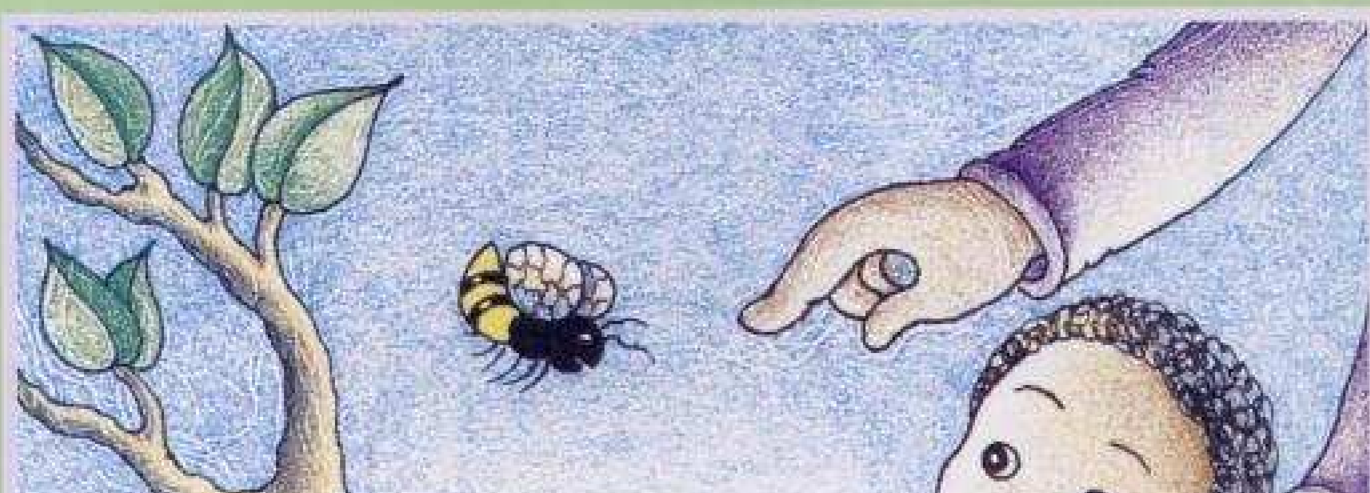
Helping Your Child



Learn Science

NAGC

National Association of
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1992 Blue Pencil Award Winner

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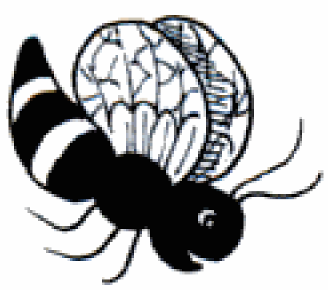
1992 DISTINGUISHED
ACHIEVEMENT AWARD WINNER

Helping Your Child Learn Science



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Foreword

"Why?"

This is the question we parents are always trying to answer. It's good that children ask questions: that's the best way to learn. All children have two wonderful resources for learning—imagination and curiosity. As a parent, you can awaken your children to the joy of learning by encouraging their imagination and curiosity.

Helping Your Child Learn Science is one in a series of books on different education topics intended to help you make the most of your child's natural curiosity. Teaching and learning are not mysteries that can only happen in school. They also happen when parents and children do simple things together.

For instance, you and your child can: sort the socks on laundry day—sorting is a major function in math and science; cook a meal together—cooking involves not only math and science, but good health as well; tell and read each other stories—storytelling is the basis for reading and writing (and a story about the past is also history); or play a game of hopscotch together—playing physical games will help your child learn to count and start on a road to lifelong fitness.

By doing things together, you will show that learning is fun and important. You will be encouraging your child to study, learn, and stay in school.

All of the books in this series tie in with the **National Education Goals** set by the President and the Governors. The goals state that, by the year 2000: every child will start school ready to learn; at least 90 percent of all students will graduate from high school; each American student will leave the 4th, 8th, and 12th grades demonstrating competence in core subjects; U.S. students will be first in the world in math and science achievement; every American adult will be literate, will have the skills necessary to compete in a global economy, and will be able to exercise the rights and responsibilities of citizenship; and American schools will be liberated from drugs and violence so they can focus on learning.

This book is a way for you to help meet these goals. It will give you a short rundown on facts, but the biggest part of the book is made up of simple, fun activities for you and your child to do together. Your child may even beg you to do them. At the end of the book is a list of resources, so you can continue the fun.

As U.S. Education Secretary Lamar Alexander has said:

> *The first teachers are the parents, both by example and conversation. But don't think of it as teaching. Think of it as fun.*

So, let's get started. I invite you to find an activity in this book and try it.

Diane Ravitch
Assistant Secretary and
Counselor to the Secretary

Contents

Introduction

Why is the sky blue?
Why do things fall to the ground?
How do seeds grow?
What makes sound and music?
Where do mountains come from?

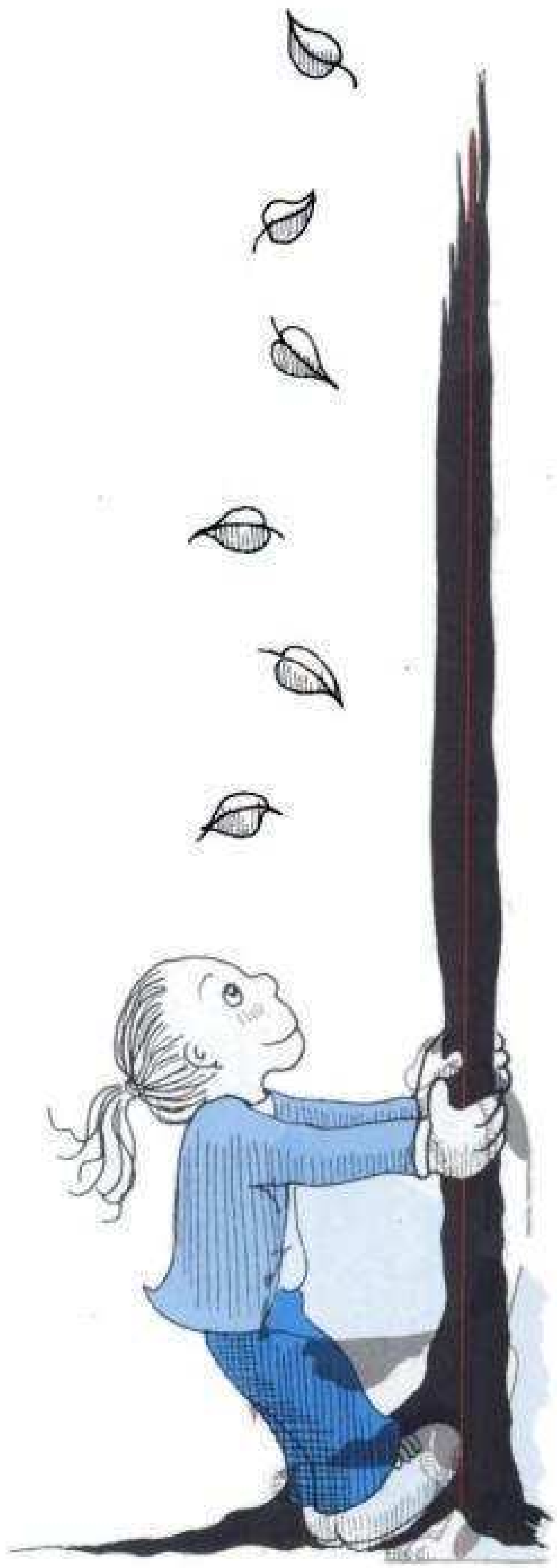
Young children ask their parents hundreds of questions like these. In search of answers, we use science to both enlighten and delight.

As parents, we must prepare our children for a world vastly different from the one in which we grew up. In the next century, this country will need citizens with more training in science and technology than most of us had in school.

Even children who don't want to be scientists, engineers, or computer technicians will need science to cope with their rapidly changing environment. But without our help, our children will not be prepared for these changes.

This book suggests ways you can interest your children from about 3 to 10 years old in science. It includes:

- Some basic information about science;
- A sampling of activities for children to do —some alone, some with supervision—in both the home and the community; and
- An appendix with practical tips on how to encourage schools to develop good science programs, a brief description of nine scientific concepts, and a list of recommended science books and magazines.



Many of the activities cost little or nothing and require no special equipment.

Science Starts at Home

We play a crucial role in determining how much science our children learn. Our enthusiasm and encouragement can spark their interest. Fortunately, youngsters of all ages are curious and love to investigate. And the earlier we encourage this curiosity, the better.

Scientific knowledge is cumulative, so children need to start learning early—at home. Many of us assume that children will learn all the science they need at school. The fact is that most children, particularly in elementary school, are taught very little science.

How You Can Help

As parents, we don't have to have a strong background in science to help our children learn science. What's far more important than knowing what sound is or how a telescope works, is having a positive attitude about science.

Every day is filled with opportunities to learn science—without expensive chemistry sets or books. Children can easily be introduced to the natural world and encouraged to observe what goes on around them.

Together, parents and children can—

- See how long it takes for a dandelion or a rose to burst into full bloom; or
- Watch the moon as it appears to change shape over the course of a month, and record the changes; or
- Watch a kitten grow into a cat.

- Bake a cake;
- Guess why one of your plants is drooping; or
- Figure out how the spin cycle of the washing machine gets the water out of the clothes.

Learning to observe objects carefully is an important step leading to scientific explanations. Experiencing the world together and exchanging information about what we see are important, too.

A nasty head cold can even be turned into a chance to learn science. We can point out that there is no known cure for a cold, but that we do know how diseases are passed from person to person. Or we can teach some ways to stay healthy—such as washing our hands, not sharing forks, spoons, or glasses, and covering our nose and mouth when we sneeze or cough.

Questioning and Listening

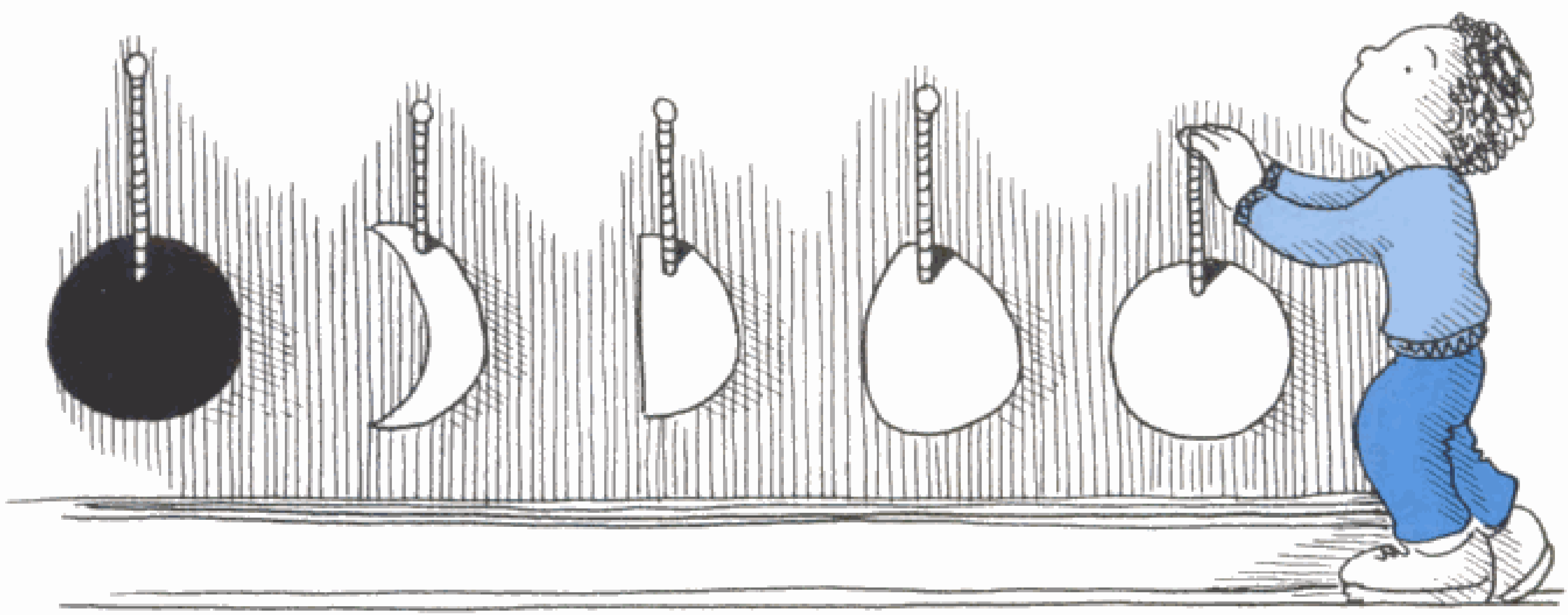
We should encourage our children to ask questions. A friend once asked Isidor I. Rabi, a Nobel prize winner in physics, "Why did you become a scientist, rather than a doctor or lawyer or businessman, like the other immigrant kids in your neighborhood?" Rabi responded:

> *My mother made me a scientist without ever intending it. Every other Jewish mother in Brooklyn would ask her child after school: "So? Did you learn anything today?" But not my mother. She always asked me a different question. "Izzy," she would say, "did you ask a good question today?" That difference—asking good questions—made me become a scientist!*

If we can't answer all of our children's questions, that's all right—no one has all the answers, even scientists. And children don't need lengthy, detailed answers to all of their questions. We can propose answers, test them out, and check them with someone else. The library, or even the dictionary, can help answer questions.

We can also encourage our children to tell us their ideas and listen to their explanations. Being listened to will help them to gain confidence in their thinking and to develop their skills and interest in science. Listening helps us to determine just what children know and don't know. (It also helps the child figure out what he or she knows.)

Simple activities can help to demystify science—and we will suggest some of these later. But children also need to learn some basic information about science and about how to think scientifically. The following section contains information for parents that can point our children toward this goal.



Watch the moon. . . and record the changes

The Basics

What Is Science?

Science is not just a collection of facts. Facts *are* a part of science. We all need to know some basic scientific information: water freezes at 32 degrees Fahrenheit (or 0 degrees celsius), and the earth moves around the sun. But science is much more. It includes:

- Observing what's happening;
- Predicting what *might* happen;
- Testing predictions under controlled conditions to see if they are correct; and
- Trying to make sense of our observations.

Science fiction writer Isaac Asimov describes science as "a way of thinking," a way to look at the world.

Science also involves trial and error—trying, failing, and trying again. Science does *not* provide all the answers. It requires us to be skeptical so that our scientific "conclusions" can be modified or changed altogether as we make new discoveries.

Children Have Their Own Ideas

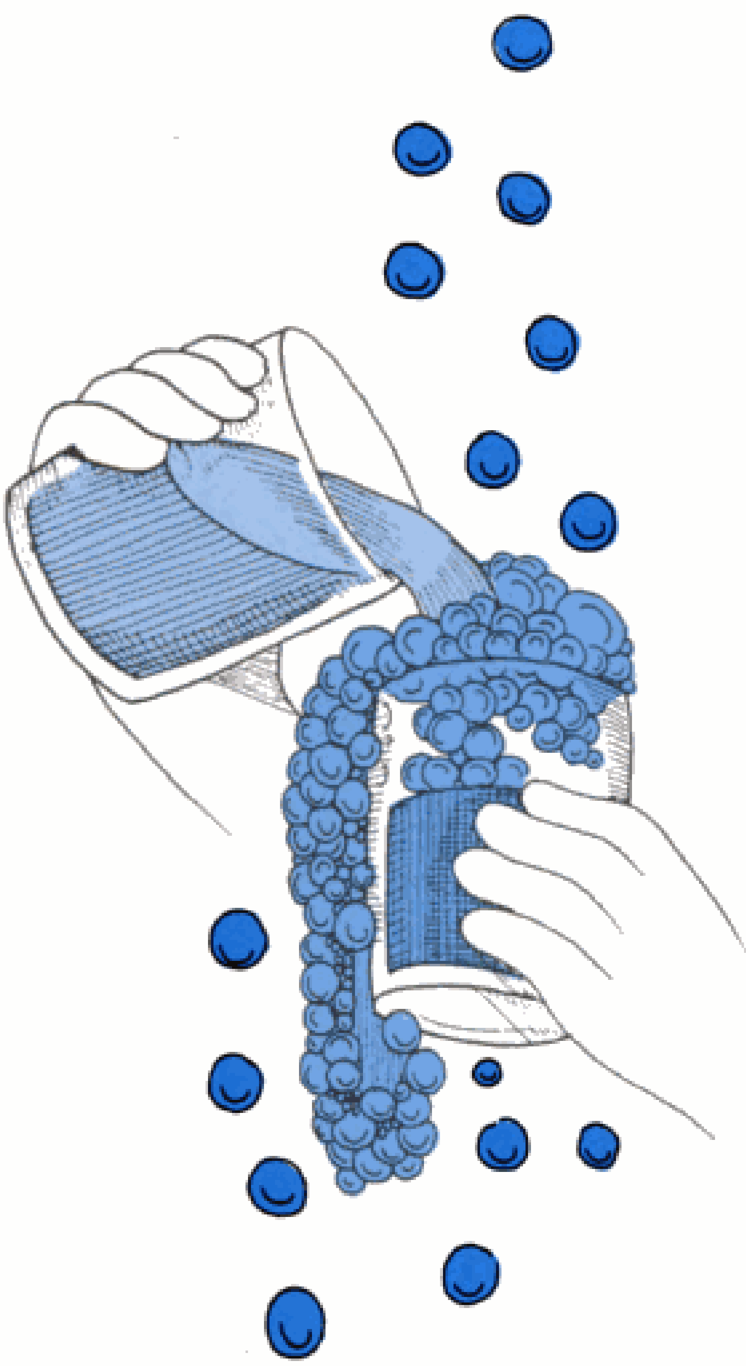
Children develop their own ideas about the physical world, ideas that reflect their special perspectives. Below are some perceptions from some sixth grade students:

> *"Fossils are bones that animals are through wearing."*

"Some people can tell what time it is by looking at the sun, but I have never been able to make out the numbers."

