Fleet

Sponsor of the 1999-2000
School Performance Series

Beakman: LIVE!
Study Guide

Hopkins Center
Outreach & Arts Education

Fleet Class Acts School Performance Series

As We Welcome You to the HOP...

A performance needs an audience, so prepare to play your part!

When you enter the Hopkins Center, an usher guides you to your seat. Backpacks, cameras, food, drink or gum are not allowed in the theater, so please plan ahead for this.

Chaperones play a vital role during the waiting time before the performance begins. This is the perfect time to escort small groups of students to bathrooms. Audience members in the balcony need to **behave safely**; chaperones carefully monitor students in the balcony.

A theater experience differs greatly from watching television or movies, or attending a sporting event.You will be sharing the theater with the performers! Most of the time during a school performance, you, as an audience member, will **watch and listen**. Any talking in the audience is distracting to performers and other audience members. Applause is the appropriate way to show approval to performers; whistles and calling out are not acceptable responses. **Respect is the rule** of the theater.

After the performance, an usher will lead you from the theater to a Hop exit. Remember when walking through the Hop that this building is used for a variety of purposes. Dartmouth students are often in classes, faculty and staff have offices and meeting rooms in the building, and concurrent performances or rehearsals may be occuring as you're leaving. **Show consideration** for all those sharing this building by remaining quiet and orderly in common areas and following the directions of the Hop staff.

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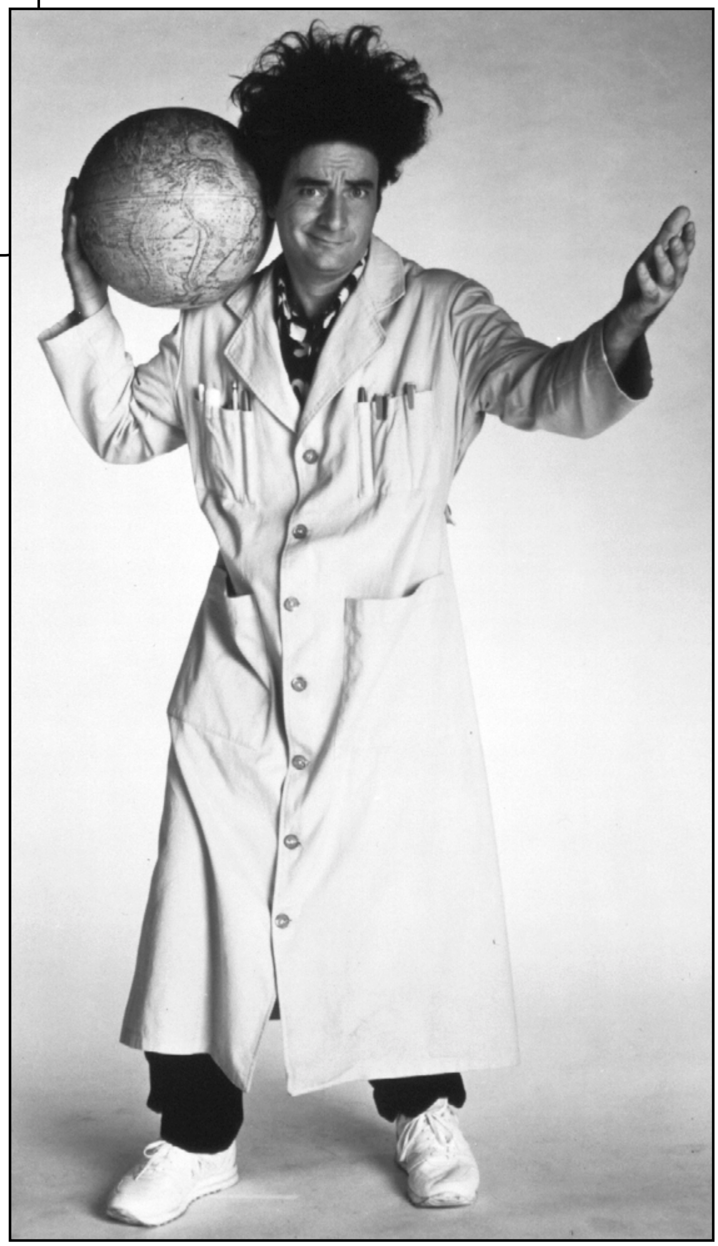
The Hopkins Center thanks Fleet Bank for generously supporting the Fleet Class Acts School Performance Series.

