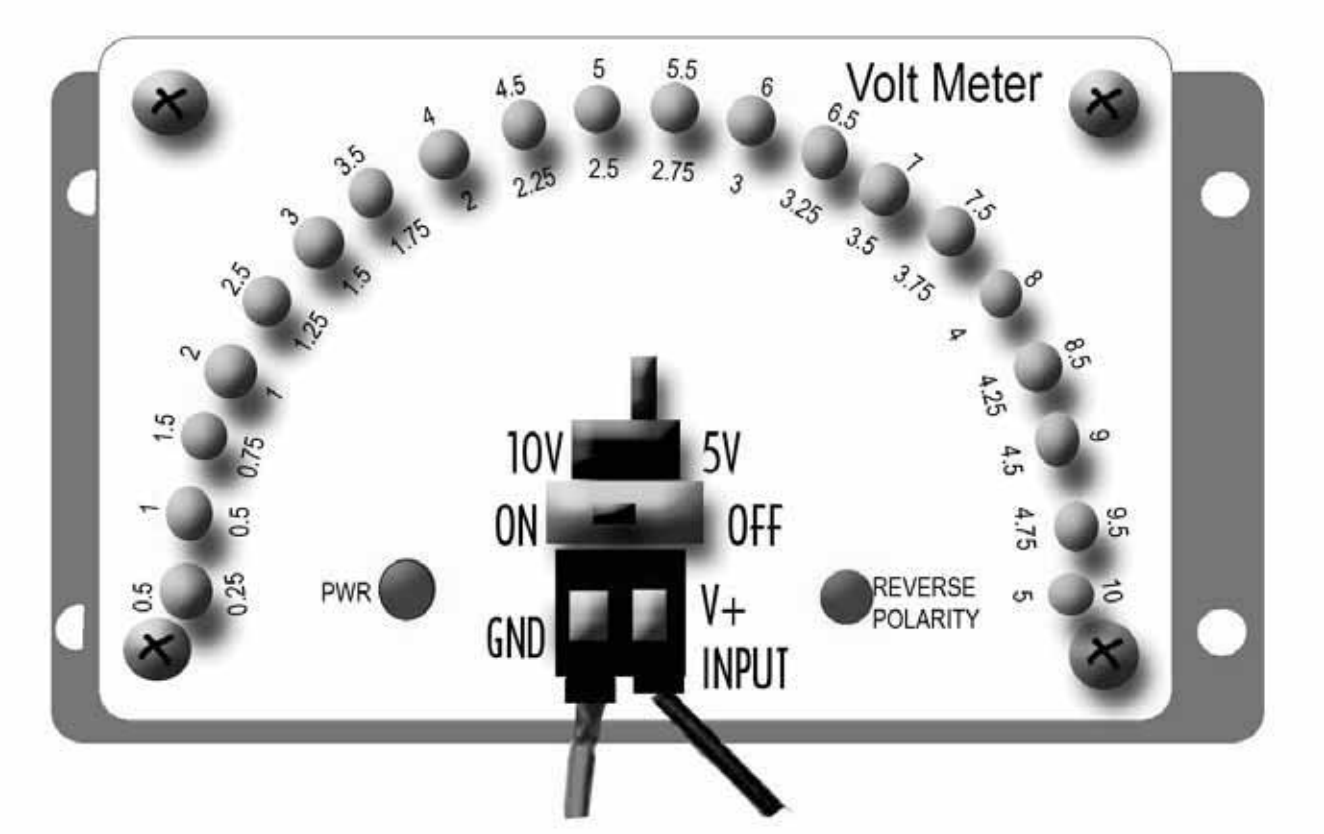
Model Assembly:

1. Cut three 2.5 cm and two 1.5 cm pieces of plastic tubing.
2. Wrap tape around one end of the dowel so that it will not fit through the holes in the jug.
3. Slide the other end of the dowel through one hole in the jug.
4. Inside the jug, slide a 2.5 cm spacer onto the dowel.
5. Slide the hub onto the dowel, then another 2.5 cm spacer. Insert the dowel through the second hole in the jug.
6. Slide the dowel through a 2.5 cm spacer, then through one hole in the plastic bottle.
7. Slide the dowel through a 1.5 cm spacer inside the bottle, through the magnet assembly, through a 1.5 cm spacer and out the hole.
8. Wrap tape around the end of the dowel to prevent the dowel from sliding out of the bottle.
9. Arrange the hub on the dowel in the exact center of the jug.
   If it does not fit on the dowel snugly, glue it to the dowel in the center of the jug. Do the same for the magnet assembly in the bottle.
10. Adjust all components until the dowel spins freely inside the jug and the bottle.
11. Attach the leads of the multimeter to the ends of the wires using the alligator clips.