"Gravity is stronger on the earth than on the moon because here on earth we have a bigger mess."

"A blizzard is when it snows sideways."



Children's experiences help them form their ideas, and these often don't match current scientific interpretations. We need to allow our children to ask questions and make mistakes without feeling "stupid."

We can help our children look at things in new ways. For instance, in regard to the blizzard, we could ask: "Have you ever seen it snow sideways? What do you think causes it to move sideways sometimes?"

Hands-On Works Best

Children, especially younger ones, learn science best and understand scientific ideas better if they are able to investigate and experiment. Hands-on science can also help children think critically and gain confidence in their own ability to solve problems. Some science teachers have explained it this way:

What engages very young children? Things they can see, touch, manipulate, modify; situations that allow them to figure out what happens—in short, events and puzzles that they can investigate, which is the very stuff of science.

But, hands-on science can be messy and time consuming. So, before you get started, see what is involved in an activity—including how long it will take.

Less Is More

It's tempting to try to teach our children just a little about many different subjects.

While youngsters can't possibly learn everything about science, they do need and will want to learn many facts. But the best way to help them learn to think scientifically is to introduce them to just a few topics in depth.

Finding the Right Activity for Your Child

Different children have different interests and need different science projects. A sand and rock collection that was a big hit with an 8-year-old daughter may not be a big hit with a 6-year-old son.

Fortunately, all types of children can find plenty of projects that are fun. If your child loves to cook, let him or her observe how sugar melts into caramel syrup or how vinegar curdles milk.

Knowing our children is the best way to find suitable activities. Here are some tips:

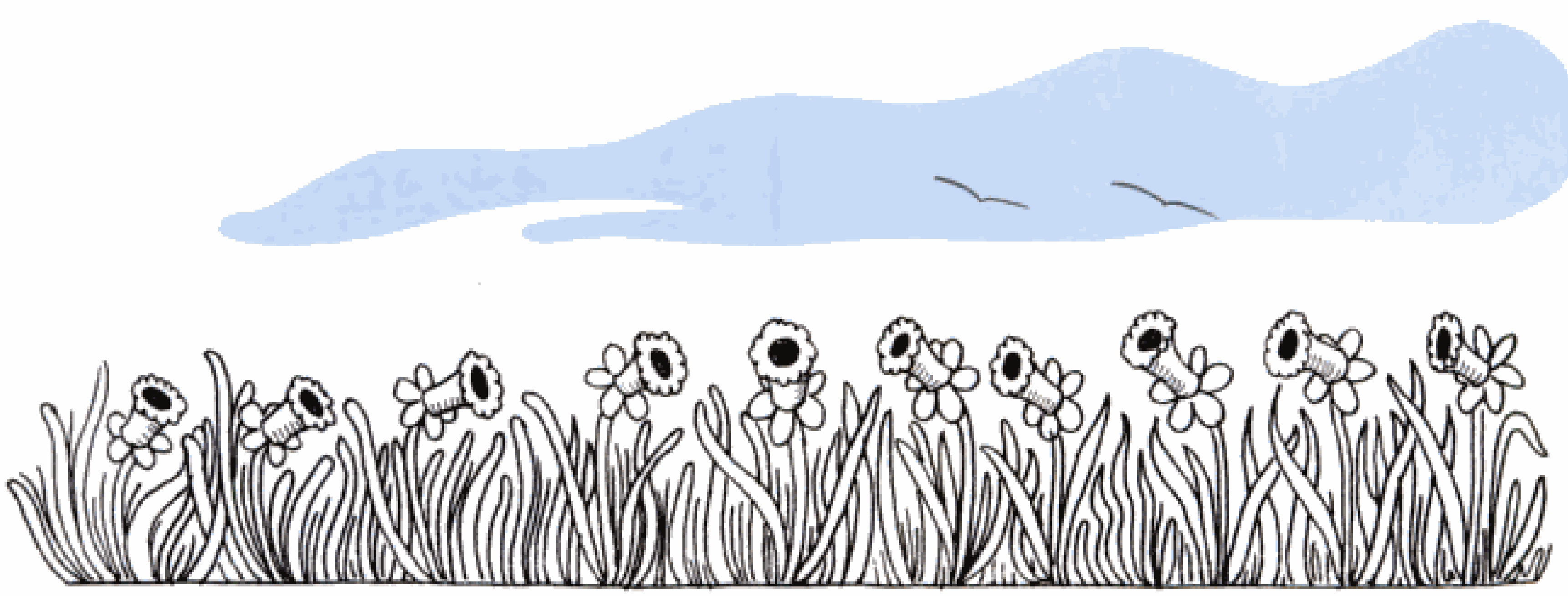
- Encourage activities that are neither too hard nor too easy. If in doubt, err on the easy side since something too difficult may give the idea that science itself is too hard.

- Age suggestions on book jackets or toy containers are just that—suggestions. They may not reflect the interest or ability of your child. A child who is interested in a subject can often handle material for a higher age group, while a child who isn't interested in or hasn't been exposed to the subject may need to start with something for a younger age group.

- Consider a child's personality and social habits. Some projects are best done alone, others in a group; some require help, others require little or no supervision. Solitary activities may bore some, while group projects may frighten others.

- Select activities appropriate for the child's environment. A brightly lighted city isn't the best place for star-gazing, for example.

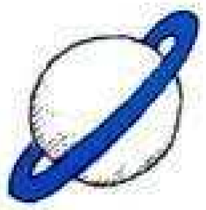
- Allow your children to help select the activities. If you don't know whether Sarah would rather collect shells or plant daffodils, ask her. When she picks something she wants to do, she'll learn more and have a better time doing it.



Important Things To Learn

Basic Concepts

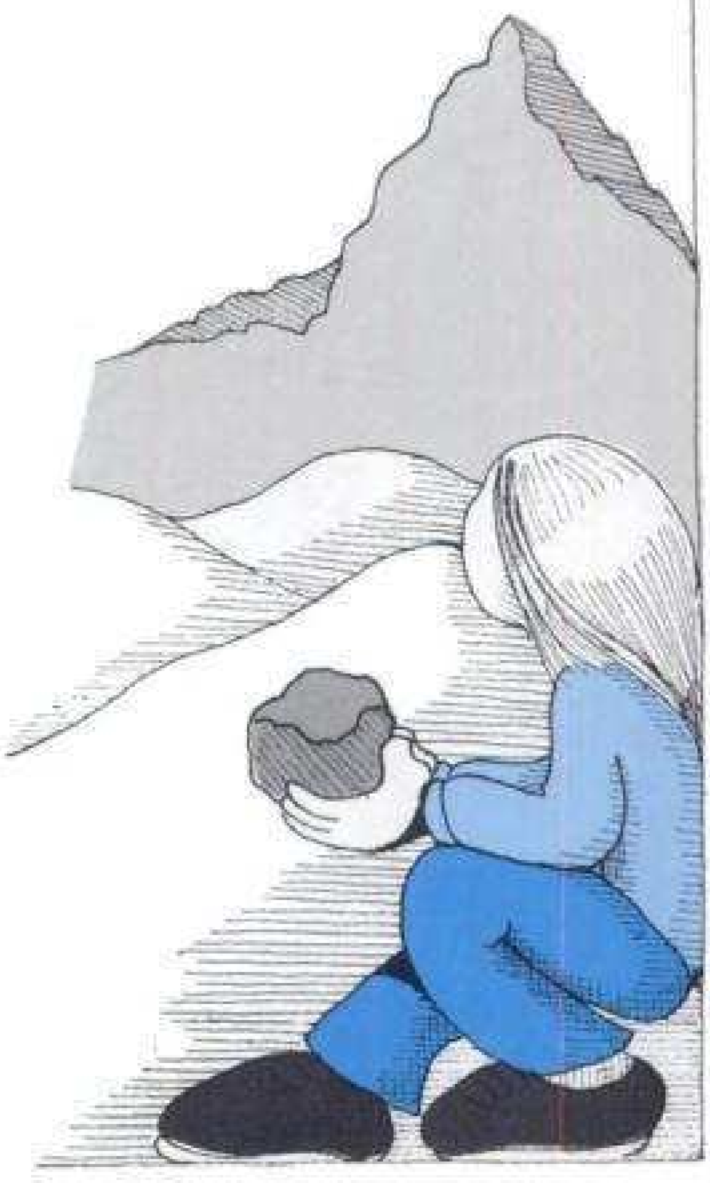
Elementary school children can be introduced gradually to nine basic scientific concepts—ones that all scientists learn. These concepts are listed at the end of this handbook. The concepts provide a framework into which scientific facts can be placed.



We will introduce three of these concepts (in this section) that you can easily introduce to your children at home or in the community. The activities described in the next two sections of this book are based on these concepts, as are many other simple science-related projects.

1. Organization

Scientists like to find patterns and classify natural occurrences. We can encourage our children to think about objects according to their size or color—for instance, rocks, hills, mountains, and planets. Or they can observe leaves or insects and group the ones that are similar.



2. Change

The natural world changes continually. Some objects change rapidly; some at a rate too slow to observe. We can encourage our children to look for changes in things:

- What happens to breakfast cereal when we pour milk on it?
- What happens over time when a plant isn't watered or exposed to proper sunlight?

- What changes can be reversed? Once water is turned into ice cubes, can it be turned back into water? Yes. But if an apple is cut into slices, can the slices be changed back into the whole apple?

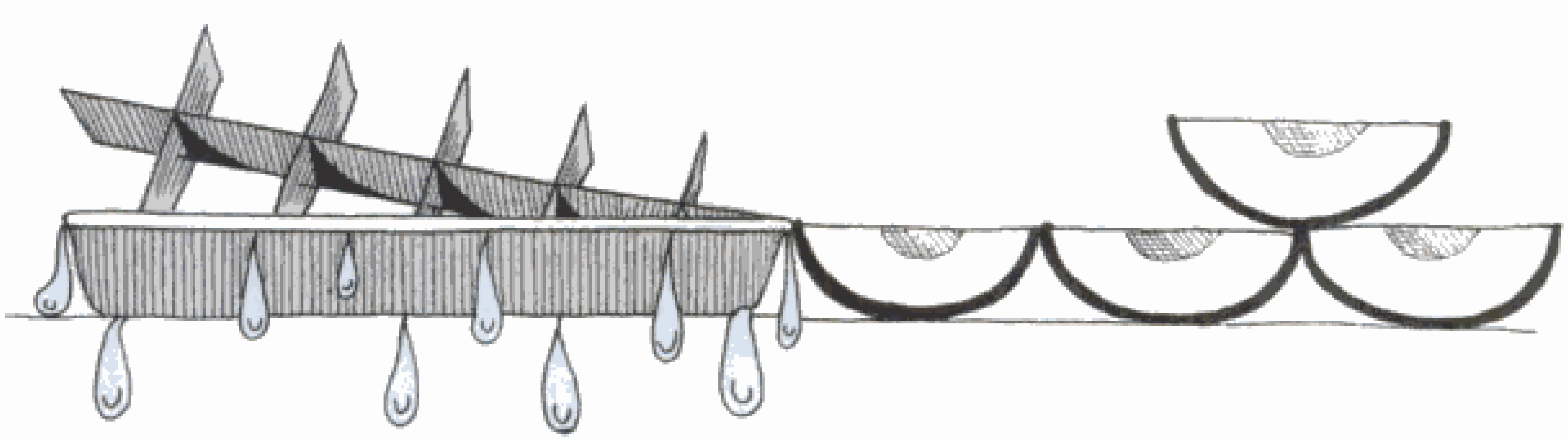
3. Diversity

Even very young children know that there are many *kinds* of objects. One thing to do is help your child explore and investigate a pond. Within and around a single pond (depending on the size and location of the pond), there may be tremendous diversity: insects, birds, fish, frogs, turtles, other water creatures, and maybe some mammals. Looking at a pond is a great way to learn about the habits, life cycles, and feeding patterns of different organisms.

Integrity

The early years of elementary school are a good time to start teaching children scientific ethics. We should tell them how important it is to be accurate about their observations. They need to know it's all right to make mistakes—we all make mistakes, and we can learn from them. But explain that important discoveries are made only if we are willing and able to correct our mistakes.

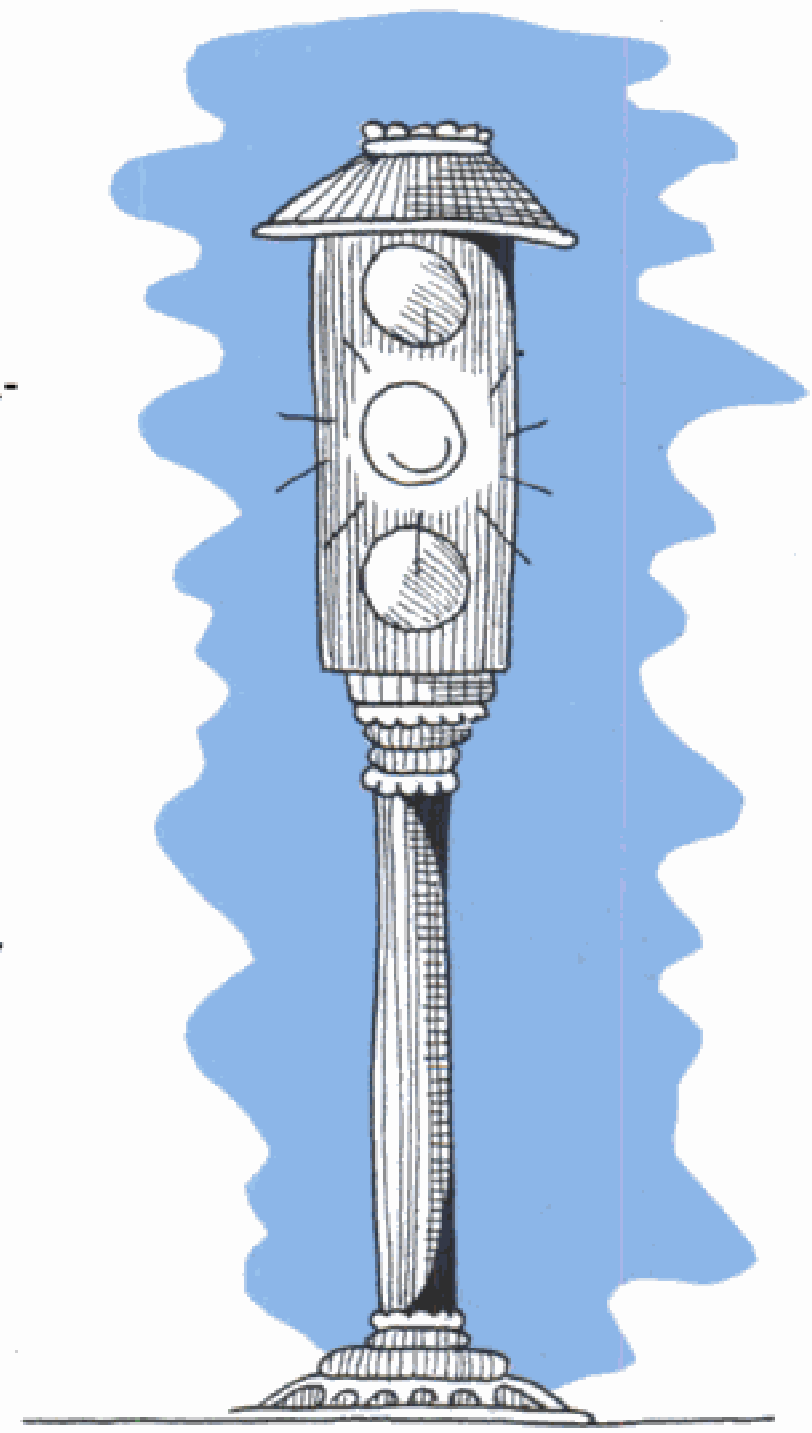
Help your children understand that we can't always take someone else's word for something. That's why it's important to find out for ourselves.