BEAKMAN: LIVE!

BEAKMAN: LIVE!

Welcome to the Hopkins Center School Performance Series study guide! This guide is designed to help you and your students prepare for, enjoy, and remember your trip to the Hopkins Center performance of **Beakman: LIVE!**



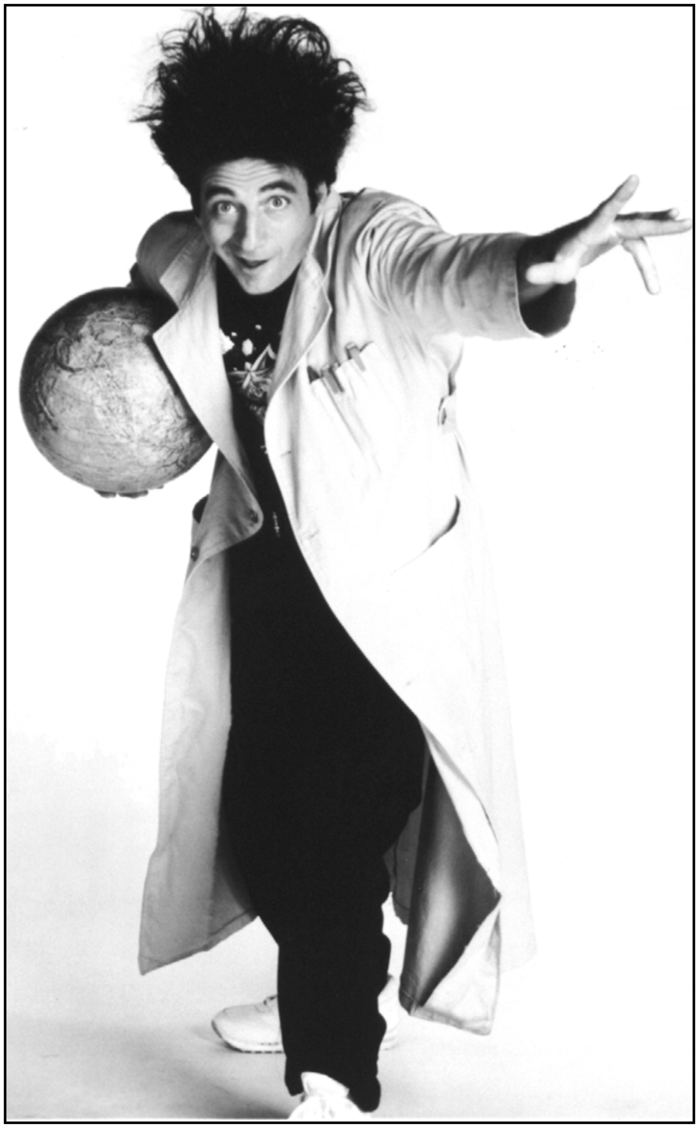
THIS GUIDE INCLUDES:

- Introduction to the Artist
- Background Information
- Vocabulary
- Learning Activities
- Additional Resources

BEAKMAN: LIVE!

BEAKMAN: LIVE!

INTRODUCTION TO THE ARTIST



He once got stuck in a model of a giant nostril, has electric-shock Kramer-style hair, and cooks up rapid-fire experiments with a kaleidoscope of crazy objects. It's Beakman, of course. The wild, wacky "scientist" from the Emmy Award-winning television kids' show *Beakman's World*. Slapstick, humor and real science are the formula for answering questions from children: What makes people burp? How does soap work? Awaken your own natural curiosity about the world around us through *Beakman: LIVE!*

Performance Artist and Guggenheim Fellow Paul Zaloom, best known as Beakman, concocts simple experiments and performs scientific demonstrations. Beakman uses a full array of tricks and is not beyond resurrecting dead scientists to teach how science can be applied to our daily lives.

Paul Zaloom got his start in the Bread and Puppet Theater, a politically based experimental and avant-garde puppet theater in Vermont. These days, though, he's best known from *Beakman's World*, a show Zaloom compares to "a post-modern Mr. Wizard with a lot of Soupy Sales thrown in." Of the "Beakman" approach Zaloom explained, "What we're interested in doing is opening the doors. We're not putting the fun in science, we're just letting the fun in science out."

WHY IS SCIENCE SCIENCE?

