# Bright Ideas For Teaching About Energy

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# MECHANICAL ENERGY

*3.11.1*
*Realize the basic concept that forces can move objects (push/pull)*

*4.11.3*
*Recognize that the motion of objects is affected by friction.*

*5.11.3*
*Recognize that the motion of objects is affected by friction.*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# EXPLAINING MECHANICAL ENERGY

**Materials Needed:**

Toy car with a spring inside
Balloons
Yo-yo

**Procedure:**

1. Push down on the car and hold it down. Say “The car has a spring in it. When I push down on the car, I’m storing my energy in the spring”

2. Let go of the car. Say” When I let go of the car, the car starts to move. The stored mechanical energy in the spring changes to motion. Why does the car stop after a while? The car stops because of friction. Friction changes some of the motion into heat.”

3. Hold up the balloon. Say” If I blow up this balloon, I’m using my kinetic energy to stretch the rubber, just like I used my energy to compress the spring in the car.” Blow up the balloon. Say “Energy is stored in stretched rubber and compressed air instead of a compressed spring. Where will the energy go if I let go of this balloon? The stored mechanical energy is converted into motion, heat and sound.”

4. Pick up the yo-yo. Say” If I let go of this yo-yo, how far back up the string do you think it will come?” Let go of the yo-yo. (It should come about 60% of the way back up the string. If the yo-yo sleeps, twist the yo-yo to tighten the string around the center spool) Say “The yo-yo only came about (60) percent of the way. Why didn’t it come back to my hand? Friction between the string and the yo-yo changed (40) percent of the energy into heat. Where is the energy stored that makes the yo-yo come back up after I let it go? The energy is stored in the yo-yo. Potential energy can be stored in many spinning objects, which sometimes are called flywheels.”

*From Secondary Science of Energy (National Energy Education Development Project (NEED).*

# FRICTION DEMONSTRATION

To show the power of friction, “ shuffle the pages of two paperback books together so that the pages are intertwined. Then call on the strongest student you have to try to pull the books apart. No matter how hard the student tries, the books will not separate because friction is holding them together. (However, you can separate the books by slightly twisting the pages as you pull.)

# SHAKING SAND

Tell students:
1. “Here, I have two containers of sand. One is filled about a third of the way and the other is filled to the top. Let’s record the temperature of the two containers in Fahrenheit and Celsius.
Since they have both been in the same environment, they should be the same temperature.”
(Record the temperatures)

2.”Now, let’s put the tops on tightly and begin shaking the containers. After thirty seconds, pass them to other students. I would like everyone in the class to shake both containers for thirty seconds. “

3. “Now, let’s check the containers of sand. Let’s check the container with a little sand in it first. (Record the temperature of the container of sand. You should see a 2-5 degree Celsius increase with the third-full one, less with the full one. The difference will be move apparent on the Fahrenheit scale since the increments are smaller on the Fahrenheit scale. A five degree difference in Celsius should equal a nine degree difference in Fahrenheit.)

4. Ask: What do you think caused the temperature change? (Shaking the container is kinetic energy – the energy of motion. By shaking the container, we moved the grains of sand, causing them to collide with each other. They rubbed against each other, causing friction between the particles and producing heat. We transformed our motion into heat.)

5. Record the temperature of the full container of sand. You should see about a 2 degree Celsius increase.

6. Ask: Why is the increase in temperature greater for container that was only 1/3 full? Because the partially filled container has more space in it, and the grains of sand collide with each other with more velocity. More velocity means more kinetic energy. In the container filled with sand, the grains of sand have little space to move.

*From Elementary Science of Energy Kit, by the N.E.E.D. Project. You can borrow this kit for 2 weeks from the Tennessee Energy Education Network. Call 1-800-342-1340 to reserve this experiment kit. The NEED Project also has a Membership kit available, valued at $35, which contains fact books, activity ideas, competition opportunities and games that reinforce learning. The Membership kit is available for $35.00 from NEED (www.need.org) or at a reduced rate of $5.00 by contacting the Tennessee Energy Education Network, 1-800-342-1340 or www.tnenergy.com*

# BOOKS ABOUT MECHANICAL ENERGY

***The Wheeling and Whirling Around Book*** by Judy Hindley

A lively celebration of circles, disks, spheres and all sorts of things that roll and spin. You have to turn the book to see the pictures and read it all. Candlewick Press, ISBN 1-56402-490-3

# MECHANICAL ENERGY - INEXPENSIVE MATERIALS TO ORDER

**EXPERIMENTING WITH MODEL ROCKETS**

For Grades 7-8. It really doesn't take a rocket scientist. This exciting series of rocketry activities—deliberately crafted to appeal to girls as much as to boys—introduces the importance of controlled experimentation to all scientific endeavors. Building on the GEMS guide Height-O-Meters, which is a prerequisite to this unit, Experimenting with Model Rockets takes students through the analysis, modification, and record-keeping involved in assessing the variables that affect rocket flight. They develop skills in planning and conducting controlled experiments, measuring in degrees and meters, and graphing and interpreting data. Safety considerations and teamwork are stressed at all times. ISBN 0-912511-20-6. 7 45-minute sessions. $16.00

*GEMS (Great Explorations in Math and Science)*
*University of California, Berkeley*
*Lawrence Hall of Science #5200*
*Berkeley, CA 94720-5200*
*Phone (510) 642-7771*
*Fax: (510) 643-0309*
*Email: gems@uclink.berkeley.edu*

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**"SINGING SONGS OF SCIENCE" CD**

This CD teaches scientific facts through music. One of the selections is Newton, Way Long Ago. It is a tribute to the famous scientist who gave us the Laws of Motion. This song goes on to explain his three Laws of Motion in very basic terms. Order online. $15.00 for CD. You can hear a sample of this song at the website listed below.