VOLTMETER DIRECTIONS



Directions:

1. Switch the tab over to 5V.

2. Press down on the “GND” button. Insert one end of the copper wire into the hole on the bottom. Release the button to secure the wire in place.

3. Repeat step two with the other wire on the “V+ Input” side.

4. Turn the volt meter on.

5. Place the Science of Electricity hub under water. The lights on the volt meter will light indicating how much electricity is being generated.

*If the “Reverse Polarity” light flashes switch the wires in the “GND” and “V+ Input” locations.

THE TALE OF ANNIE SOAKLEY

I'm Annie Soakley. I am a world traveler. Let me tell you about my last trip. It began in the Pacific Ocean. I was floating in the waves with my friends. We were bobbing up and down, watching the sun rise over the mountains. What a beautiful sight!

The sun climbed higher in the sky. I began to get warm. I got warmer and warmer. Suddenly, I rose out of the water. I floated toward the sky. I grew bigger. My molecules got farther and farther apart. I expanded.

I didn't look like a drop of water anymore. I was invisible. I had turned into water vapor. I had evaporated! I rose high into the sky. Many of my friends came with me. They had evaporated, too. Together, we formed clouds.

The wind pushed us through the sky. We sailed over the ocean toward land. The people on the beach were sad to see us. We blocked the sun.

We passed over them and headed for the mountains. The wind kept pushing us. We reached the mountains as the sun set. The air over the mountains was cold. It made me cold. As I cooled, I grew smaller. My molecules got closer together. I turned into a drop of water again. I condensed.

I was too heavy for the cloud to hold me. I began falling toward the earth. I was a rain drop! My friends condensed, too. As we fell through the air, we got colder and colder. Our molecules got closer together. We froze and became snowflakes! We all looked different and beautiful!

We fell on top of a tall mountain. When the wind pushed the clouds away, the sun came out. We began to get warmer. Our molecules pushed away from each other as they absorbed energy. We finally melted and began to trickle down the mountain. Gravity was pulling us down.

Soon, other drops of water joined us and we turned into a small creek. As we flowed down the mountain, more creeks joined us and we grew. We turned into a roaring river. We were moving very fast. We had a lot of energy.

Gradually, the land became flatter and we stopped moving so quickly. We flowed more slowly through farms and towns. Other rivers joined us until we turned into one big, wide river.

Boats and barges floated on top of us. Fish and other living things swam through us. Plants grew from our riverbed. Animals came down to our banks and drank from us.

We just kept flowing through it all, pulled by gravity. Finally, we reached the ocean. I floated out into the waves, glad to be home again. It had been an exciting trip through the water cycle.

THEY'RE DAMMING THE RIVER

Billy ran into the house, yelling, "Mom! Mom! Where are you, Mom?" He looked all around their little cabin, but his mother wasn't there. He found a note on the kitchen table. It said:

> Billy, I went to town with Grampa. I'll be back after supper. There is a sandwich in the refrigerator. Please do your homework before you go fishing. I love you.

"Shucks!" said Billy with a sigh, "That's three hours from now."

Billy wasn't hungry, but he ate his sandwich anyway, then wandered aimlessly around the cabin. Finally, he reached for his fishing pole behind the door. He had homework to finish, but he was too upset to read anything. He headed down the path to the fishing hole.

He climbed out on the low branch of his sycamore tree and dangled his feet in the water. This was his favorite place in the world, the place he came whenever he needed to be alone to think. He'd spent all last summer here after his dog, Petey, had died. Now he needed to think about the story he'd heard at school today.

As the sun went down, he slowly reeled in his line. He realized he hadn't even checked the bait the whole evening. He'd had too much on his mind. As he walked back up the path, he heard his Grampa's old 1935 Ford coming up the hill. He ran to meet his mother as she waved a thank you to her dad.

When he saw her face, he knew that she'd heard the story, too. "Mom, is it true? Are we really going to have to move?"

"Oh, Billy!" she said and pulled him close to her. "I'm so sorry!"