Activities at Home

This section contains a sampling of science activities—organized roughly from easiest to most difficult—suitable for children from preschool through the early elementary grades. In a box near the end of each activity are a few facts and explanations for those who want them. But exploring, questioning, and having a good time is more important than memorizing facts. And, although your children may be able to do the following activities alone, we encourage you to join them.

Grown-Up Alert!



The activities in this book are safe with the appropriate supervision. Some require help from an adult. Others can be carried out by children alone, if they are old enough. Look in the instructions for the **Grown-up alert!** It will highlight an activity that may need supervision. Be sure your children who can read know which activities you do not want them to try by themselves.

Young children may not fully understand that bad things can happen to them. We don't want to scare our children away from science, but we must:

- Provide supervision when it is appropriate—for example, when using heat or mixing chemicals;
- Teach children not to taste anything unless they know it is good for them and is sanitary;
- Insist children wear goggles whenever fire or splatter could endanger eyes;
- Teach children to follow warnings on manufacturers' labels and instructions;

- Keep toxic or other dangerous substances out of the reach of young children;

- Teach children what they can do to minimize the risk of accidents; and

- Teach children what to do if an accident occurs.

Results

Keeping records is an important part of science. It helps us remember what didn't work as well as what did work. Someone asked Thomas Edison if he weren't discouraged after trying thousands of experiments—without results—to make the incandescent light bulb work. He replied:

> *Results! Why, I have gotten a lot of results. I know several thousand things that won't work.*

So before starting, get a notebook for recording observations. If your children cannot write yet, they can draw pictures of what they see, or you may want to take notes for them.

We should remember, too, that seeing isn't the only way to observe. Sometimes we use other senses; we hear, feel, smell, or taste some things (children should be careful, of course, about what they taste).

Let's Go

Science can be learned in many places and environments and just as easily from everyday experiences as from formal projects and experiments. We can get our children interested in science with simple toys, books, and objects around the house and have fun while we're doing it.

So, flip through the following pages and find something that looks like fun.

The Big Picture

Looking at objects closely is an important part of science, and a magnifying glass lets us see things we don't even know are there. It also helps us see how objects are similar or different from each other.

What you'll need

A magnifying glass
Your science journal

What to do

1. Use your magnifying glass to see:

   What's hidden in soil or under leaves;

   What's on both sides of leaves;

   How mosquitos bite;

   Different patterns of snowflakes; and

   Butterfly wings.

   How many different objects can you find in the soil?

2. Draw pictures, or describe what you see, in your notebook.

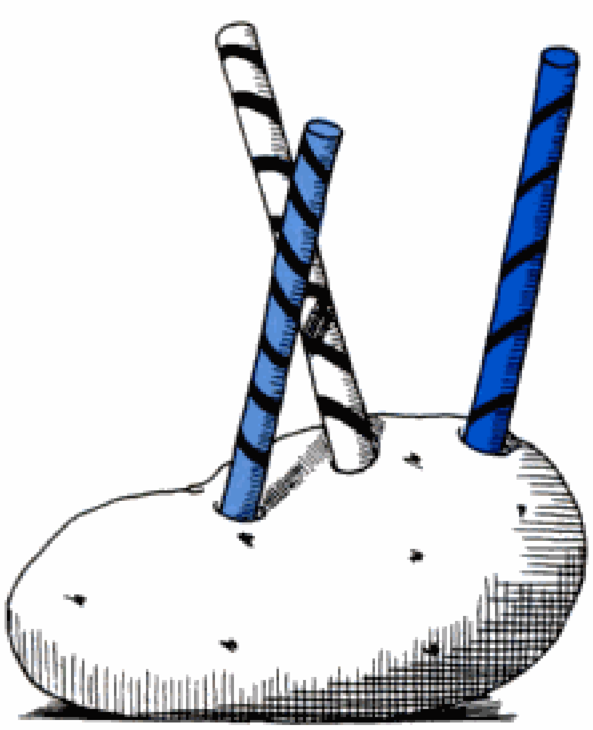
If you were able to examine a mosquito, you probably saw how it bites something—with its *proboscis*, a long hollow tube that sticks out of its head. Snowflakes are fascinating because no two are alike. Powdery scales give butterfly wings their color.

Attack of the Straws

Can a paper straw go through a raw potato? Here's an easy way to learn about inertia and momentum.

What you'll need

A raw potato
One or more paper straws
Your science journal



What to do

1. Put a potato on the table or kitchen counter and hold it firmly with one hand, making sure the palm of your hand is **not** underneath the potato.*

2. With a fast, strong push, stab the potato with the straw.

3. What happens? Did the straw bend? The straw should go into the potato. If it didn't, try again with another straw—maybe a little faster or harder.

*If the potato is old, soak it in water for about half an hour before trying this activity.

An object remains at rest (the potato, in this case) or keeps moving (the straw, in this case) unless it is acted upon by some external force.

Soap Power

Have you ever tried using soap to power a boat? This simple activity works because of "surface tension."

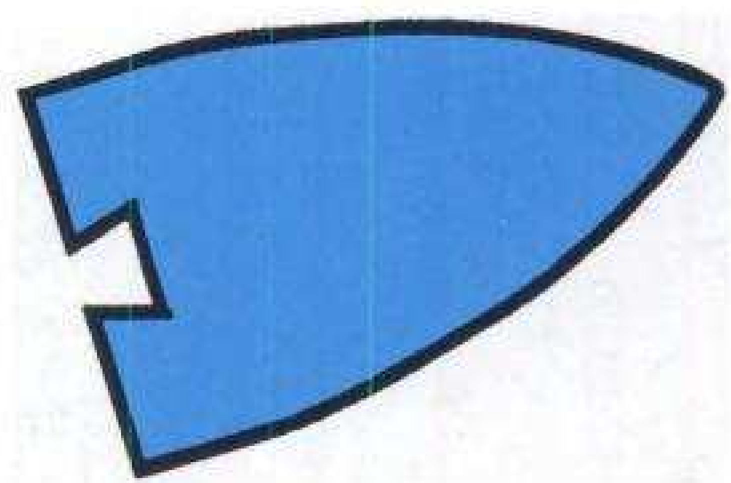
What you'll need

1 index card
Scissors
A baking dish (or sink full of water)
Liquid dish detergent
Your science journal

Your boat should zip across the water. Water molecules are strongly attracted to each other and stick close together, especially on the surface. This creates a strong but flexible "skin" on the water's surface that we call surface tension. Adding soap disrupts the arrangement of the water molecules and breaks the skin, making the boat go forward.

What to do

1. From an index card, cut out a boat like this. Make it about 2 1/2 inches long and 1 1/2 inches wide.



2. Place the boat gently on the water in the dish.

3. Pour a little detergent into the notch in the end of the boat.
What happens?
If you repeat the experiment, wash out the baking dish carefully each time you use detergent, or your boat won't go.

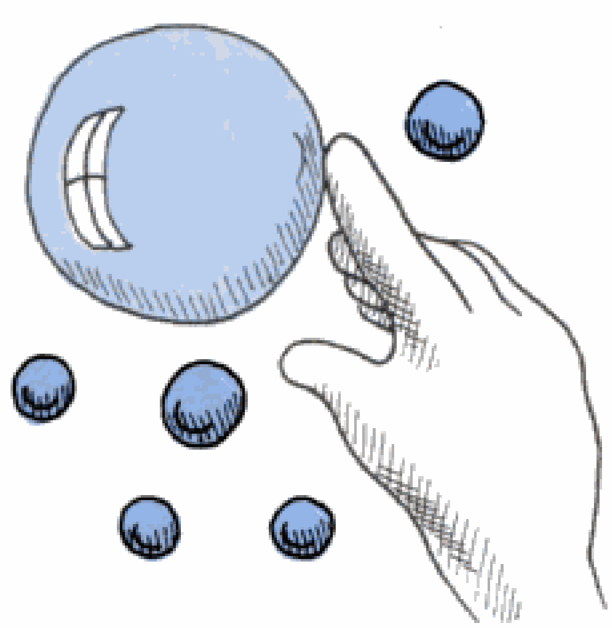
Bubbles

Who doesn't enjoy blowing bubbles? You can make bubbles at home, and they can be beautiful shapes and colors!

What you'll need

8 tablespoons of dishwashing liquid
1 quart water
1 drinking straw
A shallow tray

Grown-up alert!
1 tin can, open at both ends
Your science journal



What to do

1. Mix the dishwashing liquid with the water. Fill the shallow tray.

2. Blow through your straw as you move it slowly across the surface of the solution. How big are the bubbles you get?

3. Try making a very big bubble that covers the surface of the tray:

   Dip one end of the straw into the sudsy solution then hold the straw slightly above the surface of the solution. Blow into it very gently. You may have to try several times to make a really big bubble.

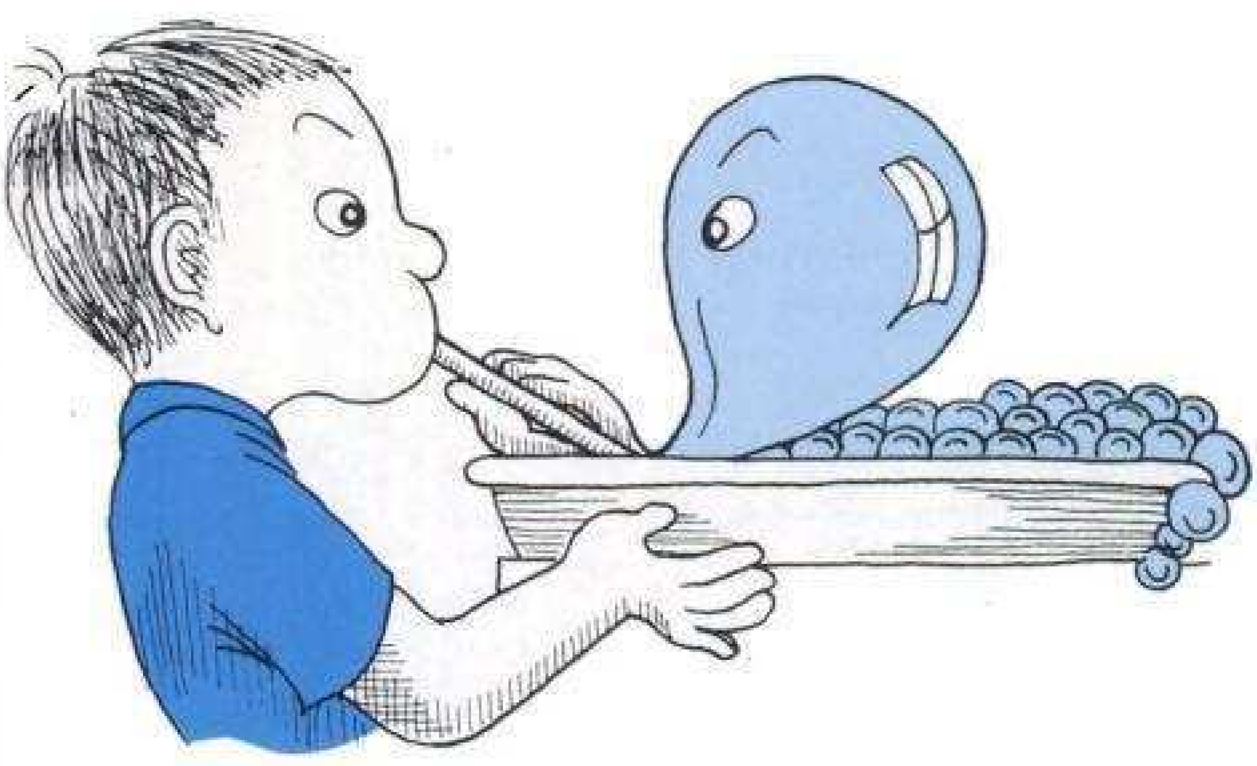
   When you have made a bubble, touch it gently with a wet finger. What happens?

   Make another big bubble. Touch this one with a dry finger. What happens?

4. Try making bubbles with a tin can (don't cut yourself) open at both ends. Dip the can into the soapy solution so that you get a soap "window" across one end when you pull it out. Blow gently on the other end to form a bubble. You can use wider tubes such as coffee cans to make still bigger bubbles.

5. Look closely at the bubbles you make. How many colors can you see? Do the colors change?

6. If you have a wand at home that is left over from a bottle of bubbles you bought at the store, you can use it with this bubble solution.



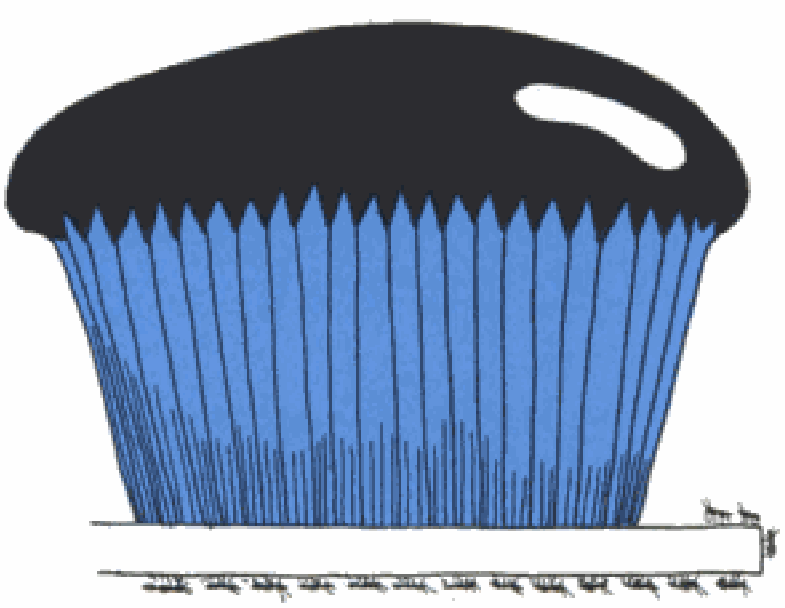
Bubbles are bits of air or gas trapped inside a liquid ball. The surface of a bubble is very thin. Bubbles are particularly fragile when a dry object touches them. That's because soap film tends to stick to the object, which puts a strain on the bubble. So if you want your bubbles to last longer, keep everything wet, even the sides of the drinking straw.

Bugs!

Some bugs help us, some annoy us, and some are downright dangerous. But you can learn a lot from bugs.

What you'll need

An insect guide and a spider guide from the bookstore or library—preferably ones with pictures
Your magnifying glass
Your science journal



What to do

1. Search your home and neighborhood for bugs.

Grown-up alert!