*J.P. Taylor*
*PO Box 150643*
*Cape Canaveral, TL 33915*
*Email: singinsongs@yahoo.com*
*Web: www.singinsongs.com/science.html*

**********

**BALLOON RACER**

Inflate the balloon attached to the back of this 4" long plastic car, and you have created a jet propulsion system that demonstrates Newton's Third Law of Motion**.** Item #1233. $1.00 each.

**PERPETUAL MOTION TOP**

Start the top spinning on its base and examine its action. These tops have a special quality – they continue spinning for hours or days without stopping! A fully detailed explanation is included along with instructions for performing two experiments…making this device both entertaining and educational. The replaceable 9-volt battery (included) lasts 100 hours or more. Item #1238. $12.50

**ROCKET BALLOON**

Flies in random, crazy motion, emitting whining, sputtering sound. Comes complete with its own inflation straw for use over and over. Great demonstration of action and reaction. String a line with a straw through it the length of the classroom. Attach the rocket balloon with tape to the straw, inflate it, and watch it travel the entire length of the classroom! Item #1235. 2 for $1.00.

*Museum Products*
*Phone: 1-800-395-5400*
*Fax: 860-572-9589*
*Web:www.museumproducts.net*

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**NEWTON'S 2ND LAW OF MOTION POSTER**

"When you accelerate a mass, the force is always with you". 19 x 25 inches. $4.25. Item #B-46

*RJD Posters*
*P.O. Box 8909*
*Moscow, ID 83843*
*Phone: 1-800-441-8558*
*Email: rjdesign@completebbs.com*
*Web: http://www.rjdposters.com/rjdesign/about.asp?*

**********

**COLLISION BALL APPARATUS**

Illustrated Newton's Third Law of Motion. Aluminum V track, 82 cm. long with 7 steel balls. Item #11738-2. $19.95

**BALL AND CARD**

Illustrates Newton's Second Law of Motion (Inertia) Item #11736. $11.95

**MOTION TASK CARDS**

Set of 36 lessons for grades 7-12. Item #TC21. $16.00 plus shipping charge of $5.00.

*TOPS Learning Systems*
*10970 S. Mulino Road*
*Canby, OR 97013*
*Phone: 503-266-8550*
*Fax: 503-266-5200*
*Email: tops@canby.com*
*Web: www.topsscience.org*

# MECHANICAL ENERGY
# RELATED WEB SITES

http://webquest.sdsu.edu/matrix/6-8-Sci.htm
**ROLLER COASTER MADNESS**
A Webquest where students design a roller coaster.

http://zebu.uoregon.edu/~probs/mech/work/Energy1/Energy1.html
**SKYDIVING**
A problem that uses the sport of skydiving to teach the conservation of mechanical energy.

http://zebu.uoregon.edu/~probs/mech/work/ski/ski.html
**DOWNHILL SKIING**
This word problem is based on the conservation of mechanical energy.

http://zebu.uoregon.edu/~oribs/mech/circ/Rotation5/Rotation5.html
**SWINGING A SLING**
A word problem that uses a sling to demonstrate the physics of motion.

http://www.acme.com/jef/science_songs
**MOTION, MOTION EVERYWHERE** (from Energy and Motion Songs)
**BALLAD OF SIR ISAAC NEWTON** (From Space Songs)
These two songs, from LPs that were produced in the late 1950s/early 1960's are now available on the Web. Listen to them online.

http://www.brainpop.com/science/seeall.weml
**NEWTON'S LAWS Motion Picture**
This site has all kinds of quick movie clips which pertain to science. View the movie online.

http://www.exploratorium.edu/skateboarding/
**SKATEBOARD SCIENCE**
Momentum, gravity, friction, and centripetal force have never been so interesting. This online exhibit from the Exploratorium explains how skateboarders seemingly break the laws of gravity with tricks shown and explained in physics terms. The site includes a video webcast, glossary, and information about equipment.

http://www.reachoutmichigan.org/funexperiments/agesubject/physicalsciences.html
**PHYSICAL SCIENCE LESSONS**
Click on "Paper Rockets" (Early Elementary), "Pencil Rockets" (Later Elementary) and "Newton Car" and "Riverboats – How Does Steam Power Big Machinery?" (Middle School) for activity ideas related to mechanical energy and motion.

http://www.teachervision.com/lesson-plans/lesson-2647.html
**POTENTIAL AND KINETIC ENERGY Printable page**

# RADIANT ENERGY

*4.14.1*
*Know that energy exists in many forms*

*4.14.2 5.14.2*
*Recognize the characteristics of light energy and sound energy*

*5.14.2*
*Observe and describe how lenses affect a beam of light.*

*6.14.1*
*Identify and describe the characteristics of waves*

*6.14.5*
*Understand the nature of light, including the electromagnetic spectrum.*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# MIXING COLORS TO MAKE LIGHT

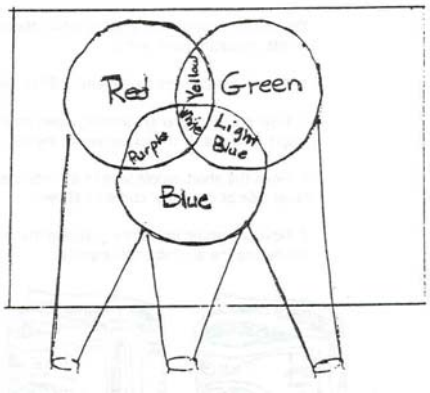
*Show how colored light can be mixed to make white light.*

**Materials:**
3 flashlights
Red, green and blue gel sheets*
A white background

**Procedure**:
1. Cover each flashlight with a different color of gel sheet. (Some instructions say use cellophane but you will get better results with gel sheets.)