They stood silent, their tears shining in the moonlight. Finally his mother shook herself and said, "Let's go inside and have some hot chocolate. I'll tell you all about it."

"Mom, we have to do something. We can't just let them take this all away. Please, Mom, can't we stop them?"

The lights in the cabin flickered off and on. Billy quickly lit the kerosene lantern that they kept on the table.

“See those lights, Billy? That’s why. Everybody wants electricity—they want radios and refrigerators, all kinds of new things that run on electricity. That’s what the meeting was about in town tonight—building a dam to make enough power for everybody in the valley.”

“I know that, Mom. But why here? Why can’t they build it someplace else?”

“They’ve studied the whole river valley, Billy. They showed us the maps tonight. This is the best place. There’s always lots of water in the river here and the valley is shaped right.”

“But we’ll have to move. I love this place.”

“There isn’t one place on this river, Billy, where there isn’t a boy just like you who’s got a special place. Most of the towns in the valley are right on the river. You know that. This is the only place where a whole town won’t have to be moved.”

“Mom, isn’t there any other way to make electricity?” asked Billy.

“Yes, some places burn coal. The people at the meeting say the dam will be a lot cheaper and cleaner, though.”

Billy’s mom put her arm around his shoulder and said, “I don’t want to move either, Billy. But the dam will mean new industry. I’ll be able to get a job. They’ll pay us good money for this place, too. Enough to buy a nice house with a refrigerator and our own car.”

“This river is my life, Mom. What’ll I do without it?” asked Billy.

“Billy, the river isn’t going to disappear. They’re going to dam it up and make a big lake, but the river below the dam and above the lake will still be there. And the lake will be a great place to fish and swim. I won’t take you away from the water, Billy. I promise. Maybe we can get a new place right on the lake.”

Billy was quiet for a moment, then asked, “How does damming the river make electricity, anyway?”

“There will be big turbines and generators at the bottom of the dam to make the electricity. It takes a lot of force to spin the turbines, so they dam the river to raise the water level. The bigger the distance between the water level and the turbines, the larger the force of the water. The dam will have gates in it to let the water flow into big pipes that channel the water to the turbines. They say it’s a sight to see.”

Billy smiled for the first time that day. “They ought to hire you, Mom, to do their talking for them.”

“Oh, Billy,” she said, “I know this is gonna be hard. I just figure we should look for the good in things rather than the bad. Let’s take our hot chocolate down to the river and sit awhile.”

HYDROPOWER SURVEY

1. The ability to do work is …
   a. energy b. electricity c. a job

2. Most of the energy we use in the United States comes from…
   a. renewable energy sources b. nonrenewable energy sources

3. The movement of electrons in a circuit is …
   a. energy b. lightning c. electricity

4. When water vapor turns into liquid water, the process is …
   a. condensation b. evaporation c. melting

5. Snow and rain are …
   a. condensation b. climate c. precipitation

6. The movement of water between the surface of the earth and the atmosphere is called …
   a. precipitation b. the water cycle c. gas

7. A dam can …
   a. control flooding b. make electricity c. both a and b

8. Harnessing the energy of moving water is called …
   a. water wheel b. hydropower c. electricity

9. A device that uses magnets and coils of wire to make electricity is a(n) …
   a. generator b. turbine c. engine

10. Hydropower is a …
    a. renewable energy source b. nonrenewable energy source

WONDERS OF WATER

Evaluation Form

State: _____ Grade Level: _____ Number of Students: _____

1. Did you conduct all of the activities?	Yes	No
2. Were the instructions clear and easy to follow?	Yes	No
3. Did the activities meet your academic objectives?	Yes	No
4. Were the activities age appropriate?	Yes	No
5. Were the allotted times sufficient to conduct the activities?	Yes	No
6. Were the materials easy to use?	Yes	No
7. Was the preparation required acceptable for the activities?	Yes	No
8. Were the students interested and motivated?	Yes	No
9. Was the energy knowledge content age appropriate?	Yes	No
10. Would you use the activities again?	Yes	No

How would you rate the activities overall (excellent, good, fair, poor)?

How would your students rate the activities overall (excellent, good, fair, poor)?

What would make the activities more useful to you?

Other Comments:

Please fax or mail to:

NEED Project
PO Box 10101
Manassas, VA 20108
FAX: 1-800-847-1820

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