Look:

Around your front door
In cracks in the sidewalk
On lamps
On lights hanging from the center of the room
On plants
In crevices in drawers
In corners of rooms

2. Identify types of bugs using the guides. Did you find:

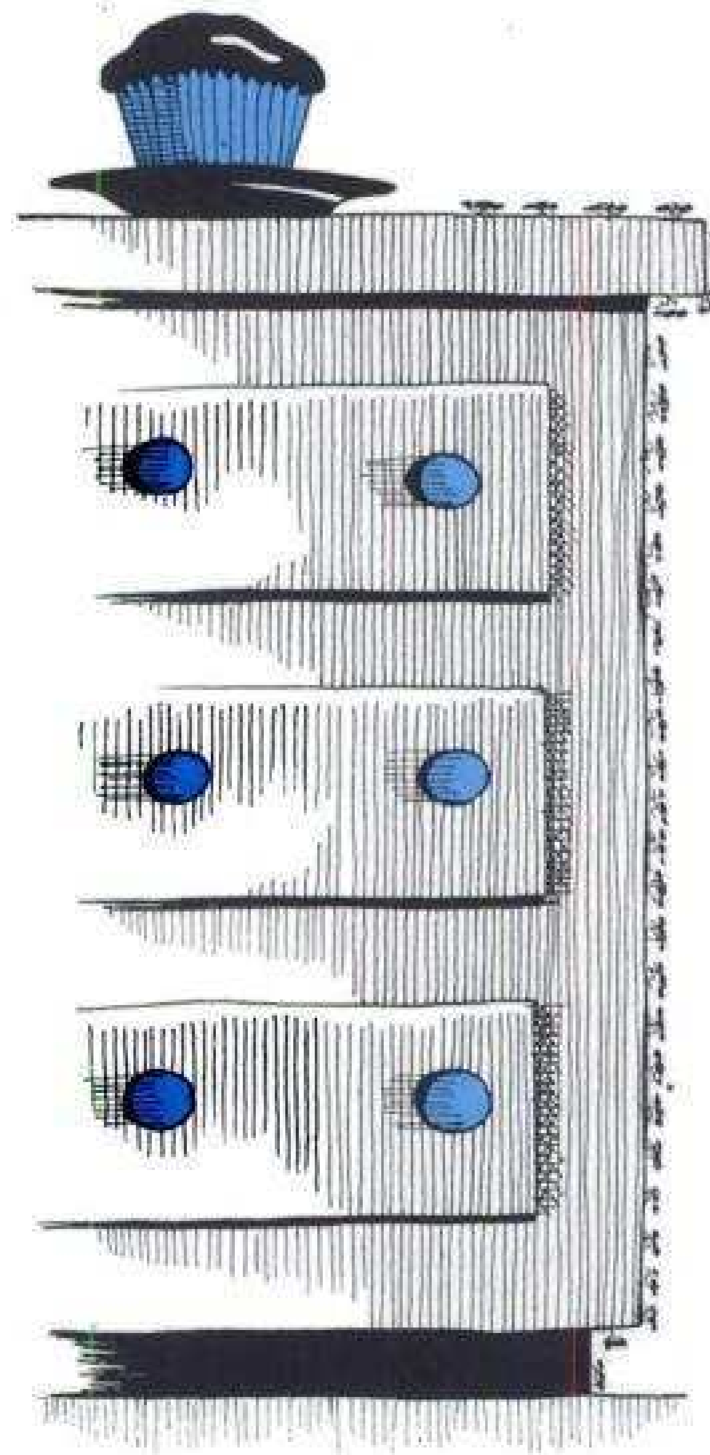
Ants?
Spiders?
Fleas?
Silverfish?
Moths?
Flies?
Ladybugs?

3. Ants can teach us how some insects work together as a community.

Watch ants scurry in and out of their ant hills or find some spilled food on the sidewalk.

Do they eat their food on the spot, or carry it back to their anthill?

When an ant finds food, it runs back to the hill to "tell" the others. As it runs, it leaves a trail that other ants in the hill can smell. The ants find the food by smelling their way along the trail.



4. Find out what the difference is between an insect and a spider.

Why do spiders spin webs?
What are webs made of?

5. Write down possible answers to all these questions in your journal or draw pictures of what you see.

Bugs do what they do to survive. They are constantly looking for food. Some bugs are both good and bad. Termites, for example, have a nasty reputation because they destroy people's houses by eating the wood. But they also break down old trees, keeping the forest floor from becoming too cluttered with dead trees.

It Floats!

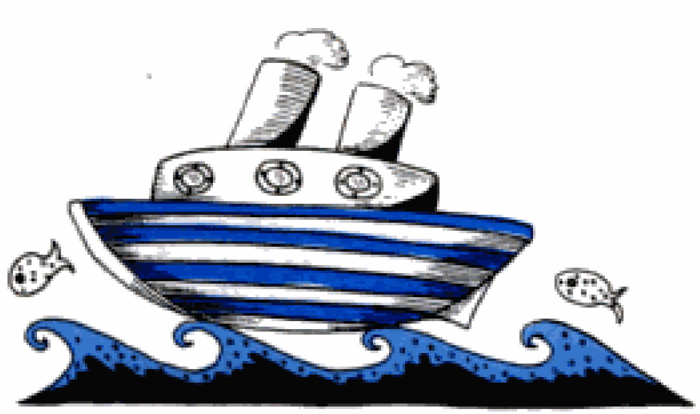
We don't usually stop to wonder why a big cruise ship can float as well as a feather. This activity helps to explain.

What you'll need

1 solid wood building block
1 plastic cap from a bottle
2 pieces of aluminum foil (heavy duty if you have it)
1 chunk of clay

Grown-up alert!

1 pair of pliers
1 bathtub (or sink) filled with water
Your science journal



What to do

1. Hold the wood block in one hand and the plastic cap in the other hand.

   Which one feels heavier?
   Do you think the wooden block will float, or will it sink?
   Will the plastic cap float, or sink?

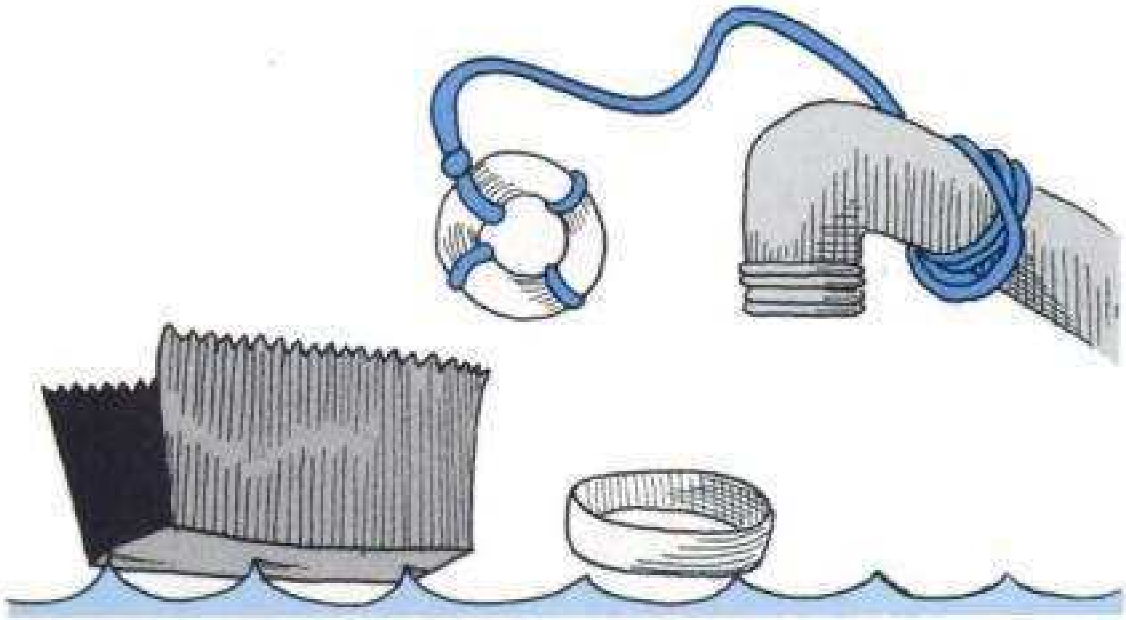
2. Put both of them *on* the water to test your predictions. What happens? Put both of them *under* the water. What happens now?

3. Take a piece of aluminum foil and squeeze it into a solid ball with the pliers. Drop it in the water. Does it float or sink?

4. Get another piece the same size and shape it into a little boat. Place it on top of the water. Does it float now?

5. Try the same experiment with clay. Make a ball and drop it in the water. What happens?

6. Shape the clay into a boat and put it *on* the water. Does it float now?



The clay and foil balls sink because they are squeezed into small shapes, and only a small amount of water is trying to hold up the weight. When you spread out the clay or foil, it floats because the weight is supported by a lot more water.

Slime!

Oil the hinges of a door and it will stop squeaking. Rub petroleum jelly on lips to prevent them from becoming chapped. These slippery substances are called lubricants. They are very important in modern technology.

What you'll need

4 envelopes unflavored gelatin
Square baking pan
A mixing bowl
Liquid dish detergent
Vegetable oil
2 bowls
A watch with a second hand

Grown-up alert!

A table knife
8-ounce cup
Your science journal

What to do

1. In a mixing bowl, dissolve the 4 envelopes of gelatin in 2 cups of hot tap water.

2. Coat the inside of the pan with vegetable oil. Pour the gelatin mixture into the pan and put it in the refrigerator until firm (about 3 to 4 hours).

3. Use the knife to cut the gelatin into cubes about 1 x 1 x 1 inch. You should have about 64 cubes.

4. Place 15 cubes into a bowl. Place the second bowl about 6 inches (about 15 centimeters) away from the cube bowl.

5. When your parent or a friend says "go," start picking up the gelatin cubes one at a time with your thumb and index finger (don't squeeze!). See how many cubes you can transfer to the other bowl in 15 seconds.

Grown-up alert!

Do not eat the gelatin cubes after they have been handled or after they are covered with lubricant.

6. Put all the cubes back in the first bowl. Pour 1/4 cup dish detergent over the cubes. Gently mix the detergent and the cubes so that the cubes are well-coated.

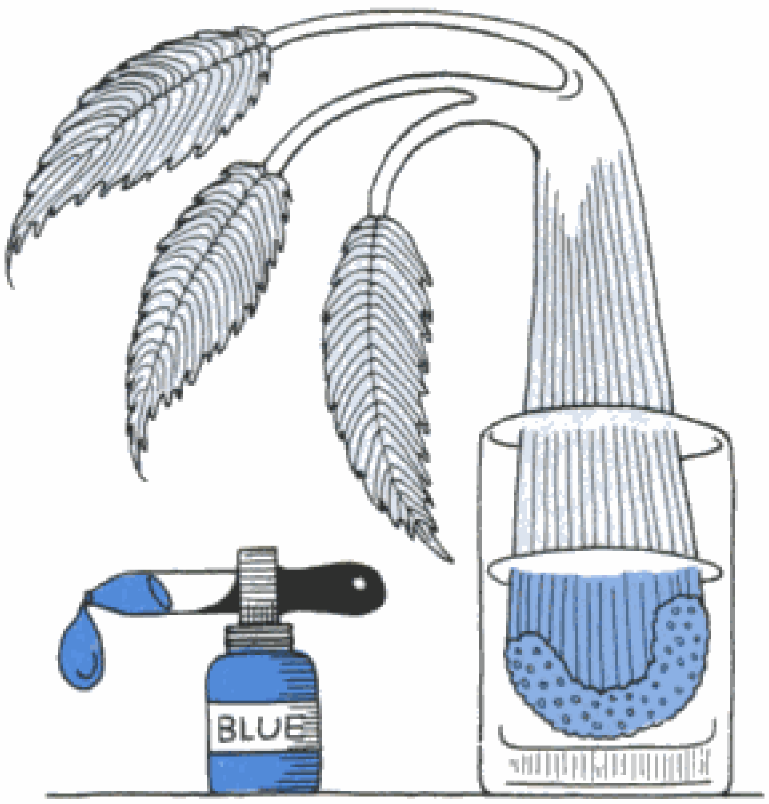
7. Use the same method as before to transfer as many cubes as possible in 15 seconds.

8. Throw away the cubes and detergent and wash and dry both bowls. Put about 15 new cubes into one bowl and pour 1/4 cup water over the cubes, again making sure the cubes are thoroughly coated. See how many cubes you can transfer in 15 seconds.

9. Throw away the cubes and water. Put about 15 new cubes into one bowl. Pour 1/4 cup of vegetable oil over the cubes. Make sure they are well coated. See how many cubes you can transfer in 15 seconds.

10. With which liquid were you able to transfer the most cubes? With which liquid were you able to transfer the fewest cubes? Which was the best lubricant (the slipperiest)? Which was the worst?

Cars, trucks, airplanes, and machines all have parts that rub against one another. These parts would heat up, wear down, and stop working if we didn't have lubricants. Lubricants reduce the amount of friction between 2 surfaces that move against each other.



Celery Stalks at Midnight

Did you ever wonder how a paper towel can soak up a spill, or how water gets from a plant's roots to its leaves? The name for this is "capillary action."

What you'll need

4 same-size stalks of fresh celery with leaves
4 cups or glasses

Grown-up alert!

Red and blue food coloring
A measuring cup
4 paper towels
A vegetable peeler
A ruler
Some old newspapers
Your science journal

What to do

1. Lay the 4 pieces of celery in a row on a cutting board or counter so that the place where the stalks and the leaves meet matches up.

2. Cut all 4 stalks of celery 4 inches (about 10 centimeters) below where the stalks and leaves meet.

3. Put the 4 stalks in 4 separate cups of purple water (use 10 drops of red and 10 drops of blue food color for each half cup of water).

4. Label 4 paper towels in the following way: "2 hours," "4 hours," "6 hours," and "8 hours." (You may need newspapers under the towels).

5. Every 2 hours from the time you put the celery into the cups, remove 1 of the stalks and put in onto the correct towel. (Notice how long it takes for the leaves to start to change.)

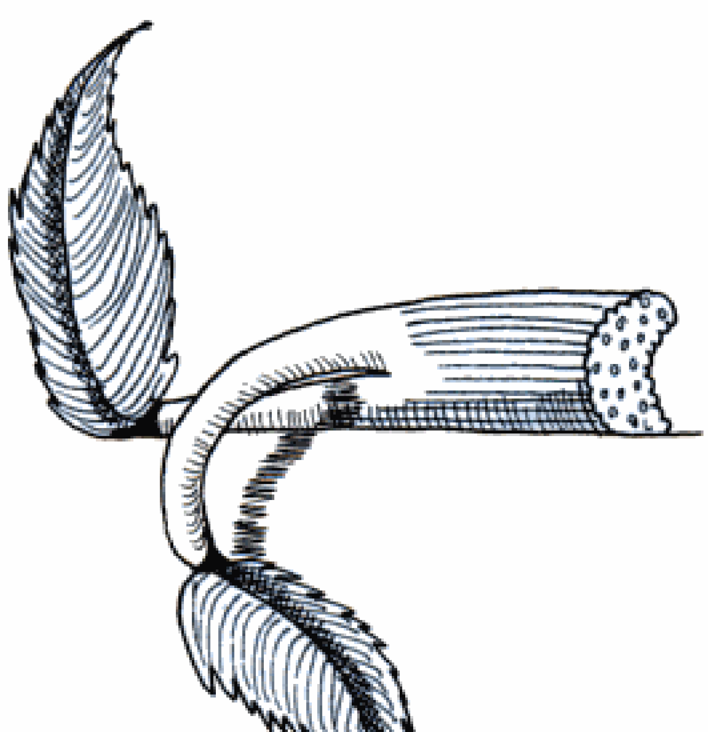
6. Each time you remove a stalk from the water, carefully peel the rounded part with a vegetable peeler to see how far up the stalk the purple water has traveled.

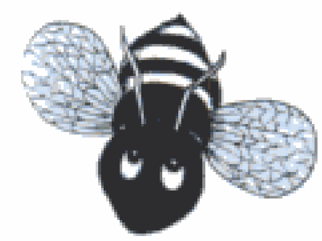
7. What do you observe?
Notice how fast the water climbs the celery.
Does this change as time goes by? In what way?

8. Measure the distance it has traveled and record this amount in your science journal.

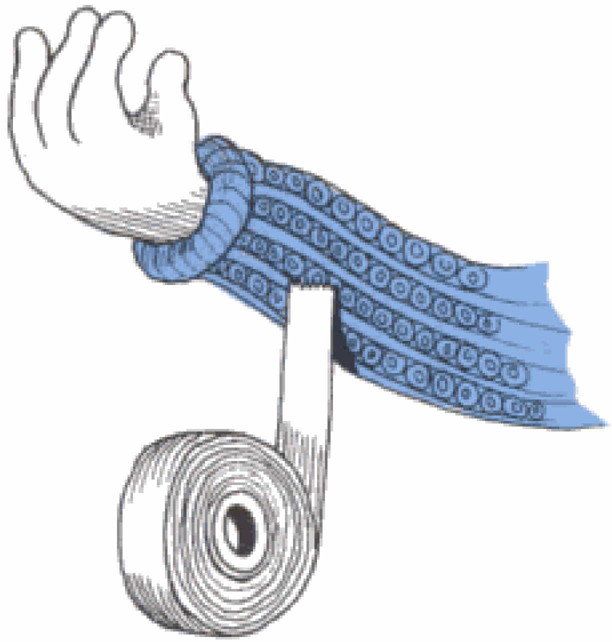
9. Make a list of other objects around your house or in nature that enable liquids to climb by capillary action.
Look for paper towels, sponges, old sweat socks, brown paper bags, and flowers.

What other items can you find?