2. Project the red, green and blue flashlight against a white background. (Stand close to the background)

3. Gradually move the different lights together. You will begin to see the colors of purple, yellow, blue and white where the colors overlap.




**ORDERING INFORMATION**
*Gel sheets are available from theater supply stores. A sheet usually costs about $7.00. You can get many flashlight-sized circles from one sheet. If you are just covering three flashlights for you to use as a demonstration, you will need sheets approximately 6” x 6”. (Before ordering, ask if they have any remnants they could let you have or sell very cheaply). We got our gel sheets from

Bandit Lites
1600 J. P. Hennessy Drive
LaVergne, TN 37086
Phone: 615-641-9000
Fax: 615-641-9010
Contact: Cori

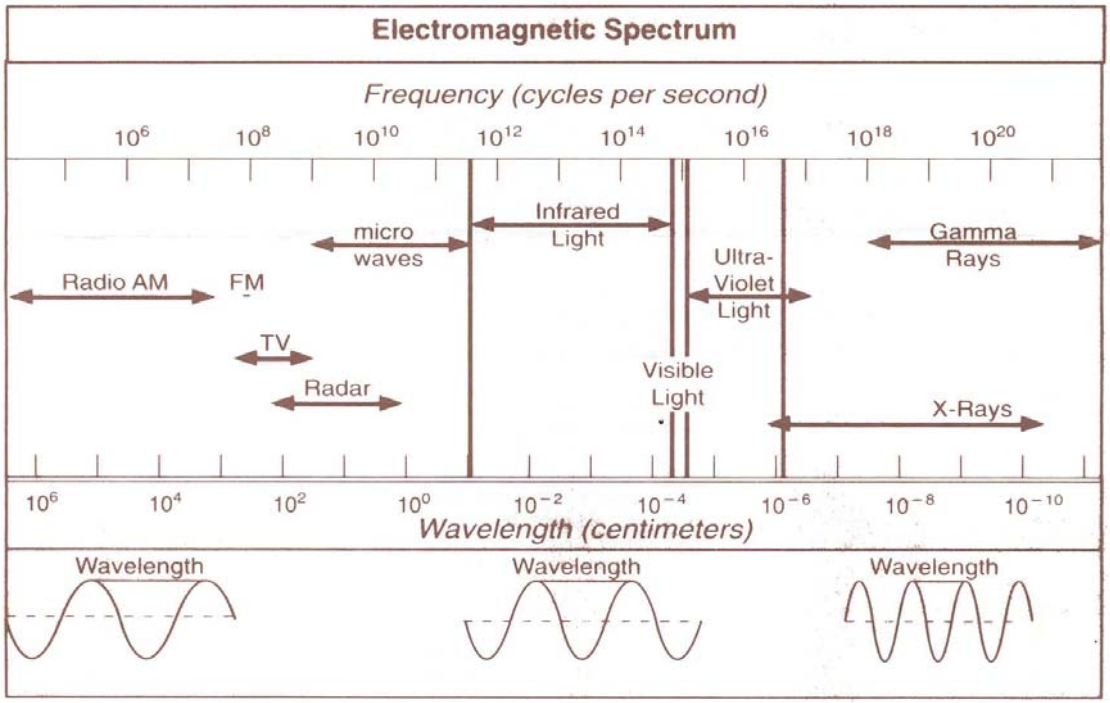
# The Electromagnetic Spectrum

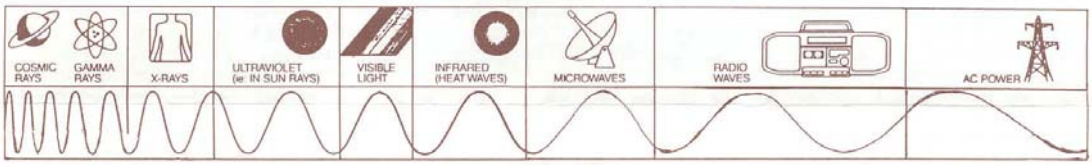
The chart showing the electromagnetic spectrum is designed to illustrate the properties of radiation at different energy levels. The gamma rays and X-rays are waves of pure energy. Like all electromagnetic waves, they travel at the speed of light.