The word science comes from an old Latin word meaning knowledge, and scientists today still think of themselves as simply pursuing the acquisition of knowledge. Letting kids know that science starts with nothing more than curiosity and imagination releases them to begin asking questions about the world around them.

Teachers must struggle with the tension between curriculum demands, a set of predetermined goals, and allowing students to set and meet their own goals. It's important to allot time for students to engage in scientific inquiry that follows their natural learning affinities. Yet, these activities must be more than simply hands-on exercises. After students have formulated their questions and devised ways to answer them, they present and explain the process to the class. As they proceed, students justify their work to themselves and to one another, learn to cope with problems such as the limitations of equipment, and react to challenges posed by the teacher and classmates.

Beakman's performance stresses the fun in science while answering real kids questions. Those questions deal with everything a kid ever wanted to know about subjects from gravity to how sound works. Getting kids to think, to ask questions, and to see science in everyday life needn't be intimidating or boring. One way for teachers to make science more accessible is to allow students to pursue their own interests in greater depth. Because we believe that experimentation is the heart of science and is also what makes it fun, we include a sampling of activities to ignite the imagination. They are excerpted from:

Barron's Science Wizardry for Kids by Margaret Kenda and Phyllis S. Williams
The Concise Encyclopedia of the Sciences, Ed. John-David Yule
The National Science Education Standards
The 1995 Grolier Multimedia Encyclopedia
The Science Book of Electricity by Neil Ardley
The Science Book of Sound by Neil Ardley
The Science Book of Hot and Cold by Neil Ardley
The Vermont Standards
The Way Things Work by David Macauley
http://www.discoveryschool.com

Students of all ages have questions about themselves, their world, and how things work. Basing learning experiences on student directed questions is one sure way to engage students and motivate them to learn. For those who feel the pull of curriculum demands, it is important to remember the state standards that each activity targets. All of the following activities relate to one or more specific standards; involve content and processes; lead to products and performances (which can be used to assess student learning); engage students; and promote active learning.

BEAKMAN: LIVE!

VOCABULARY

Air Pressure	The force exerted over an area by the weight of the atmosphere.
Center of Gravity	The point at which all of an object's weight may be regarded as being concentrated.
Conduction	The direct transmission of heat through a substance from a region of high temperature to a region of low temperature.
Conductor	Any material that transfers heat; the opposite of an insulator. Metals and carbon are good conductors; glass and porcelain are poor conductors.
Conservation of Energy	In a closed system, energy cannot be created or destroyed; the level of total energy within the system remains constant.
Convection	The movement of heat energy through a liquid or gas which expands as its temperature rises.
Heat Exchange	The movement of heat from one region to another, always moving in the direction of hot to cold.
Infrasound	Sound-like waves of frequencies below the usual audible limit of 20 Hz.
Insulation	Any material that is a poor conductor of heat, and that is used to suppress the flow of heat.
Radiation	The transfer of heat by infrared rays (i.e. heat reaches the Earth from the Sun by radiation).
Sonic Boom	A high intensity sound wave occurring when an airplane traveling faster than the speed of sound overtakes the pressure waves it creates.
Static Charges	Either positive or negative; an object that has equal quantities of positive and negative charge is neutral; two objects that have the same charge repel each other; objects with opposite or unlike charges attract each other.
Thermal Equilibrium	An object is in thermal equilibrium with its surroundings if no heat enters or leaves it, so that all its parts are at the same temperature as the surroundings.
Ultrasound	Pressure waves similar to sound waves but occurring at frequencies above 20,000 Hz.
Vaporize	To change a state of matter from solid or liquid form to the form of a gas.
Wave	A disturbance or tiny movements traveling through space. The chief characteristics of a wave are speed, wavelength, frequency and amplitude. Waves transport energy (heat and sound) and show the properties of

WHAT IS HEAT?

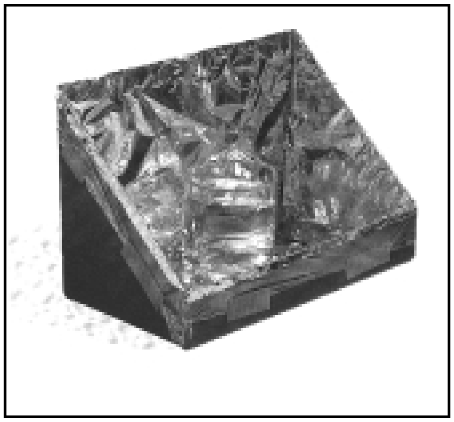
Heat is energy. The Law of **Conservation of Energy** tells us that the energy in a system can move and change form, but it can't go away. Heat is transferred by **conduction, convection** and **radiation**.