Capillary action happens when water molecules are more attracted to the surface they travel along than to each other. In paper towels, the molecules move along tiny fibers. In plants, they move through narrow tubes that are actually called capillaries. Plants couldn't survive without capillaries because they use the water to make their food.



Sticky Stuff

Adhesives are used to stick things together. Many adhesives we use every day are made in factories. Others occur in nature and have important uses for plants and animals.

What you'll need

Baking flour
Measuring cup
Egg white
Food coloring
4 small bowls
4 plastic spoons
Aluminum foil
Cotton balls
Toothpicks
Bits of cloth
Glitter
Blunt-tip scissors
Colored yarn or ribbon
Colored paper
Your science journal

What to do

1. Search your home to track down everything you can that is sticky. See how many of the following you can find:

Grown-up alert!

Tape
Postage stamps
Car bumper sticker
Envelopes containing glue
Honey
Wall paper with glue
A decal on a t-shirt
Spackle
A bicycle tire patch
Glue for fake fingernails
Peanut butter
An adhesive bandage

2. Make a list of everything you can find in nature with an adhesive. For example:

Barnacles that stick to boats, ships, and rocks
Spiders that use sticky threads to create webs that trap their food
Pine trees that produce sticky sap

3. What adhesives can you think of that are used

in hospitals?
in offices?
in auto repair shops?

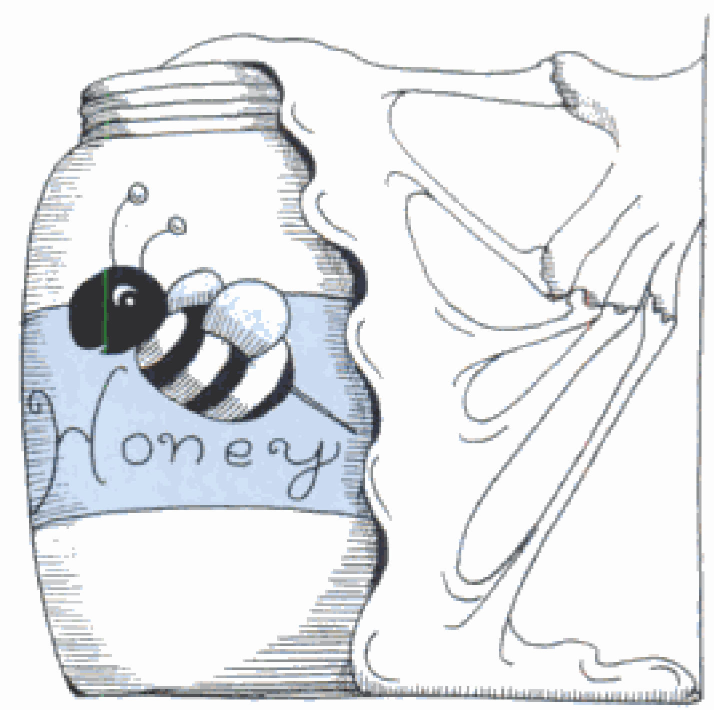
4. Make a poster or collage using adhesives.

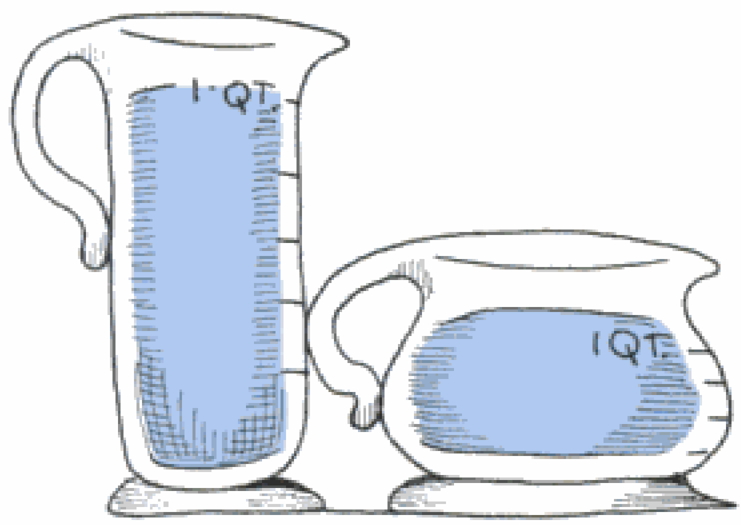
Make 3 bowls of flour-and-water paste. In each bowl, add 1/4 cup water to 1/2 cup flour and mix until smooth. Add a different colored food coloring to each of the 3 bowls and mix.

Crack open an egg and separate the white into a bowl. Throw away the yolk. The white is your clear glue.

Make shapes on your poster or collage out of the colored flour and water paste. Use the egg white to attach aluminum foil, cotton balls, toothpicks, cloth, glitter, ribbon, yarn, and colored paper.

What makes glue, paste, or tape stick to things? Wood, paper, and many other materials have tiny cracks and holes in them. When we glue things together, sometimes the glue seeps into the tiny openings and hardens, making the materials stick together. Other times, the molecules on the surface of an object get tangled up with the glue molecules, making the objects stick together. Finally, glue may stick because of a chemical reaction.





Splish Splash

There are many ways to measure things. At bath time, use different sized containers to measure volume.

What you'll need

Measuring spoons and cups of different sizes
Milk containers of different sizes—for example, pint, quart, half-gallon, and gallon (or 1 liter, 2 liter, and 4 liter)
A funnel
2 containers that hold the same amount (such as a 1 or 2 quart pitcher and storage bowl), but are different shapes—one tall and thin, and one short and squat

Grown-up alert!

1 bathtub or sink filled with water
Your science journal

What to do

1. Fill a small container (such as a quart) with water. Then pour the water (using the funnel, if necessary) into a larger container (a half-gallon or gallon). How many small containers does it take to fill one large one?

2. How many tablespoons does it take to make half a cup? And how many cups to make a quart?

3. Find out how many quarts (or liters) it takes to fill a gallon (or a 4-liter container).

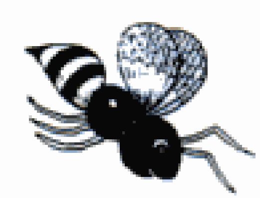
4. Next, fill the gallon (or 4-liter) container, and use the funnel to pour the water into the little containers. How many times will it fill the pint (or 1/2-liter) container?

5. Fill the short, squat container with a given amount of water—3 cups, for example.

Pour this water into the tall, thin container.

Do your eyes try to tell you the tall, thin container holds more than the short, squat one? *Does* it hold more?

Can you write all this in your science journal?



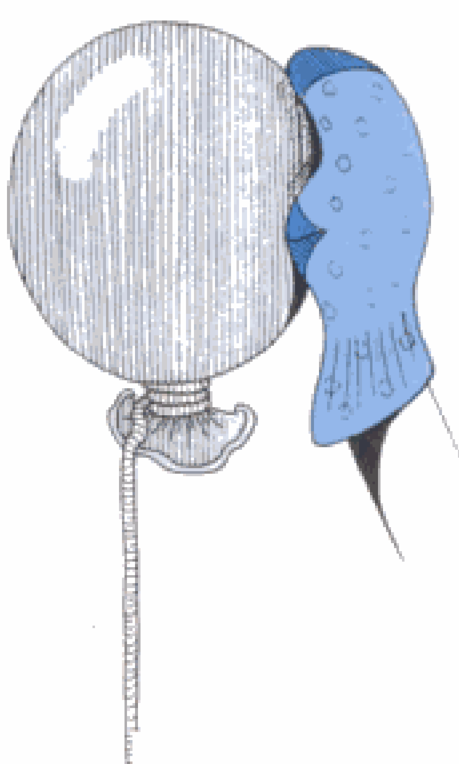
Water and other liquids take the shape of whatever container they are in. Containers of certain sizes have names—cup, pint, quart, liter, or gallon, for example. This activity provides an introduction to *volume* and *measurement*.

Hair-Raising Results

Have you ever been shocked when you walked across a rug or touched a light switch? Wait until a cool, dry day to learn about static electricity.

What you'll need

A cool, dry day
2 round balloons (inflated and tied)
2 20-inch pieces of string
1 wool or acrylic sock.
1 mirror (or more)
1 friend (or more)
Your science journal



What to do

1. Tie a string to each inflated balloon.

2. Rub a balloon on your hair for about 15 seconds. Be sure to rub around the whole balloon.

   What happens to your hair?
   What happens when you bring the balloon back close to your hair?

3. Rub the balloon on your hair again and have a friend (or parent) do the same with the other balloon.

4. Each of you hold the string to 1 balloon, letting the balloons hang freely, but without letting them touch anything.

5. Slowly move the 2 balloons toward each other, but don't let them touch.

What do you see?
Do the balloons push away from each other, or do they pull toward each other?

6. Place your hand between the two hanging balloons.

What happens?

7. Place a sock over 1 hand and rub 1 balloon with the sock. Then let the balloon hang freely. Bring your sock-covered hand near the balloon.

What happens?

8. Try rubbing both balloons with the sock and then let them hang near each other.

What happens now?

9. Look for other examples of static electricity around the house.

Have you ever felt a shock when you touched a metal doorknob on a cold winter day?
What often happens when you remove the clothes from the dryer?

All materials contain millions of tiny particles, called protons and electrons, that have electric charges. Protons have positive charges, and electrons negative ones. Usually, they balance each other, but sometimes when two surfaces rub together, some of the electrons rub off one surface onto the other and we can have static electricity. Materials with like charges (all positive or all negative) move away from each other; those with opposite charges attract each other.

Moldy Oldies

Molds are tiny microscopic plants that can help or hurt us. Molds like some environmental conditions better than others. Find out which ones they prefer by watching mold grow.

What you'll need

Grown-up alert!

3 cups containing a little coffee or leftover food.
Your magnifying glass.
Your science journal.

What to do

1. Put 1 cup with coffee or leftover food on a sunny windowsill, 1 in the refrigerator, and 1 in a dark cupboard.

   Look inside the cups every day for several days and write down what you see. Your magnifying glass will help. (It may take a few days for the mold to start growing.)

2. Does ***temperature*** affect the mold's growth? See if the cup left on the windowsill grows mold

   more slowly,
   more quickly, or
   at the same rate as the one in the refrigerator.

3. Does ***light*** affect the growth of the mold?

Does the cup on the windowsill grow mold at the same rate as the one in a dark cupboard?

4. Look around your home for other molds. Inspect:

Pickles in a jar
Cottage cheese
Bread
Paint on the walls
Oranges
House plants
Tiles around the bathtub or shower.

5. Are the molds all the same color, or are they different?

We can find molds in all sorts of unexpected places. Unlike green plants, they can't make their own food from sunlight. Instead, they live directly off of what they are growing on.

Molds can be a nuisance when they settle on our food or possessions. But molds are also useful. The green spots on old oranges are penicillin mold. This is what the medicine is made from.

Plants

Plants are the only things on earth that turn sunlight into food. They do it through a process called photosynthesis, which is explored in this activity.

What you'll need

Some household plants
A book on plant care from a store or the library

Grown-up alert!
Plant fertilizer
Paper
Scissors
Your science journal
Your magnifying glass

What to do

1. Look in your plant-care book, or ask a grown-up, to find out how much water each plant needs. Some may need to be watered more than others.

2. Take two clippings from one plant. Put one in a glass of water. Put the other one in a glass with no water. Check each day to see how long the one without water can survive.

3. Water the rest of the plants each week for several weeks. Fertilize some of the plants but not others during this time. Label the ones you fertilized.

4. Record the following in your science journal for those plants that got fertilized and for those that didn't:

   Did any of the plants start to droop?

   Did any of the plants have yellow leaves that fell off?

   Did the plants grow toward the light?

5. See what happens when a plant (or part of a plant) doesn't get any light:

Cut 3 paper shapes about 2 inches by 2 inches. Circles and triangles work well, but you can experiment with other shapes, too.

Clip them to the leaves of a plant, preferably one with large leaves. Either an indoor or an outdoor plant will do. Be very careful not to damage the plant.

Leave one paper cutout on for 1 day, a second on for 2 days, and a third on for a week.

How long does it take for the plant to react? How long does it take for the plant to return to normal?

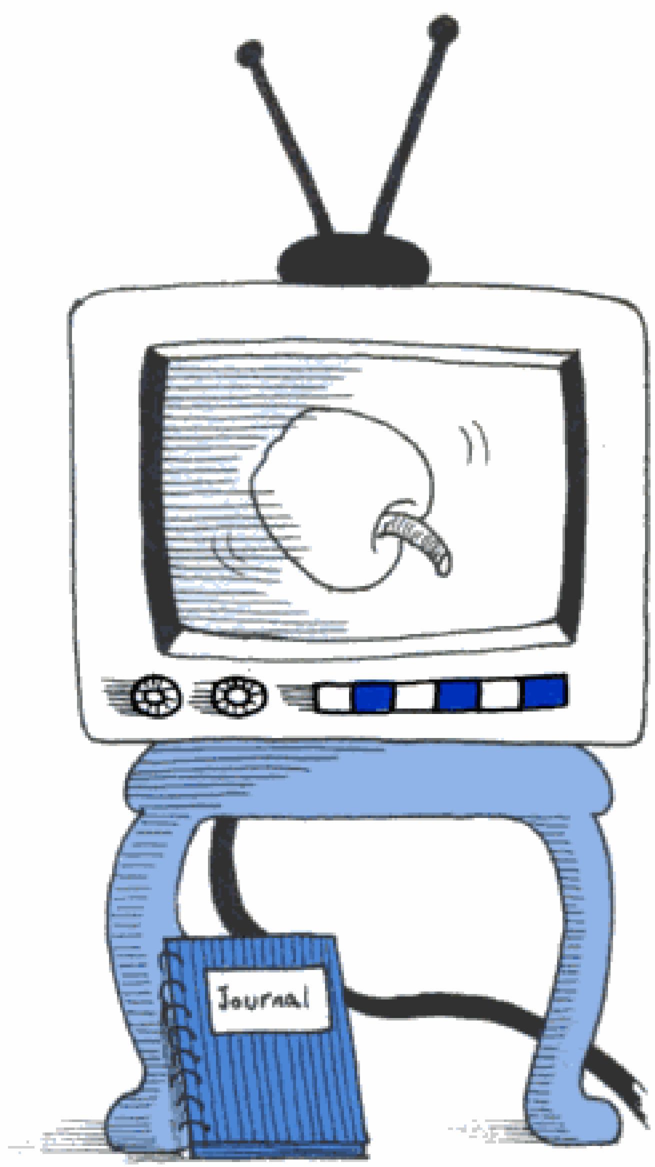
Photosynthesis means to "put together using light". Plants use sunlight to turn carbon dioxide from the air, and water into food. Plants need all of these to remain healthy. When the plant gets enough of these things, it produces a simple sugar, which it uses immediately or stores in a converted form of starch. We don't know exactly how this happens. But we do know that chlorophyll, the green substance in plants, helps it to occur.

Television

Science can be learned from television. Even though the quality varies a lot, some programs provide a marvelous window on science.

What you'll need

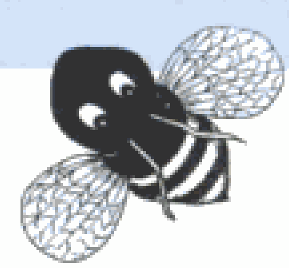
A television set
A VCR, if you have one
Your science journal



What to do

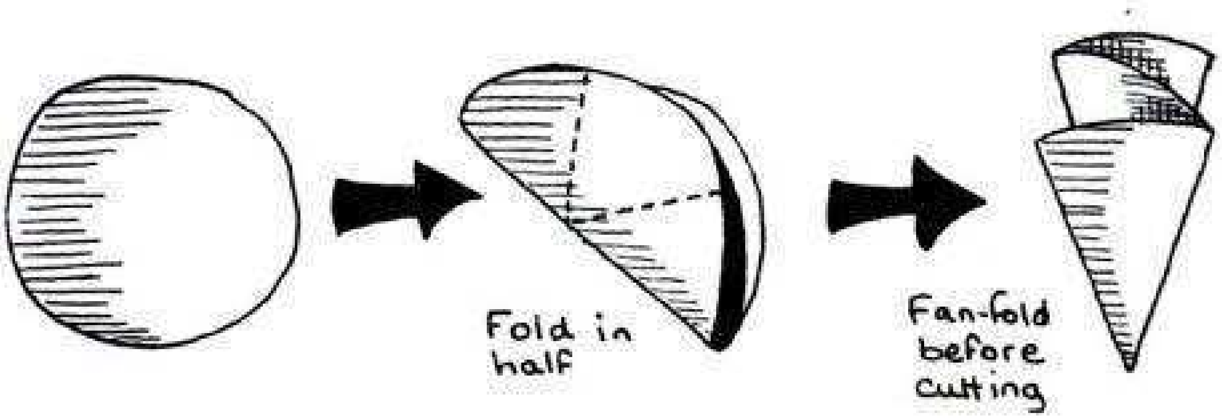
1. Look on the regular networks, public television stations, and cable channels (The Discovery Channel, for example) for science programs such as 3-2-1 Contact, Reading Rainbow, Nature, Nova, Newton's Apple, The Voyage of the MIMI, Mr. Wizard's World, and National Geographic, Jacques Cousteau, Cosmos, and Smithsonian Institution specials.
2. Look for reports of scientific discoveries and activities on regularly scheduled news programs, and for TV characters with science-related jobs—doctors, for instance.
3. If you have a VCR, tape science shows so you can look at them later and stop—or replay—parts that are particulary interesting or hard to understand and so you can talk to someone about them.
4. Watch some of these programs with an adult so you can ask questions.