Using the chart, you can see that:
a. As you go across the spectrum from left to right, the frequency (in cycles per second) of the electromagnetic radiation increases and the radiation becomes higher in energy.

b. As the frequency increases, the wavelength – that is, the distance covered by one cycle – decreases. The wavelength is equal to the velocity of light divided by the frequency. Students should recognize that a characteristic of the highest energy electromagnetic rays (gamma rays) is a short wave length.

c. Some sources of less energetic electromagnetic waves include radio and television, microwave ovens, X-ray machines, and radar. Of course, it also includes the Sun and other objects and events in space that send gamma rays and cosmic rays to Earth.
*From U.S. Dept of Energy in reactions newsletter (American Nuclear Society)*



# A RADIOMETER

(Light into Motion and Heat)

A radiometer is a device with a four-bladed vane balanced on a needle inside a sphere. Because opposite surfaces of the vanes are black and white, incident radiant energy is absorbed or reflected to a different degree. The result is a spinning vane. The brighter the light, the faster it spins.

A radiometer has very little air inside – it is almost a vacuum. The black and white vanes are hanging on a needle. There is nothing else inside the bulb. When you put the radiometer in the light, the vanes begin to turn. The brighter the light, the faster they spin. The black van absorbs most of the radiant energy that strikes it and reflects only a little The white vane reflects most of the radiant energy that strikes it, and absorbs only a little.

When you put the radiometer in light, the vanes absorb energy and the light energy is changed into heat energy. The air molecules inside the bulb bounce off the vanes with more energy. If both sides were the same color, the vanes would never move.

But the vanes aren't the same color on both sides. The black side is absorbing more energy than the white side. When the air molecules hit the black side, they bounce back with more energy than when they hit the white side.

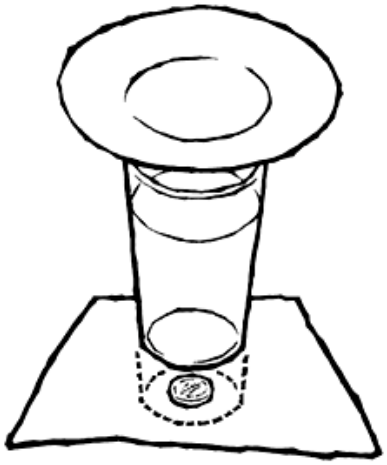
### ORDERING INFORMATION

*You can purchase radiometers from several science equipment companies. One such company is American Science and Surplus (http://www.sciplus.com/). Their radiometer is available at $10.95 each, Item 3817. You may order from their web site.

*From Elementary Science of Energy (the National Energy Education Development – NEED – Project). The NEED Project has a kit, valued at $35, filled with all kinds of energy-related materials, games, activities, competitions, and a quarterly magazine, Energy Exchange. You can request a kit for only $5.00 from The Tennessee Energy Education Network by calling 1-800-342-1340.*

# DISAPPEARING PENNY

Place a penny on a white piece of paper. Put a clear glass filled with water on top of the penny. Can you see the penny? Where is the best place to see it? Now place a saucer on top of the water glass. Try to find the penny without looking straight down through the water glass. Can you do it? You'll have to try it!



### How did the penny disappear?

We see objects because light rays reflect off them and into our eyes. But light bends each time it hits a substance of a different density. The light reflecting off the penny must pass through air, glass, and water (all with different densities) to get to your eye but the light bends so many times that by the time it gets to your eye, it looks like it's someplace it's not!

***Science Try-Its at***
***http://www.ktca.org/newtons/tryits/14/sciencetryits.html***

# THE INVISIBLE ENERGY IN LIGHT

**Materials:**

5 solar beads for each student*
2 clear Ziploc bags with five beads in each
1 piece of string for each student
1 large bowl or water
Clear spray sunscreen
Fabric
White and black paper
Umbrella

**Procedure Ideas:**

1. Have the students string the beads into bracelets in a room with no sunlight.

2. Have the students hold the bracelets close to an indoor light source and observe the beads.

3. Take the students outside into the sun and have them observe the beads.

4. Move into a shaded area and observe the color and intensity of the beads.

5. Have the students hold the bracelets under an umbrella, the white and black paper, and a piece of fabric. Observe any changes in the beads.

6. Spray one bag with sunscreen. Observe the bags. Note any difference.

7. Ask the students: How can you tell there is energy in the light from the sun? Is all light the same? Where do you find ultraviolet light? What materials can stop ultraviolet light? What things can you do to keep from getting sunburned? If you put on sunscreen and stayed in the water all day at the pool, do you think you could still get a sunburn?

*Solar beads are white when there is no ultraviolet radiation. The beads contain special pigments that change color when they absorb ultraviolet (UV) radiation. They are not affected by visible light and do not react to indoor light or when shielded from UV radiation. The beads help demonstrate to children that ultraviolet light is invisible. It is the light that causes sunburns –it changes into heat when it touches someone. We can't see it, but we can use the solar beads to tell it's there.

## Ordering information:

A package of 250 UV detecting beads can be purchased from Educational Innovations $6.95.
http://www.teachersource.com/ or call 1-888-912-7474. item UV-AST.
They can also be purchased from Museum Products. Item #154. 170 per package. $5.00/package.Phone: 1-800-395-5400, FAX: 860-572-9589;Web: http://www.museumproducts.net/

***From Energy Exchange Magazine.Nov/Dec. 2002. (National Energy Education Development Project (NEED) Project.) The NEED Project Membership kit, valued at $35, filled with all kinds of energy-related materials, games, activities, competitions, and a quarterly magazine, Energy Exchange. You can request a kit for only $5.00 from The Tennessee Energy Education Network by calling 1-800-342-1340.***

# COLORS OF THE RAINBOW

**Materials List:**

Prisms
Flashlights
Overhead

**Procedure:**

1. Turn on the overhead projector. Ask students what color the light is (white).
   Present the prism to the class. Ask students to predict what will happen when the prism is placed on the overhead

2. Place the prism on the overhead. Manipulate the prism until a rainbow is seen on the wall or ceiling. Ask the students what colors they see.