It always flows from a region of higher temperature to one of lower temperature (hot air moves towards cold air). Its effect on a substance may be simply to raise its temperature, or to cause it to expand, melt (if a solid), **vaporize** (if a liquid) or increase its pressure (if a confined gas).

The sun is our world's constant generator of heat. Heat from the sun produces the energy to sustain all life on this earth. Food produces heat inside our bodies. Burning fuels, such as coal, oil, gas and wood, create heat outside of our bodies.

Hot and cold are caused by the same thing—heat. Cold objects contain less heat than hot ones. An object can become more or less hot through **heat exchange**. An object can retain heat as **insulation** creates heat storage.

You can build a trap that will catch heat **waves** from the sun and warm things up.



Materials to make your own heat trap:

√ Glass of water
√ Large cardboard box
√ Aluminum foil
√ Plastic wrap
√ Scissors
√ Ruler
√ Tape
√ Pen

1. Draw matching diagonal lines across the short sides of the box.
2. Carefully cut the corners and most of one side off the box.
3. Line the inside of the box with aluminum foil.
4. Place the box somewhere sunny and set the glass of water inside it. Cover the box with plastic wrap.
5. After 30 minutes, carefully test the water with your finger.

Extensions: Waves of heat from the sun pass throgh the plastic wrap and warm the air in the box. Because the warm air can't escape, heat builds up inside the box. This is how a greenhouse works! Can you think of other situations in which this happens? What other applications can come from this principle?

BEAKMAN: LIVE!

LEARNING ACTIVITIES

HOW DOES THE SAME THERMOS KEEP THINGS HOT AND COLD?

A thermos has a shiny lining and tight seals that don't allow much heat to escape. Insulation (which can be foam, water, or even air) surrounding an inner container also keeps the heat from escaping. Heat cannot get into the inner container, either, which is how a thermos also keeps cold drinks cold.

Materials to make your own thermos:

- √ Large jar with lid
- √ Small jar with lid
- √ Small glass
- √ Warm water
- √ Tape
- √ Wide cork
- √ Scissors
- √ Aluminum foil

What To Do:

1. Wrap two layers of aluminum foil around the small jar and tape them in place.
2. Pour warm water into the glass and the small jar. Put the lid on the jar.
3. Place the cork in the center of the bottom of the large jar and set the small jar on top of it.
4. Put the lid on the large jar. This is your insulated container.
5. Wait for five to ten minutes. Take the jar out and dip a finger in the water. It is still warm, unlike the water in the glass,which has cooled.

Extensions: Have students describe their experiment by explaining it in terms of heat storage. Can they think of other situations where this happens? What other applications can they come up with for this principle?

SOUND

How do I hear sounds?

Sound is formed when a vibration happens. Loudness is determined by the size of the vibrations. Pitch is determined by the speed of the vibration. Frequency is the number of vibrations per second. Faster vibrations produce higher pitches; slower vibrations perduce lower-frequency pitches. The lowest note on the piano is at 30 vibrations per second; the highest note on the piano vibrates at 4000 vibrations per second, or 4000 Hertz.

Humans hear sounds that fall in the range of 20-20,000 Hertz (Hz). Hertz are units for measuring vibrations per second. Some animals hear frequencies lower than ours, while many animals hear higher frequencies. If you were to blow a dog whistle, you would hear nothing at all, yet a dog would hear it due to its capacity to hear higher frequencies.

Make a drum and see how it detects sound. Your ears detect sounds in the same way.