Some TV programs give misleading information about science as well as about scientists. It is important to know which things on television are real and which ones aren't.



5. Snowflakes are made of ice crystals and are beautiful, but they are hard to see clearly. You can make paper snowflakes.

Take a circle of paper (use thin paper) and fold it as shown below.



Make cuts along all the edges. Unfold them.

When certain liquids and gases cool and lose water, crystals are formed. Crystals are made up of molecules that fit neatly together in an orderly package. All crystals of the same material have the same shape, regardless of the size.

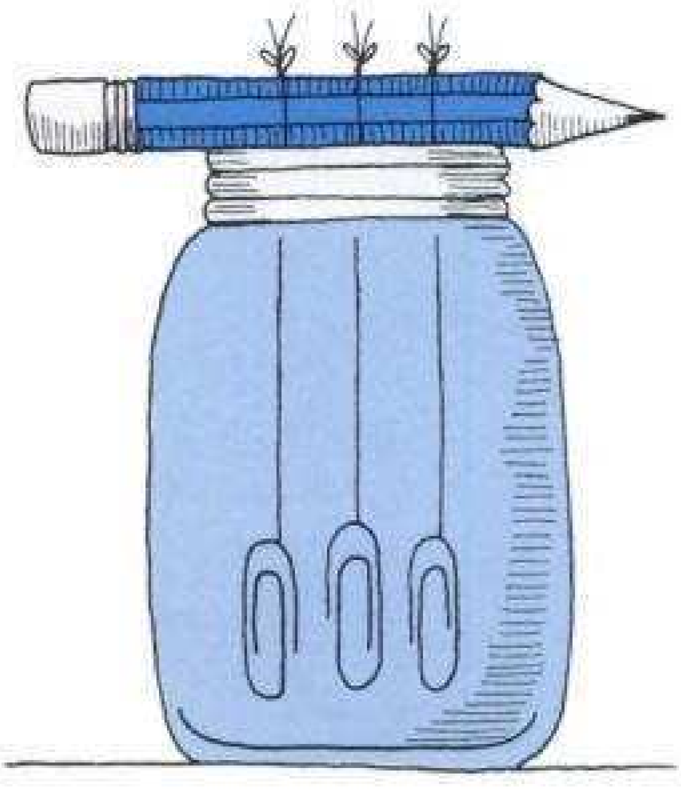
6. Grow rock candy crystals from disslolved sugar.

Grown-up alert!

Pour a cup of boiling water into a dish and add 1 3/4 cups of sugar. Stir until the sugar is completely dissolved. Prepare a jar or glass as shown.

Wash the paper clips and use clean string. When the sugar water is cool, pour it into the jar and put it where no one will move it. Hang the paperclips in the water and put the pencil on top of the jar.

Some crystals should form in a few days. Some may grow to be half an inch on each side. To save them, take them out of the water and keep them dry. But they may disappear—they are good to eat.

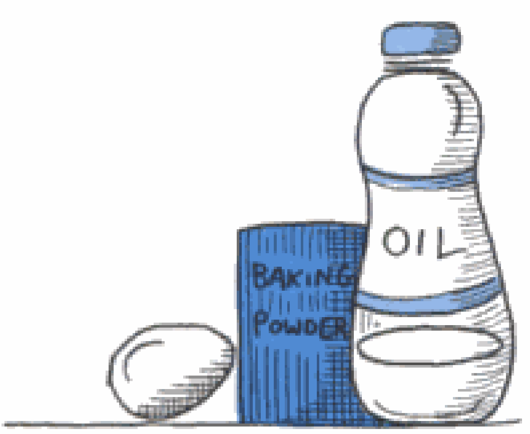


Cake!

Learn about chemical reactions by baking 4 small cakes, leaving an important ingredient out of 3 of them. The ingredients are only for 1 cake, so you'll need to measure and mix 4 times.

What you'll need

A small soup or cereal bowl
Several layers of aluminum foil
A pie pan
Cooking oil to grease the "cake pans"
Measuring spoons
A cup or small bowl for the egg
A small mixing bowl
Your science journal



Ingredients (for one cake)

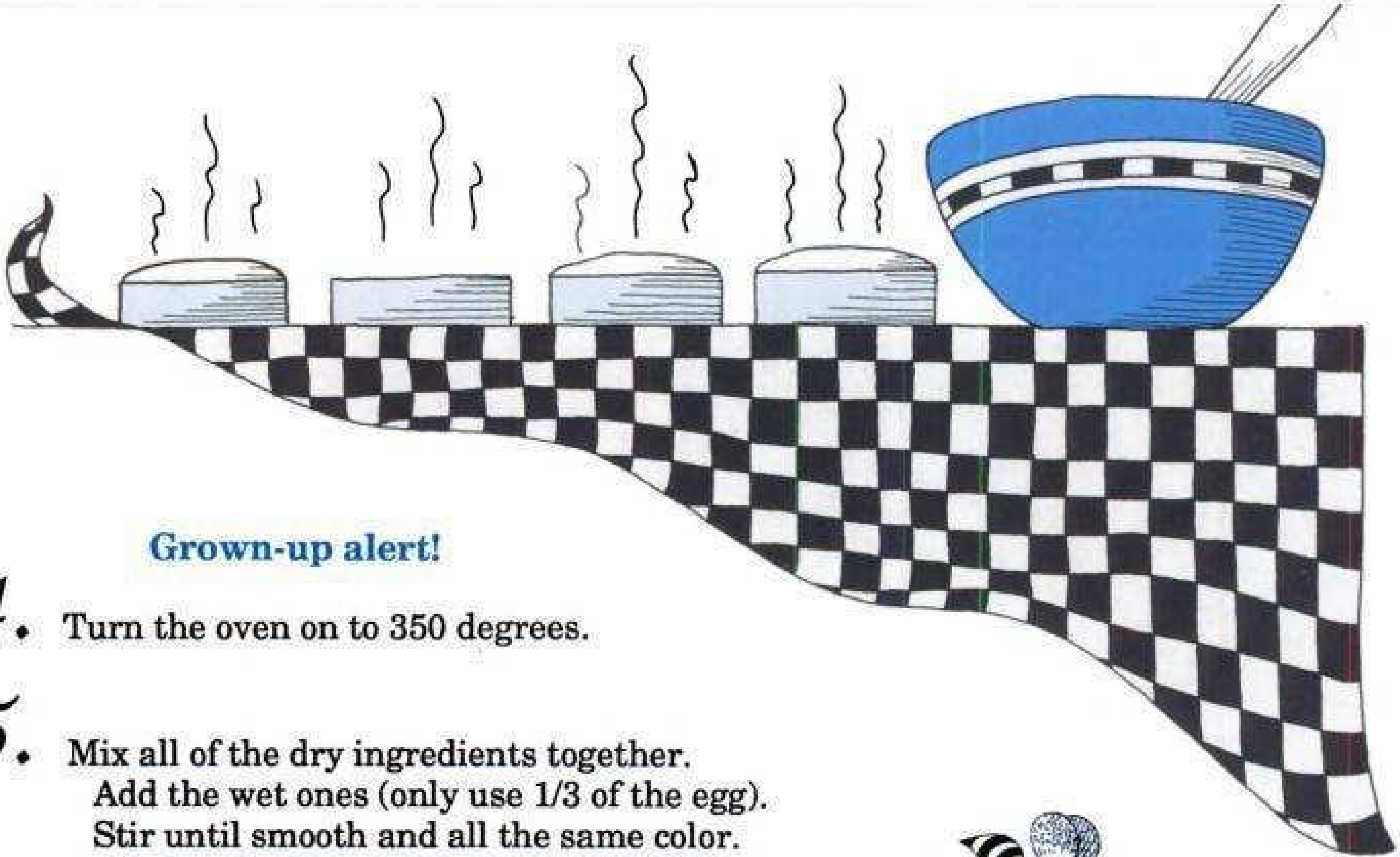
6 tablespoons flour
3 tablespoons sugar
Pinch of salt
2 or 3 pinches baking powder
2 tablespoons milk
2 tablespoons cooking oil
1/4 teaspoon vanilla
Part of an egg
(Break egg into a cup, beat until mixed. Use 1/3 of it. Save the rest for 2 of the other cakes.)

What to do

1. Wrap several layers of aluminum foil around the outside of a cereal or soup bowl to form a mold.

2. Remove your foil "pan" and put it in a pie pan for support.

3. Oil the "inside" of your foil pan with cooking oil so the cake doesn't stick.



Grown-up alert!

4. Turn the oven on to 350 degrees.

5. Mix all of the dry ingredients together.
   Add the wet ones (only use 1/3 of the egg).
   Stir until smooth and all the same color.

6. Pour batter into the "pan."

7. Bake for 15 minutes.

8. Bake 3 more cakes:
   Leave the oil out of one.
   Leave the egg out of another.
   Leave the baking powder out of the third.
   Cut each cake in half and look at the insides.
   Do they look different?
   Do they taste different?

9. Write about, or draw pictures of, what you see and taste.

Heat helps some chemical reactions to occur as the cake bakes:

It helps baking powder produce tiny bubbles of gas, making the cake light and fluffy (this is called leavening).

It causes protein from the egg to change and make the cake firm.

Oil keeps the heat from drying out the cake.

Here are a few suggestions to help make your visit worthwhile:

Discuss expectations with your children ahead of time. What do they think they'll find at the zoo? Very young or insecure children may go to the zoo with a more positive attitude if they are assured that it has food stands, water fountains, and bathrooms.

Don't try to see everything in one visit. Zoos are such busy places that they can overwhelm youngsters, particularly preschoolers and those in primary grades.

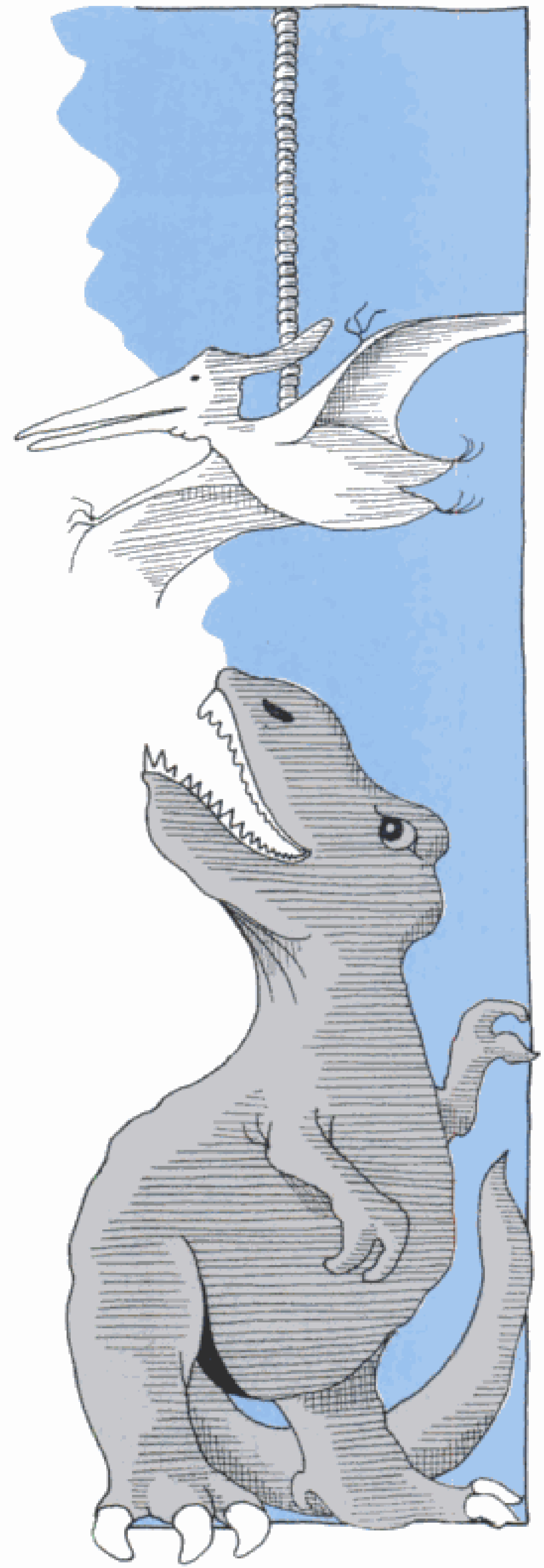
Try to visit zoos at off times or hours (in winter, for example, or very early on a Saturday morning). This provides some peace and quiet and gives children unobstructed views of the animals.

Look for special exhibits and facilities for children, such as "family learning labs" or petting zoos. Here, children can touch and examine animals and engage in projects specially designed for them. For example, at the HERPlab (derived from the word herpetology) at the National Zoo in Washington, D.C., visitors can learn about reptiles and amphibians by doing everything from assembling a turtle skeleton to locating the different parts of a snake.

Plan follow-up activities and projects. A child who particularly liked the flamingos and ducks may enjoy building a bird house for the back yard. One who liked the mud turtle may enjoy using a margarine tub as a base to a papier-mâché turtle.

Museums

Museums are designed today to interest visitors of all ages. Science and technology museums, natural history museums, and children's museums can be found in many middle-sized and smaller communities like Bettendorf, Iowa, and Worland, Wyoming, as well as in large metropolitan areas like Los Angeles, Chicago, and New York.



Museums vary in quality. If possible, seek out those that provide opportunities for hands-on activities. Look for museums with:

- Levers to pull;
- Lights to switch on;
- Buttons to push;
- Animals to stroke; and
- Experiments to do.

Natural history museums sometimes have hands-on rooms where children can stroke everything from lizards to Madagascan hissing cockroaches.

Many museums offer special science classes. Look for omnitheaters. These enable visitors to see movies on subjects ranging from space launches to rafting on the Amazon projected on a giant screen. The sounds and sights of the experience are extremely realistic.

If you are unfamiliar with museums in your area, consult a librarian, the Yellow Pages of your telephone book, a local guidebook, or the local newspapers, which often list special exhibits.

Many tips for visiting the zoo are also helpful when you visit museums or other community facilities. For example, don't try to cover too much on one visit, and do try visiting at off hours when the crowds won't seem overwhelming.

Planetariums

Planetariums have wonderful exhibits and activities for youngsters. There are about 1,000 planetariums in the United States, ranging from small ones that hold about 20 people to giant facilities with 300 or more seats. These facilities are particularly useful for children in urban areas, where metropolitan lights and pollution obstruct one's view of the solar system. Inside planetariums, children often can:

- Use telescopes to view the rings of Saturn;
- See the "sky" with vivid clarity from inside the planetarium's dome; and
- Step on scales to learn what they would weigh on the moon or on Mars.

To find the nearest planetarium, call the astronomy or physics department at a local college, your local science museum, or the science curriculum specialist or science teachers in your school district.

Aquariums

Aquariums enable youngsters to see everything from starfish to electric eels. Children particularly enjoy feeding times. Call ahead to find out when the penguins, sharks, and other creatures get to eat. And check for special shows with sea lions and dolphins.

Farms

A visit to a farm makes a wonderful field trip for elementary school youngsters. But parents can also arrange visits. If you don't know a farmer, call the closest 4-H Club for a referral. Consider dairy farms, as well as vegetable, poultry, hog, and tree farms.

On a dairy farm, see the cows close up, view silos, and learn what cows eat. Find out from the farmer:

- Up to what age do calves drink only milk?
- When do they add other items to their diets? What are they?
- Why are the various foods a cow eats nutritious?

A visit to a farm also enables children to identify the difference between calves, heifers, and cows; to watch the cows being milked; to see farm equipment; to sit on tractors; and to ask questions about how tractors work.