3. Bring up that when the overhead projector was first turned on the light was white, but what made it change? Discuss the prism and the fact that it is clear. Where could the colors have come from?

4. Introduce the difference between refraction and reflection. When the light passes through the prism it is bent, and so this is how we see color.

**Science Behind It:** Photons are particles of energy that makes up light, and light is a wave. When we see white light we are actually viewing all of the colors of the rainbow combined. The colors of the rainbow are: red, orange, yellow, green, blue, indigo and violet. It is easy to remember the colors if we think of ROY G. BIV, which contains the first letters of all the colors. Every color of light has its own particular amount of energy, and forms a particular wave. Violet, for instance is the shortest wave and red has the longest wave. The prism breaks the white light into a spectrum, and then the light is separated by the amount of energy, wave, and frequency it is associated with. Light is refracted as it passes through glass that makes up the prism. Refraction is when light passes through the object but is bent in the process, it is important to keep this definition in mind and not to confuse it with reflection, which is when light bounces off an object. The amount a color is bent is relative the amount of energy it produces. Violet, for instance, is bent the most, whereas red is bent the least. In a homemade prism, light rays are bent as they pass through water. We see rainbows when light hits droplets of water at various angles. The bow of the rainbow will vary by the position of the sun or light source. **It is important to remind students to NEVER look directly into light source, because it may damage their eyes.**

*From http://www.utdallas.edu/dept/sci_ed/Barbara/Fall2002/Sec001/PhysicalAM/Rainbows.doc*

# TIPS ON REMEMBERING THE DIFFERENCE BETWEEN CONVEX AND CONCAVE

## Concave -

"A concave lens looks like the opening to a cave, therefore you can remember that it curves inward."
http://www.lessonplanspage.com/ScienceConvexConcaveLenses69.htm

"It might help you to remember the difference in the shapes of the two lenses if you remember that a cave is hollow in the center, just as a concave lens is hollow in the center".

http://www.bbc.co.uk/scotland/education/bitesize/other/sos/physics/waves/answerwaves_38.shtml

"An easy way to remember the difference is to think of a lens with a side *caved* or *dented* in".
http://www.andrews.edu/~calkins/math/webtexts/geom02.htm

## Convex –

"The stomach of Rex is convex!"
http://www.museumonline.at/1999/schools/via/bayreuth/12e.html

"A convex mirror is also called a converging mirror. The first few letters are the same. If you can remember this, then it is easy to remember that a concave mirror must be a diverging mirror."
http://www.telusplanet.net/public/ccollins/phys/light/light.html

Convex lenses refract parallel light rays to they come together at a single point (convergence)
Remember: **Con**vex lenses **con**verge. Concave lenses refract the rays so they come apart (divergence)

# BOOKS ABOUT LIGHT

***All the Colors of the Rainbow*** by Allan Fowler. (Scholastic, 1999)

***Arrow To The Sun.*** Gerald McDermott

A Pueblo Indian myth that explains that the rainbow is used to bring the spirit of the Lord of the Sun to the world of people. (Viking) **ISBN**: 0-670-13369-8

***Bear Shadow.*** Frank Asch

When Little Bear's shadow gets in the way of his catching a fish, he decides to get rid of it. No matter what he does though, it won't go away!

After reading this book, discuss Groundhog Day and what a shadow is. Darken the room and use a tall, bright floor lamp to let the children experiment with their shadows. (Silver Burdette, reprinted 1996) **ISBN** 03-823365-6-9.

***Fireflies!*** Julie Brinckloe

A young boy is proud of having caught a jar full of fireflies, which seems to him like owning a piece of moonlight, but as the light begins to dim, he realizes he must set the insects free or they will die. (Scott Foresman/ Pearson K-12, 1986.) **ISBN**: 0689-710550-0

***Light.*** Sarah Waldman.

4-8 years. Award-winning illustrator Neil Waldman and his daughter, Sarah, combine their talents for the first time to capture in words and art the childlike joy and wonder of the creation story from the book of Genesis. “A joyous use of contemporary graphics to retell the first story.” (Harcourt, Inc. 1993). **ISBN** 0152208704

***Light Fantastic***. Philip Watson

In this book you'll have fun experimenting with color and light and often end up with something to keep or use. (Beech Tree)
**ISBN** 0-688-00975-1

***Light Magic.*** Trudy Rising and Peter Williams.

*Light Magic* has been written by two Canadian science educators. It is packed full of information about solar, wind, chemical, sound, heat and electrical energy and the energy of motion. A large selection of hands-on experiments provides ways to explore the causes and effects of energy. (Greey de Pender/Books from OWL). 1994. 64pp, **ISBN** 1-895688-16-7 (paper) $9.95

***Rainbow Rider.*** Juane Yolen

Saddened to discover that sand, tumbleweed, and cactus are not suitable friends, the Rainbow Rider flings his tears to the sky, and something special happens. (Crowell). **ISBN**: 0-690-00301-3

***See Hear – Playing With Light and Sound.*** Milan Tytla.

Grade 4-6-Readers are encouraged to explore the senses of sight and hearing through 18 hands-on activities. A list of materials needed and step-by-step procedures are given. (Toronto: Annick Press LTD, 1994). **ISBN**: 1-5-503798-87

***Sound and Light: Science Facts and Experiments*** (Young Discoverers Series)

Grade 3-6. This book of conceptual diagrams, facts, and experiments introduces students to sound and light. Realistic illustrations accompany short explanations of thunder and lightning, light waves, shadows, mirrors, refraction, lenses, how the eye works, and the visible light spectrum. Step by step instructions and labeled illustrations guide students in the use of household items to make a periscope, a simple magnifier and rainbows. Other activities involve students in simple demonstrations of light traveling in straight lines, and refraction of light. (Kingfisher books, 1993)
**ISBN**: 1-85697-935-0.