Materials:

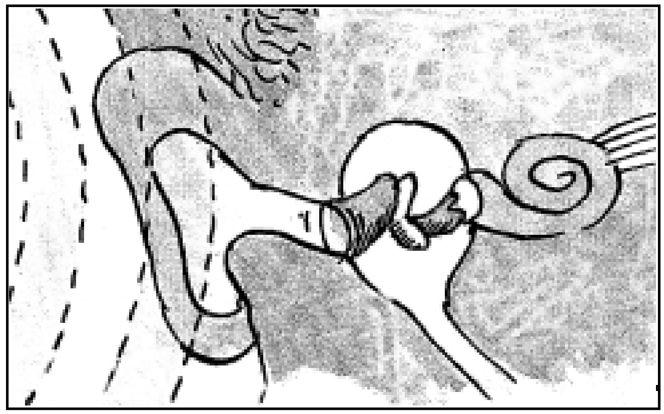
- √ Rubber band
- √ Scissors
- √ Tape
- √ Saucepan
- √ Uncooked rice
- √ Large spoon
- √ Plastic bowl

1. Cut the piece of plastic so that it is bigger than the top of the bowl.
2. Stretch it tightly over the top of the bowl and secure it with the rubber band.
3. Tape the plastic down to keep it taut. This is your drum.
4. Sprinkle a few grains of rice on top of the drum. Hold the saucepan near the drum and hit it sharply with the spoon.

Extensions: Have the students talk about what they observe. Can they draw correlations between this drum and their own eardrums? How is this related to the phenomenon of thunder?

BEAKMAN: LIVE!
LEARNING ACTIVITIES

SEEING SOUND



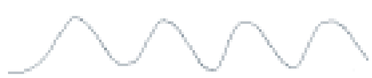
As sound waves enter the ear, the pressure differences between the ripples of waves vibrate a thin sheet of skin inside the ear. This skin is called the ear drum. These vibrations pass to the cochlea in the inner ear, where they are converted into electric signals. The signals travel along the auditory nerve to the brain where the sound is translated.

Playing an instrument makes part of it vibrate rapidly back and forth. The vibration produces sound waves in the air, which travel to our ears.

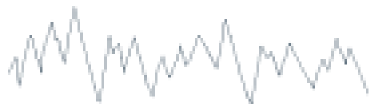
These sound waves are small, but they cause rapid changes in air pressure at the same rate as the vibration of the musical instrument. The sound wave from each instrument makes its own kind of pressure changes. If we could see these waves, we would see curved and jagged lines that are in various patterns and sizes, according to the pitch and volume of the musical sound.

The pitch of a musical note depends on the frequency of the vibrations and shape of the sound waves.

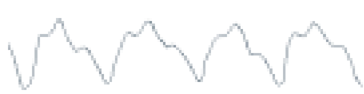
Tuning Fork
A tuning fork makes a pure sound with even, rounded sound waves.



Violin
The violin makes a bright sound that has jagged waves.



Flute
The flute creates a more mellow sound than the violin, and rounder sound waves.



Each wave is created by a particular pattern of vibration in an instrument. The sound of music causes our eardrums to vibrate in the same pattern as the instrument being played. These vibrations are "translated" by the brain so that we can recognize which instrument is being played.

BEAKMAN: LIVE!
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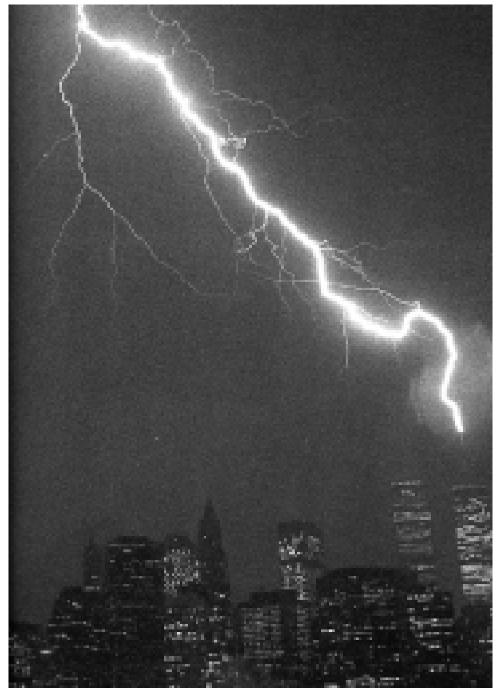
LEARNING ACTIVITIES

THUNDER

Where does thunder come from?

In a thunderstorm, a flash of lightning makes a powerful sound wave. This wave spreads out through the air. When the sound wave reaches our ears, we hear a thunderclap.