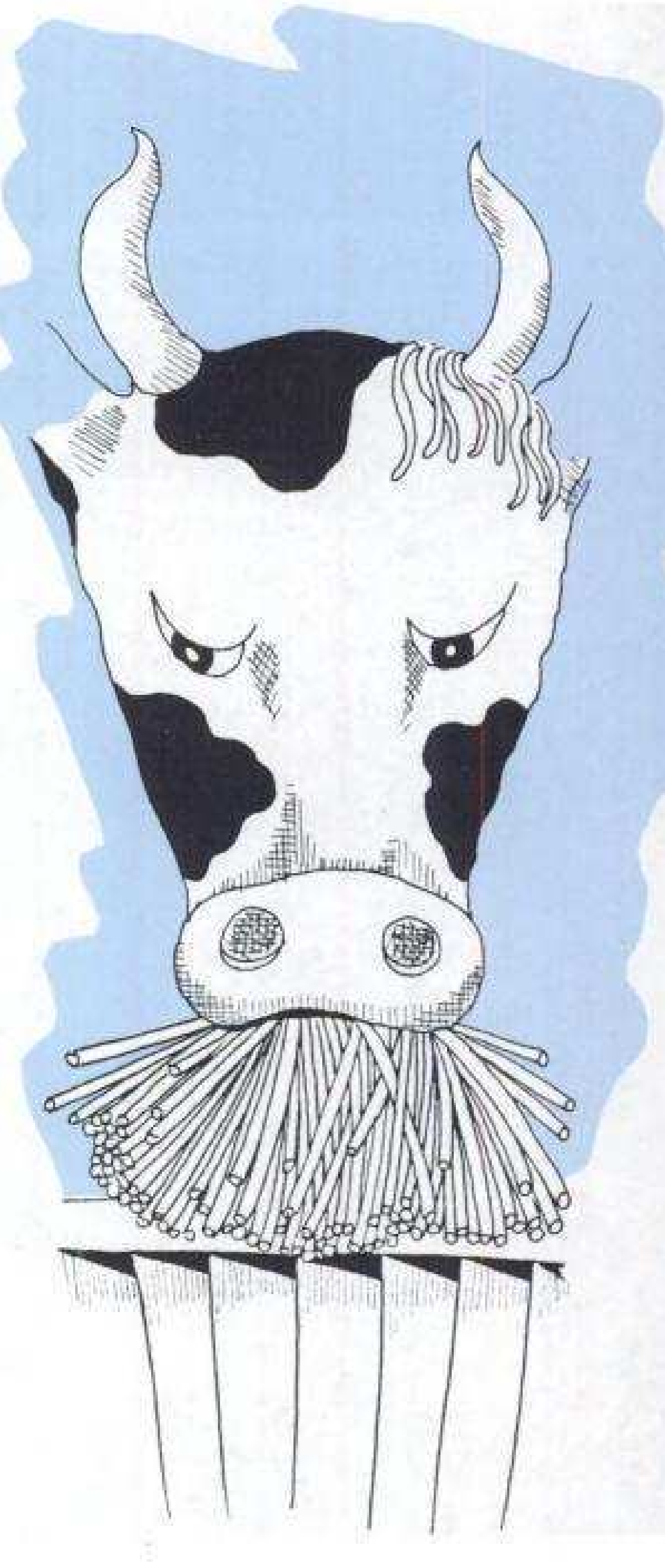
If you visit a vegetable farm, encourage your children to look at the crops and ask questions about how they grow. If your children grew up in an urban area, they may have no idea what potatoes or beans look like growing in a field.

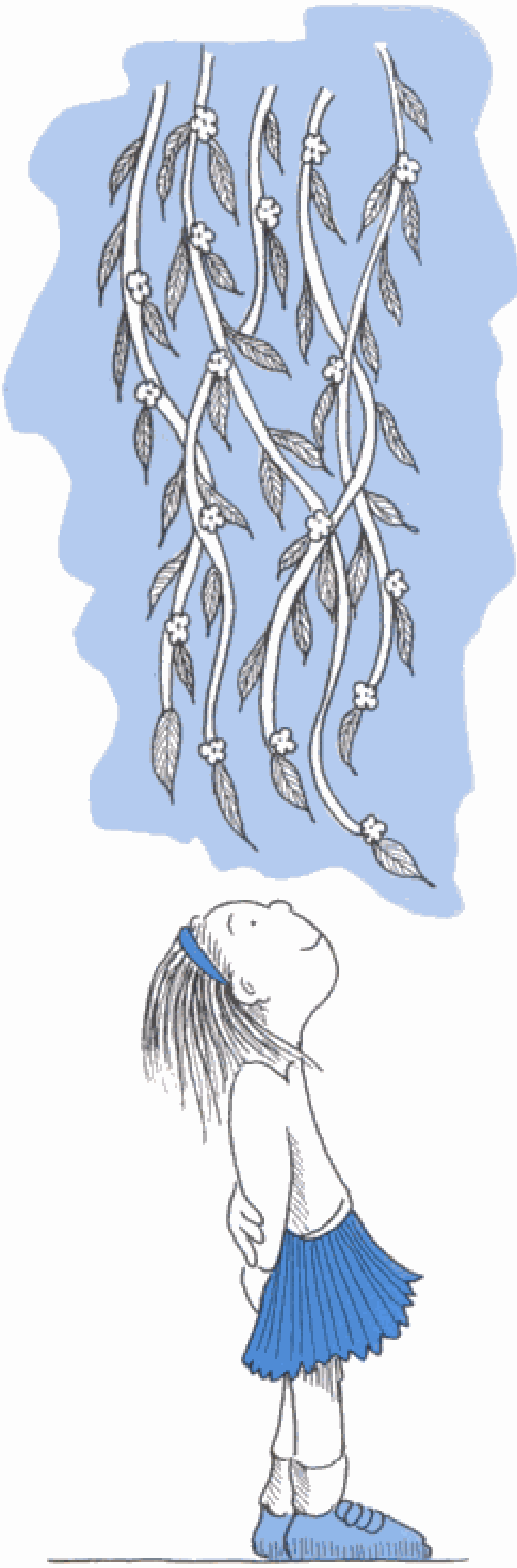
People Who Use Science in Their Work

See if your children can spend part of a day or even an hour with a park ranger, pharmacist, veterinarian, chemist, engineer, or laboratory technician. This can teach the importance of science for many jobs. Before the visit, encourage your children to read about the work so they will be able to ask good questions during the visit.

Nature Hikes

Many communities have parks, forests, or nature areas in which to walk. Some of these have centers where visitors can do everything from observe beehives to learn about flora and fauna. If these facilities are unavailable, walk around your neighborhood and help your children:





- Collect and identify leaves or rocks
- Observe pigeons, squirrels, butterflies, ants, or spider webs;
- Observe differences among the dogs and cats you see; and
- Talk about the special features of the birds and flowers you encounter.

Science Groups and Organizations

There are special groups and organizations for children in many communities. Check out:

- Boy Scouts, Girl Scouts, or Camp Fire, Inc.;
- Y.M.C.A.s or Y.W.C.A.s;
- 4–H groups; or
- The National Audubon Society.

Some groups focus solely on a particular science activity—ham radios, for instance, or computers. Schools sometimes organize groups for students with special science interests.

Science Camps

Contact the National Audubon Society, which runs ecology camps, the National Wildlife Federation's Ranger Rick Wildlife Camp in North Carolina (which is a good choice for children who love nature); or the U.S. Space Camp at Huntsville, Alabama. (See Notes section.)

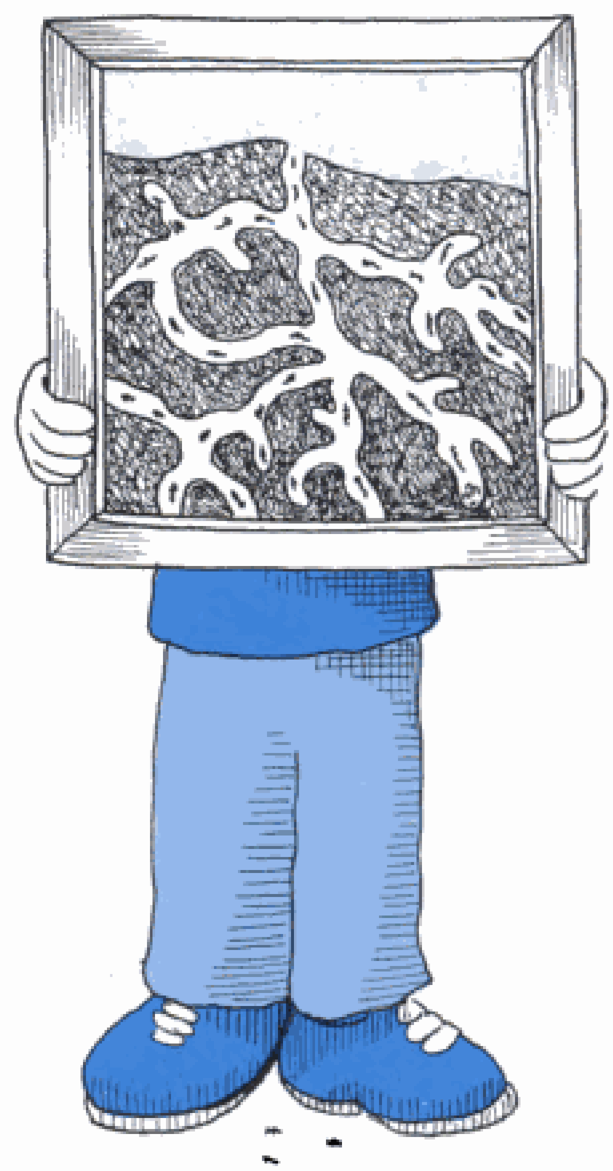
Other Community Resources

Look into botanical gardens, weather stations, hospital laboratories, sewage treatment plants, newspaper plants, radio and television stations, and after school programs such as Hands On Science Outreach, Inc., (HOSO) or a Challenger Center.

Learning from Toys

Children don't need fancy science toys or kits to learn science. But if you want to buy some for your children, plenty are available. Look in toy stores, hobby shops, other specialty shops, or in catalogs. It is beyond the scope of this booklet to recommend specific toys. However, these tips can guide you:

- Children may not benefit if a toy or activity is a poor match for their interests or temperaments.
- Learn what the toy can and cannot do before you buy it. Many youngsters have looked through a toy telescope and been disappointed when they couldn't see bumps and craters on the moon.
- Read instructions carefully so you gain everything possible from the toy.



In the Library and the Bookstore

Libraries and bookstores have a growing number of books to teach children science. Many are educational, beautifully illustrated, and fun to read. But science can also be learned from "non-science" books, such as fiction, biographies, autobiographies, and history books.

When selecting books, remember that recommended reading levels printed on the jackets or backs of books are not always helpful. After the third grade, what children read is usually based as much on interest as it is on reading level.

The National Science Teachers Association asks a range of questions when evaluating books for young people:

Is the author reliable? Does the author have have a good background and reputation? Is the content interesting to children? Is the sequence of events logical? Is the material accurate? Is the format pleasant? Are the illustrations accurate, and do they match the text? Is the vocabulary appropriate? (Big words are OK as long as they are explained and used in context.) Are biases evident (biases against race, sex, or nationality)? Does the book glorify violence? Are controversies handled fairly?

Are the suggested activities safe? Practical?

If you need help in selecting books, consult a children's librarian or bookstore clerk.

The appendix of this booklet lists some of the science books appropriate for elementary school children, and suggests places to find still more. The appendix also lists magazines and periodicals for elementary school children that focus on science.

Parents and the Schools

Educators and policymakers are working to improve elementary school science, but parents also can help. Here's how:

1. Visit your child's elementary school and see what kind of science instruction is available. During your visit, look for clues as to whether science is valued.

- Do you see displays related to science? Science learning centers?
- Are science-related drawings on the bulletin boards? Are there plants, terrariums, aquariums, or collections (of rocks or insects, for example)?
- Do you see any science equipment in evidence? Are there magnifiers? Magnets? Pictures? Films?
- Does the school library contain science books? If so, ask the librarian if the children are encouraged to read them.
- Is there enough space in the classrooms or elsewhere in the school for students to conduct experiments?
- In science classes, do students work with materials, or is the teacher always demonstrating? Do students discuss their ideas, predictions, and explanations with each other as well as with the teacher?

2. Ask questions about the science program at parent-teacher conferences or PTA meetings. Or set up an appointment with the school principal. This provides you with information about the science program and lets educators know you think science is important. Educators are more apt to teach subjects they know parents are interested in. Here are some things to find out:

- What facilities and resources are available to teach science? If the school budget for science is inadequate, has the school or district tried to obtain resources fromthe community, particularly the business community?
- How often is science taught? Every day, once a week, or only once in a while?
- Do the school and/or your children's teachers have clear goals and objectives for teaching science?
- Can students do hands-on science projects?
- Are activities available that parents can use at home to supplement class instruction?

3. Take action.

- If the science program is inadequate, talk with your child's teacher or meet with the principal. If that brings no results, write to or meet with school board members. You might get better results if you organize with other parents who have similar concerns.
- Volunteer your services to improve the science programs. You can:

  Assist teachers and students with classroom science projects;

  Chaperone science-related field trips;

  Offer to set up a science display in the school's front hallway or in your child's classroom;

  Lead hands-on lessons (if you have a good science background yourself);

  Help in a computer laboratory or other area requiring adult supervision; and

  Volunteer to raise funds for computers, a classroom guinea pig, or field trips.

Concepts

The National Center for Improving Science Education recommends that elementary schools design curricula that introduce nine scientific concepts. Many of the activities described in this handbook teach these concepts, which are drawn from the center's recent report, *Getting Started in Science: A Blueprint for Elementary School Science Education*. The nine concepts are:

1. Organization. Scientists have made the study of science manageable by organizing and classifying natural phenomena. For example, natural objects can be assembled in hierarchies (atoms, molecules, mineral grains, rocks, strata, hills, mountains, and planets). Or objects can be arranged according to their complexity (single-celled amoeba, sponges, and so on to mammals).

Primary grade children can be introduced to this concept by sorting objects like leaves, shells, or rocks according to their characteristics. Intermediate grade children can classify vegetables or fruits according to properties they observe in them, and then compare their own classification schemes to those used by scientists.

2. Cause and effect. Nature behaves in predictable ways. Searching for explanations is the major activity of science; effects cannot occur without causes. Primary children can learn about cause and effect by observing the effect that light, water, and warmth have on seeds and plants. Intermediate grade children can discover that good lubrication and streamlining the body of a pinewood derby car can make it run faster.

3. Systems. A system is a whole that is composed of parts arranged in an orderly manner according to some scheme or plan. In science, systems involve matter, energy, and information that move through defined pathways. The amount of matter, energy, and information, and the rate at which they are transferred through the pathways, varies over time. Children begin to understand systems by tracking changes among the individual parts.

Primary children can learn about systems by studying the notion of balance—for example, by observing the movements and interactions in an aquarium. Older children might gain an understanding of systems by studying the plumbing or heating systems in their homes.

4. Scale refers to quantity, both relative and absolute. Thermometers, rulers, and weighing devices help children see that objects and energy vary in quantity. It's hard for children to understand that certain phenomena can exist only within fixed limits of size. Yet primary grade children can begin to understand scale if they are asked, for instance, to imagine a mouse the size of an elephant. Would the mouse still have the same proportions if it were that large? What changes would have to occur in the elephant-sized mouse for it to function? Intermediate grade children can be asked to describe the magnification of a microscope.

5. Models. We can create or design objects that represent other things. This is a hard concept for very young children. But primary grade children can gain experience with it by drawing a picture of a cell as they observe it through a microscope. Intermediate grade children can use a model of the earth's crust to demonstrate the cause of earthquakes.

6. Change. The natural world continually changes, although some changes may be too slow to observe. Rates of change vary. Children can be asked to observe changes in the position and apparent shape of the moon. Parents and children can track the position of the moon at the same time each night and draw pictures of the moon's changing shape to learn that change takes place during the lunar cycle. Children can also observe and describe changes in the properties of water when it boils, melts, evaporates, freezes, or condenses.

7. Structure and function. A relationship exists between the way organisms and objects look (feel, smell, sound, and taste) and the things they do. Children can learn that skunks let off a bad odor to protect themselves. Children also can learn to infer what a mammal eats by studying its teeth, or what a bird eats by studying the structure of its beak.