***Super Science Book of Light***. Grades 5-8.

This textbook, written for grades 5 through 8 as part of the SUPER SCIENCE series, introduces students to the science behind lasers, fiber optics, mirrors, and lenses. Students read about where light comes from, the difference between starlight and sunlight, and how the eye receives light. During the course of their reading, they participate in activities that help them understand how light functions in vision, in photosynthesis, and as an energy source. For example, after reading about the visible spectrum, students investigate color mixing by making a spinning color wheel. (Thomson Learning, 1993) **ISBN**: 1-56847-022-3. Order from Steck-Vaughn Company, PO Box 690789, Orlando FL 32819, (800) 531-5015, Fax: (800) 699-9459, http://www.steck-vaughn.com/

***The Art of Hand Shadows***. Albert Almonznino

Clear explanations and over 70 illustrations demonstrate how to position your hands to make lifelike shadows of a lumbering dinosaur, a pair of playful monkeys, an eagle taking flight, a cat scratching itself, a howling wolf, a neighing horse, a dog that eats a rabbit, and many other figures. Good advice also on how to organize a performance of your own shadow art. (Dover Publications, 2002). **ISBN:** 0486418766

***The Rainbow Fish***. Marcus Pfister.

The Rainbow fish, with his coloring, glimmering scales is far and away the most beautiful fish in the entire ocean, but because of his vanity, he finds himself alone with no one to admire his beauty. Watch as young readers delight in the wonderfully illustrated book which teaches an important lesson to young and old alike.. Available for $9.95 at http://www.teachersource.com/catalog/index.html. Item #BK-210.(North-South books, 1996). **ISBN:** 15-58-5853-6-2. (Extend this literature connection to include science with Ultraviolet Detecting Beads. See the" Inexpensive Materials To Order" section in this ACCENT unit.)

***The River That Gave Gifts***. Margo Humphrey

This picture story, with hand printed rather than typeset text, about children who want to give gifts to a beloved elderly woman before her sight becomes too poor to see them, emphasizes respect for the elderly and the value of imagination. Three children prepare gifts they know will be appreciated, but through thought and imagination the fourth child provides light by which the gifts can be seen. (Children's Book Press. ISBN: 0-89239-027-1. Reading level ages 9-12.

# RADIANT ENERGY -
# FREE MATERIALS TO ORDER

**ON THE TRAIL OF ENERGY: Classroom Poster**
Download this black-and white poster image from the web site below and photocopy it. Have students locate the forms of energy illustrated on it, including radiant energy (energy that travels in waves, such as sunlight, radio waves, and X rays).

http://www.blm.gov/education/00_resources/articles/energy/energy4.html

**********

**A JOURNEY THROUGH OUR EYES – CD-ROM**
For Grades 4-7.This is an interactive program about eye care and eye safety. Vision is a miraculous and intricate process – something most of us take for granted. Eye problems and concerns should not be thought of as being limited to older people. Abut 12% of American children under five have clinically significant vision problems. One in four children from 5-9 years of age has vision problems, and it is estimated that over 150,000 school children suffer eye injuries each year. The more young people know about how their eyes work and what kind of regular care the eyes need, the more likely they will be to practice eye safety and preventive eye care throughout their lives. The activities within the program have been designed for students ages 9-13. This CD-ROM is provided to you on "permanent Loan" which means you may keep it as long as you like and use it as often as you wish, year after year, until you are notified that it has been withdrawn from use. For a list of all the free videos on permanent loan, see http://www.vpw.com/educational

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*St. Petersburg, FL 33715*
*Fax: 800-358-5218*
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**THE ELECTROMAGNETIC SPECTRUM (poster)**
Visible light is only one kind of electromagnetic radiation--the kind to which human eyes are sensitive. There is also invisible radiation, to which our eyes are completely insensitive. This poster sketches the entire range of electromagnetic radiation. FREE. To receive your poster, write to the address below. Requests submitted any other way will not be honored.