Speed of Sound

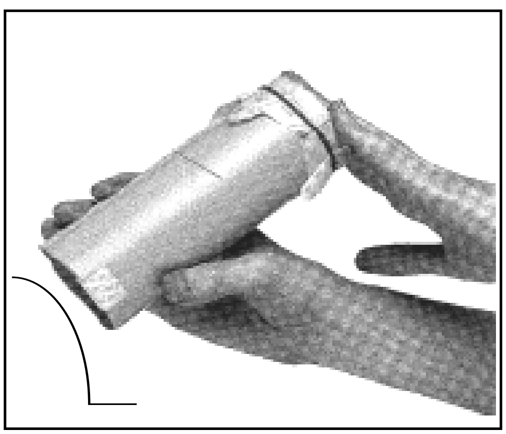
The ancient Greeks knew that sound was related to the motion of air. Efforts to measure the speed of sound in air began in the 17th century.

We know now that sound travels 340 meters (or 1,115 feet) per second—that's how long it takes the sound of thunder to reach our ears.

You can create your own traveling sound waves.

Materials:

- √ Thin plastic
- √ Stiff paper
- √ Cardboard tube
- √ Strip of paper
- √ Pencil
- √ Tape
- √ Scissors
- √ Rubber band



1. Use the tube to trace a circle on the piece of paper.
2. Cut out the circle.
3. Make a hole in the center of the circle with the pencil.
4. Tape the circle firmly to one end of the tube.
5. Fold the plastic over the other end of the tube, and secure it with the rubber band.
6. Make a fold in the paper strip and tape one end to a flat surface so that the other end sticks up.
7. Position the end of the tube so the hole is directly above the paper strip. Sharply tap the other end of the tube.The tap makes the air inside the tube vibrate and a sound wave travels out of the tube, shaking the paper strip.

STATIC ELECTRICITY

Why is there lightning in a thunderstorm?

Electricity causes the lightning we see in the sky. This “invisible” energy of electricity is all around us. You can generate electricity with a balloon. Rubbing objects together, as with a balloon and a wool sweater, can produce static electricity.

Objects with static electricity in them are said to have a “charge.” There are two kinds of **static charge**—”positive” and “negative.” These different charges attract or repel each other.

Materials to make repelling balloons:

√ Balloons
√ Paper
√ Wool or fleece cloth
√ String
√ Scissors

1. Inflate the balloons and tie the ends. Rub the balloons on the cloth and observe what happens when you hold the balloons up to a wall, to yourself, next to a stream of water running from a faucet.
2. Use a long piece of string to fasten two balloons together. Hold the string at its center point, letting the balloons hang down. What happens when you slide a piece of paper between the balloons?
3. Cut the paper into small shapes and hold the charged balloon above them.

Extensions: Have the students come up with their own experiments. Can they explain their observations in terms of static charges? Can they come up with other situations in which this happens?

Ask your students to observe and record the effects of electric charge (e.g. charges repel) and investigate non-magnetic sources, and materials that are conductors and non-conductors of electricity.

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ADDITIONAL RESOURCES

A Handbook to the Universe: Explorations of Matter, Energy, Space, and Time for Beginning Scientific Thinkers by Richard Paul; Chicago Review Press, 1993.

Art & Physics: Parallel Visions in Space, Time, and Light by Leonard Shlain; Quill, 1993.

Energy and Power by Rosie Harlow; Kingfisher Books, 1995.

Experimenting With Time by Robert Gardner; Venture Books, 1995.

Exploring With a Magnifying Glass by Kenneth G. Rainis; Venture Books, 1991.

Eyewitness Books: Music by Neil Ardley; Alfred A. Knopf, 1989.

Hot and Cold (Start-Up Science) by Jack Challoner; Raintree/Steck Vaughn, 1996.

Janic Vancleave's 202 Oozing, Bubbling, Dripping and Bouncing Experiments by Janice Pratt Vancleave; John Wiley & Sons, 1996.

Kitchen Chemistry and Front Porch Physics by Marie A. Hoyt; Educational Services Press, 1983.

Light (Science Through Art) by Hilary Devonshire. This book is out of print, but it's worth it to search for a used copy through the Dartmouth Bookstore or Amazon.com.

Magic... Naturally! : Science Entertainments & Amusements by Vicki Cobb; Harper Collins Children's Books, 1993.

Matter and Energy: Physics in Action by John Clark; Oxford University Press, 1994.

Sound; The Hands-On Approach to Science by Andrew Haslam, Alexandra Parsons; World Publications, 1997.

200 Illustrated Science Experiments for Children by Robert J. Brown, Bob Brown; 1988.