8. Variation. To understand the concept of organic evolution and the statistical nature of the world, students first need to understand that all organisms and objects have distinctive properties. Some of these properties are so distinctive that no continuum connects them—for example, living and nonliving things, or sugar and salt. In most of the natural world, however, the properties of organisms and objects vary continuously. Young children can learn about this concept by observing and arranging color tones. Older children can investigate the properties of a butterfly during its life cycle to discover qualities that stay the same as well as those that change.

9. Diversity. This is the most obvious characteristic of the natural world. Even preschoolers know that there are many types of objects and organisms. In elementary school, youngsters need to begin understanding that diversity in nature is essential for natural systems to survive. Children can explore and investigate a pond, for instance, to learn that different organisms feed on different things.

Notes

Text Notes

The following notes refer to the text portion of this booklet.

Page 3. See Berger, Melvin, (1985). *Germs Make Me Sick!* Harper & Row Publisher, New York, New York.

Page 3. *New York Times*, January 19, 1988. Letter to the editor.

Page 5. Asimov, Isaac, "Science and Children," (1986). In *Science Fare* by Wendy Saul and Alan R. Newman. Harper & Row, Publishers, Inc., New York, xii.

Page 5. National Science Resources Center (NSRC) Newsletter, (Spring 1988). Smithsonian Institution and the National Academy of Sciences. From 5th and 6th grade students of Ben Stewart, retired teacher, Jefferson Elementary School, St. Louis, Missouri.

Page 6. Atkin, J. Myron Atkin and Raizen, Senta A., (1988). "Seeing, Touching, and 'Figuring Out What Happens': The Role of Science in At-Risk Education." In papers from conference sponsored by the Stanford University School of Education, November 17–18, 1988.

Page 9. The National Center for Improving Science Education, (1989). *Getting Started in Science: A Blueprint for Elementary School Science Education.* The NETWORK, Inc., Andover, Mass., and Washington, D.C.,; and Bilogical Sciences Curriculum Study, Colorado Springs, Colo.

Page 40. Suggestions from Judy White, chief of the office of education at the National Zoo, Washington, D.C.

Page 41. Cleaver, Joanne, (1988). *Doing Children's Museums: A Guide to 225 Hands-On Museums.* Williamson Publishing, Charlotte, Vermont.

Page 44. A publication by Judith Erickson, *Directory of American Youth Organizations*, 1988–89 Edition, lists appropriate groups. It is published by Free Spirit Publishing Company.

Page 47. Contact Audubon Camps and Workshops, Audubon Society, 61113 Riversville Road, Greenwich, CT 06831; Ranger Rick Wildlife Camps, National Wildlife Federation, 1412 16th St. NW, Washington, DC 20036; or U.S. Space Camp, Space and Rocket Center, One Tranquility Base, Huntsville, AL 35807.

Page 47. Contact Hands On Science Outreach, 4910 Macon Road, Rockville, MD 20852; or Challenger Center for Space Science Education, 1101 King Street, Suite 190, Alexandria, VA 22314.

Page 47. Many of these suggestions are contained in *Science Fare* by Saul and Newman, 80.

"Activities at Home" Notes

The experiments were adapted in part from the following sources:

"Sticky Things," "Hair-Raising Results," "Slime," "Soap Power" and "Celery Stalks at Midnight" from *WonderScience*, American Chemical Society/American Institute of Physics, Washington, D.C. Reprinted with permission from *WonderScience*, Copyright © 1989 and 1990, American Chemical Society. From the January 1990, December 1989, January 1990, October 1989, and the May 1989 issues, respectively.

"Soap Power" is also from *Simple Science Experiments with Everyday Materials* by Muriel Mandell (1989). Sterling Publishing Co., Inc., New York.

"The Big Picture" from *Simple Simon Says: Take One Magnifying Glass* by Melvin Berger (1980). Scholastic Inc., New York.

"It Floats" and "Splish Splash" from *Learn While You Scrub: Science in the Tub* by James Lewis (1980). Meadowbrook Press, N.Y.

"Moldy Oldies" from *The Wild Inside* by Linda Allison (1989). Little, Brown and Company, Boston, Toronto.

"Crystals" is from *The Wild Inside; Mr. Wizard's Experiments for Young Scientists* by Don Herbert (1959), Doubleday, Inc., Garden City, N.Y.; and *Exploring Science Through Art* by Phillis Katz (1990), Franklin Watts, New York.

"Cake" from *Messing Around With Baking Chemistry* by Bernie Zubrowski (1981). Little, Brown and Company, Boston, Toronto; and *Science Experiments You Can Eat* by Vicki Cobb (1972), Harper & Row, New York.

"Bubbles" from *Bubbles* by Bernie Zubrowski (1979). Little, Brown, and Company, Boston, *Simple Science Experiments with Everyday Materials*, and *The Wild Inside*.

Resources

Listed below are a few of the many excellent science books available for elementary school children. A special thank you to the American Association for the Advancement of Science for its recommendations, many of which received positive reviews in its publication *Science Books & Films.* Suggestions also came from *Science Fare*, by Wendy Saul and Alan R. Newman; from *The New York Times Parent's Guide to the Best Books for Children,* by Eden Ross Lipson; from *Science for Children*, by the National Science Resources Center; and from Phyllis Marcuccio at the National Science Teachers Association.

The Consumer Information Center (CIC) has many booklets and pamphlets available free or for a small fee. For a free catalog, write to Consumer Information Center, Pueblo, CO 81009.

There are many local, county, state, and federal offices that can help. Contact your state energy or environmental office or state department of education; the county cooperative extension service; or a county, state, or national park near you for information and literature. Also try the U.S. Department of the Interior (Fish and Wildlife Service, National Park Service, Bureau of Land Management), the U.S. Department of Agriculture (Forest Service, Cooperative Extension System), and the U.S. Army Corps of Engineers.

1. Dinosaur books (particularly suitable for children in primary grades):

Aliki, (1981). *Digging Up Dinosaurs*, Thomas Y. Crowell, New York.

Aliki, (1985). *Dinosaurs Are Different,* Thomas Y. Crowell, New York.

Lauber, Patricia, (1987). *Dinosaurs Walked Here and Other Stories Fossils Tell,* Bradbury Press, New York.

Richler, Mordecai, (1987). *Jacob Two-Two and the Dinosaur.* Knopf, New York.

Sattler, Helen, (1981). *Dinosaurs of North America*, Lothrop, Lee & Shepard, New York.

2. Animal and wildlife books:

Arnold, Caroline, (1982). *Animals that Migrate.* Carolrhoda, Minneapolis.

Arnold, Caroline, (1988). *Penguin.* Morrow Junior Books, New York.

Coldrey, Jennifer, (1987). *Discovering Flowering Plants.* Bookwright, New York.

Cutchins, Judy, and Johnston, Ginny, (1989). *Scoots the Bog Turtle.* Atheneum, New York.

Lerner, Carol, (1987). *A Forest Year.* Morrow Junior Books, New York.

McClung, Robert, (1988). *Lili: A Giant Panda of Sichuan.* Morrow Junior Books, New York.

McClung, Robert, (1988). *Major: The Story of a Black Bear.* Shoe String Press, Inc., Hamden, Conn.

McNulty, Faith, (1986). *Peeping in the Shell: A Whooping Crane Is Hatched.* Harper & Row, New York.

Powzyk, Joyce, (1988). *Tracking Wild Chimpanzees.* Lothrop, Lee & Shephard, New York.

Pringle, Laurence, (1977). *The Hidden World: Life Under a Rock.* Macmillan, New York.

Scott, Jack Denton, (1976, 1978). *Discovering the American Stork*, and *Discovering the Mysterious Egret.* Harcourt, Brace Jovanovich, New York.

Selsam, Millicent, (1984). *Where Do They Go? Insects in Winter.* Scholastic, Inc., New York.

Spencer, Guy J., (1988). *A Living Desert.* A Troll Question Book, Mahway, N.J.

U.S. Fish and Wildlife Service. *Take Pride in America with Mark Trail*. Activity book listed in the CIC catalog.

3. Astronomy and physics:

Adler, Irving, (1980). *The Stars: Decoding Their Message*. Thomas Y. Crowell, New York.

Arnold, Caroline (1987). *A Walk on the Great Barrier Reef*. Carolrhoda, Minneapolis.

Asimov, Isaac, (1988). *How the Universe Was Born*. Gareth Stevens, Inc., Milwaukee.

Asimov, Isaac, (1989). *Is There Life on Other Planets?* Gareth Stevens, Inc., Milwaukee.

Bronowski, Jacob (1987). *Biography of an Atom*. Harper Junior, New York.

Hines, Anna Grossnickle, (1989). *Sky All Around*. Clarion, New York.

Lauber, Patricia (1987). *Volcano: The Eruption and Healing of Mount St. Helen's*. Bradbury Press, New York.

Maurer, Richard, (1985). *The NOVA Space Explorer's Guide: Where to Go and What to See*. Clarkson N. Potter/WGBH, Boston.

Radlauer, Edward and Ruth, (1987). *Earthquakes*. Children's Press, Chicago.

U.S. Army Corps of Engineers (1988). *Stars in Your Eyes: A Guide to the Northern Skies*. Listed in the CIC catalog.

4. Anatomy:

Allison, Linda (1976). *Blood & Guts: A Working Guide to Your Own Insides*. Little, Brown and Company, Boston, Toronto.

Balestrino, Philip, (1989). *The Skeleton Inside You*, revised edition. Crowell, New York.

Smith, Kathie Bilingslea, and Crenson, Victoria (1987, 1988). *Hearing; Seeing; Smelling; Tasting; Thinking*; and *Touching*. A Troll Question Book, Mahwah, N.J.

5. Applied science:

Adkin, Jan, (1980). *Moving Heavy Things*. Houghton Mifflin, Boston.

Macaulay, David, (1975, 1981, 1988). *Pyramid*, *Cathedral*, and *The Way Things Work*. Houghton Mifflin, Boston.

Marsoli, Lisa Ann, (1986). *Things to Know about Going to the Dentist*. Silver Burdett, Morristown, N.J.

Munro, Roxie, (1989). *Blimps*. Dutton, New York.

Shapiro, Mary J., (1986). *How They Built the Statue of Liberty*. Random House, New York.

6. Fiction incorporating science:

George, Jean Craighead, (1972). *Julie of the Wolves*. Harper & Row, New York.

Holling, Holling C., (1941). *Paddle-to-the-Sea*. Houghton Mifflin, Boston.

Hurwitz, Johanna, (1978). *Much Ado about Aldo*. Morrow, New York.

Law, Felicia, (1985). *Darwin and the Voyage of the Beagle*. (A fictionalized account of the voyage to Galapagos), Andre Deutsch, Bergenfield, N.J.

Scott, O'Dell, (1960). *Island of the Blue Dolphins*. Houghton Mifflin, Boston.

7. Biographical figures:

Look for books about:

Nathaniel Bowditch, the early 19th century American mathematician and astronomer and author of the best book on navigation of his time;

George Washington Carver, the agricultural scientist who discovered over 300 uses for the peanut;

Marie Curie, the Polish-born French physicist famous for work on radioactivity;

Charles Darwin, the English naturalist reknowned for his work on evolution;

Amelia Earhart, the aviation pioneer;

Louis Pasteur, one of the world's foremost early microbiologists whose research led to pasteurization;

Sally Ride, the American astronaut and scientist; or

John Augustus and Washington Augustus Roebling, U.S. civil engineers and designers of the Brooklyn Bridge.

8. Science experiments:

Allison, Linda, (1988). *The Wild Inside: Sierra Club's Guide to the Great Indoors.* Little, Brown & Co., Boston, Toronto.

Barr, George (1986). *Science Projects for Young People.* Dover Publications, Inc., New York.

Carson, Mary Stetten, (1989). *The Scientific Kid: Projects, Experiments and Adventures.* Harper & Row, New York.

Cobb, Vicki, and Darling, Kathy, (1980). *Bet You Can't! Science Impossibilities to Fool You.* Lothrop, Lee & Shephard, New York.

Cobb, Vicki, (1972). *Science Experiments You Can Eat.* Harper & Row, New York.

Gardner, Robert, (1989). *Science Around the House.* Julian Messner, New York.

Herbert, Don, (1959). *Mr. Wizard's Experiments for Young Scientists.* Doubleday, Inc., Garden City, N.Y.

Katz, Phyllis, (1990). *Exploring Science Through Art.* Franklin Watts, New York.

Lewis, James, (1989). *Learn While You Scrub: Science in the Tub.* Meadowbrook Press, Deephaven, Minn.

Shermer, Michael, (1989). *Teach Your Child Science: Making Science Fun for the Both of You.* Lowell House, Los Angeles.

Stacy, Dennis, (1988). *Nifty (and Thrifty) Science Activities: Demonstrations, Experiments, and Learning Labs.* David S. Lake, Belmont, Calif.

Stein, Sara, (1980). *The Science Book.* Workman Publishing, New York.

Stine, Megan, and seven others, (1989). *Still More Science Activities* (from the Smithsonian Institition). Galison Books, GMG Publishing, New York.

Toney, Sara D., (1986). *Smithsonian Surprises: An Educational Activity Book.* Smithsonian Institution, Washington, D.C.

Van Cleave, Janice Pratt, (1989). *Chemistry for Every Kid.* Wiley, New York.

Zubrowski, Bernie, (1981). *Messing Around with Drinking Straw Construction.* Little, Brown and Company, Boston, Toronto.

Zubrowski, Bernie, (1985). *Raceways: Having Fun with Balls and Tracks.* William Morrow and Company, New York.

9. Magazines and periodicals:

3-2-1 Contact, Children's Television Workshop, One Lincoln Plaza, New York, NY 10023. Provides puzzles, projects, experiments.

Chickadee, Young Naturalist Foundation, P.O. Box 11314, Des Moines, IA 50340. Information, activities about nature-related topics.

Cricket, the Magazine for Children, Box 52961, Boulder, CO 80322–2961. Stories and experiments for elementary school children.

Ladybug, Cricket Country Lane, Box 50284, Boulder, CO 80321–0284. Stories and activities for preschoolers and beginning readers.

National Geographic World, National Geographic Society, 17th and M Streets NW, Washington, DC 20036. Excellent photographs, art, narratives.

Odyssey, Kalmbach Publishing Company, 1027 North Seventh Street, Milwaukee, WI 53233. Describes concepts and principles of astronomy.

Owl, Young Naturalist Foundation, P.O. Box 11314, Des Moines, Iowa 50304. Answers children's questions about nature and science.

Ranger Rick, National Wildlife Federation, 1412 16th Street NW, Washington, DC 20036–2266. Helps children enjoy nature and appreciate need for conservation through indoor and outdoor activities.

Science Weekly, Subscription Department, Science Weekly, P.O. Box 70154, Washington, DC 20088–0154. Focuses on topics in science, math, and technology.

Scienceland, Scienceland, Inc., 501 Fifth Avenue, New York, NY 10017–6165. Each volume focuses on a scientific topic.

WonderScience, American Chemical Society, 1155 16th Street NW, Washington, DC 20036. *WonderScience* is a science activity publicaton for children and parents.

Additional titles are available from libraries, bookstores, and from the following sources:

The American Association for the Advancement of Science (AAAS) reviews science books for children in *Science Books and Films.* For a subscription, write to SB & F Subscriptions, AAAS, Room 814, 1333 H Street NW, Washington, DC 20005.

Science Fare by Wendy Saul and Alan R. Newman includes listings. It was published by Harper & Row, New York, in 1986.

An object remains at rest (the potato, in this case) or keeps moving (the straw, in this case) unless it is acted upon by some external force. The Children's Book Council and the National Science Teachers Association each year cite outstanding science trade books for children. A list is available by writing to the National Science Teachers Association, Public Information Office, 1742 Connecticut Avenue NW, Washington, DC 20009. Send a stamped, self-addressed envelope.

"Books for Children" from CIC is an annual listing from the Library of Congress of the best books recently published for preschool through junior high school-age children. It includes books on science and nature. Send $1.00 to Consumer Information Center, Pueblo, CO 81009.

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Margaret Scott is an award-winning illustrator and designer who contributes to several national magazines, including *Science and Children* and *Smithsonian*. Her artwork is also seen on the editorial pages of the *Washington Post*, the *Kansas City Star*, the *Philadelphia Inquirer*, and other newspapers. She has illustrated eight books in the past four years for groups such as the American Psychologial Association, Reading Is Fundamental, and B'nai B'rith Women. She earned a bachelor's degree from Syracuse University and attended the Maryland Institute College of Art in Baltimore.

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Listen to them and pay attention to their problems.

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Encourage them to use an encyclopedia.

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Take them to the library—get them their own library cards.

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