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*Department W, Room 267 C*
*Science & Technology Center*
*Tufts University*
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*Medford, MA 02155*

# LIGHT ENERGY –
# INEXPENSIVE MATERIALS TO ORDER

**RADIOMETER**
A four bladed vane is balanced on a needle inside a sphere. Because opposite surfaces of the vanes are black and white, incident radiant energy is absorbed or reflected to a different degree. The result is a spinning vane. The brighter the light, the faster it spins. Simple, but compelling. Order from the Website. $10.95 each. Item #3817

*American Science and Surplus*
*Po Box 1030*
*Skokie, IL 60076*
*Phone: 1-847-647-0011*
*Fax: 847-647-5010*
*Web: www.sciplus.com/conact.cfm*
*Web: www.sciplus.com*

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**DARK SHADOWS**
Kit where students freeze their shadow, bubble-up a shadow rainbow, tell time with solar shadows, build a shadow box. Item # WG 5204. $12.99

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*Greensboro, NC 27425-5665*
*336-632-0084/800-321-0943*
*Fax: 336-632-0087*
*http://www.carsondellosa.com/mainsearch.pl*

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**COSMIC LIGHT SHOWS**
Interest Level K-8. Every once in a while the universe dazzles us with one of its various "light shows." Spectacular color photographs of these cosmic fireworks and the easy-to-read text of this book help explain to children the phenomena of meteor showers, comets, northern and southern lights, eclipses. $15.96 (hard cover); $5.36 (paperback). Available from the web site below**. ISBN**: 0-86505-690-0 (paperback)

**LIGHT**
Fascinating information and experiments help show why light is the most important source of energy. Simple, clear text explains what light is and helps make difficult scientific concepts like reflection and optical illusions easy to understand. History boxes feature the scientists who made the discoveries and inventions. Student will learn how we see things around us, how to bend light, why your reflections is smaller than yourself, how to make your own pinhole camera and periscope. $15.95 (hardcover); $7.16 (paperback). Available from the web site below. ISBN: 0-7787-0606-0 (paperback).

**LIGHT, COLOR AND ART ACTIVITIES**
Interest level 3-9. This amazing art activity book gets children involved in the science of light and color by combining interesting information with a multitude of fun art projects. $17.96 (hardcover); $8.06 (paperback). ISBN: 0-7787-1142-0 (paperback).

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Fill this 4"x4"x8" acrylic container with fluid to create giant rainbows in your classroom. WW 160-7847. $28.95

**SCIENCE IN ACTION VIDEO – LENSES AND MIRRORS (Grades 5-8)**
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**MIRRORS AND HOLDER SET**
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One-of-a-kind, eye-catching optics reference. Can be used as a quick reference for the lab or the classroom. Explains basic principles of optics and light: wavelength, color, lenses, mirrors, and other optical principles. 22" x 32". $9.95. Item #CR3054417

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22" x 24" filter sheets for photographic effects, home lighting display, theatrical productions, light show, etc. Sheets are approximately 0.2mm in thickness. Can be easily cut. Use them singly or in color combinations for one of a kind effects. Cut them to fit inside flashlights. Combining the flashlight beams will produce white light. These gel sheets are also available from theatrical supply stores.
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Red gel sheet – Item CR3035137 - $9.95
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**RAINBOW GLASSES**
Hands-o light exploration with economical cardboard glasses. (Pkg. Of 6).
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This terrific pigment is used to make paint and other products glow in the dark. To make a super glowing paint, simply mix this non-toxic powder with Elmer's glue. The pigment can be activated by just about any light source including sunlight, fluorescent, incandescent and ultraviolet light. Use our colored light sticks to demonstrate the pigment's greater sensitivity to blue light. Mix this glowing pigment 20-30% by weight to make the best phosphorescent paint.
Item # GLO-100A. $3.95

**PHOSPHORESCENT VINYL SHEET**
This 'glow-in-the-dark' material absorbs light and slowly emits it over a few minutes. By placing your hand over the sheet in the light, you can see your hand print (actually your hand's shadow) 'printed' on the sheet when it is placed in the dark. In a darkened room, a flash from a camera will excite this material. The material has a stick-on backing and can be cut with scissors. (12" wide.)
$10.25 for quantities of 1-10.

**CHEMICAL LIGHT STICKS**
Chemical light sticks don't create heat or sparks when lit and are completely waterproof. Place one in warm water and one in cold water and observe the effect of temperature on the rates of chemical reactions. 4" chemical light sticks - $10.95 for a package of 12. Item #SS-450AST(for assorted colors)

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These highly efficient, 13,500 lines per inch, double axis, holographic diffraction grating lenses separate light from any source into its spectral components for study and analysis. Great for firework displays and differentiating between incandescent, mercury vapor, and sodium vapor street lamps. Lenses are mounted in fluorescent cardboard frames. Sold in sets of 10 glasses. Item #PG-1 $7.95 for 1-10 packages.

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These contain a pigment which changes color when exposed to ultraviolet light from the Sun or other UV source. Each package contains 240 beads. Item #UV-AST. $6.95 per package.

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**ENERGY: HEAT, LIGHT and SOUND (Downloadable book) (Grades 1-3)**
80 pages. This book, designed with good science and easy teaching in mind, covers these concepts: energy can move and change things, energy exists in many forms, light is energy you can see, light moves in a straight line, light can pass through some materials and is stopped by other materials, light can be controlled by blocking a light source, heat is energy you can feel, heat can cause things to move and change, heat travels from warm objects to cold ones, heat can be controlled by containing it, sound is energy you can hear, sound energy is created by vibrating objects, sound travels at different speeds through different materials, sound can be controlled by changing the length of, or directing, sound waves, light, heat, and sound can move and change matter. Contains many reproducible, ready-to-go resources, such as record sheets, logbook forms, mini-books, and picture cards. Illustrated throughout with fun, helpful line art. All 80 pages perforated for easy removal. ISBN: 155-799-6903. $9.95 Download from web site.

**LIGHT: REFLECTION AND REFRACTION (Downloadable book) (Grades 3-6)**
16 pages. Students take part in a variety of activities designed to look deeply into the subject of light. This award-winning volume gets students involved hands-on with activities that explore these concepts: Where does light come from? , transparent, translucent, opaque, prisms, colors of light, how we see, and magnification. Other activities: how light travels, reflection, reflected art, Seeing is believing?, and more. Also features a two-sided, full-color (one side) pull-out poster about Light (and the spectrum) on one side and Your Eyes Can Fool You on the other side. Illustrated throughout with helpful line art as well as fun recurring "mouse" characters. All 16 pages perforated for easy removal. $5.95. ISBN# 1557992940

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**MORE THAN MAGNIFIERS (Grades 2-8)**
In this ingenious unit on physics, optics, and light, students use two lenses (available from Carolina Biological Supply Company) in different ways to create optical instruments and learn how the measurable properties of lenses are used in magnifiers, simple cameras, telescopes, and slide projectors. ISBN: 0-912511-62-1. $10.50.

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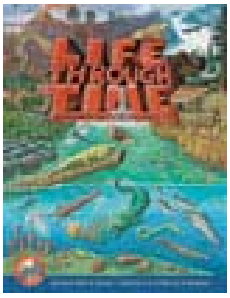


In this guide, intriguing activities deepen student understanding of the electromagnetic spectrum, enabling students to detect and consider wavelengths other than visible light. Activities feature energy stations, including infrared (TV remove); microwave (Pager); ultraviolet (black light) and other devices. Students come up with their own tests to see what blocks each wavelength, and what does not. They learn how these other wavelengths can be used to “see” things we cannot see with our eyes - allowing space scientists to detect and image objects, phenomena, and sources of energy far off in space. ISBN 0-924886-69-2. 5 activities. $21.00

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How do you make a distorted checkerboard perfectly square without touching it? You’ll be challenged, amused and entertained for hours with 238 geometric tricks, psychological illusions, and 3-D mazes. Offers “how-to’s” for making your own optical tricks with simple sheets of paper, glasses of water – even your own fingers! Item #SC15111. $19.95

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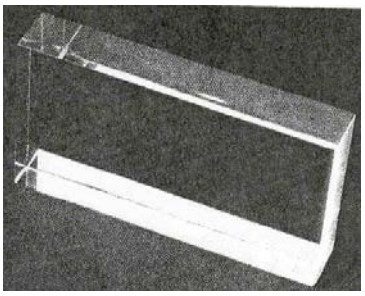

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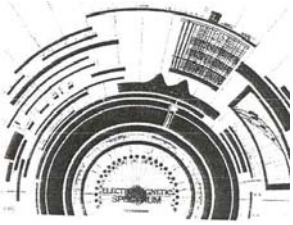

**HEAT, LIGHT and SOUND Reproducible book. Grades 1-3**
Curriculum-oriented worksheets that provide a focused unit of information on each subject. Cleverly illustrated puzzles, games and activities give hands-on experiences to students. Item #13871-2. $4.95.

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*Email: teachersaid@mindspring.com*
*Web: http://www.zteacher.com/teachersaid-ky/*

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**LIGHT AND SOUND task cards. Grades 6-12**
Part of their Self-Directing Task Card Series. It is an 88 page soft-bound book organized into three main parts: Introduction, Teaching Notes (36 lessons) and 36 reproducible line masters. Item #17. $16.00

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*Web: http://www.topsscience.org/*

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**SCIENCE WITH LIGHT AND MIRRORS (book)**
By K. Woodward. Ages 6-9. This colorful book is packed with exciting scientific activities designed to help young children explore the intriguing properties of light. All the experiments and tricks are safe and easy to carry out, using easily ordinary household equipment. Real examples show how people exploit the way light behaves for driving mirrors, periscopes, lenses and so on. The text and illustrations are clear and simple, so children can enjoy using the books by themselves. Further notes give more detailed explanations for adults who wish to work with their children. $4.95 (Paperback) **ISBN**: 0-7460-0696-9 (paperback) You can order from the website below.

**SCIENCE WITH LIGHT AND MIRRORS (kit)**
Ages 8-10. This kit offers both simple and exciting scientific activities designed to help children explore the intriguing properties of light. Just a few ordinary household items are all that is needed for most of the tests. Included are some hard-to-find items that will perform well in making the 'unbreakable' mirrors, periscope and kaleidoscope. **ISBN** 1-58086-358-2

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A tutorial that reflects the physics of light to our everyday lives.

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http://askeric.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Physics/PHS0020.html
**ASK ERIC LESSON PLAN: Laws of Reflection**

http://cse.ssl.berkeley.edu/light/measure.html
**UNIVERSE OF LIGHT**
Studies light behavior, light measurement, amplitudes and waves. From Berkeley.

http://curry.edschool.virginia.edu/murray/Light/How_Light_Works.html
**HOW LIGHT WORKS**
A complete lesson plan is available on this site. This site contains various activities on white light, the spectrum, refraction and more in order to teach grade schoolers a basic understanding of important concepts relating to light and color.

http://faculty.washington.edu/chudler/chvision.html
**VISION ACTIVITIES**
Activities involving blind spots, depth perception, shifting images, and more.

http://faldo.atmos.uiuc.edu/w_unit/LESSONS/day.night.html
**DIRECT AND DIFFUSED LIGHT**
This activity creates an understanding of the differences between direct and diffused light.

http://faldo.atmos.uiuc.edu/w_unit/LESSONS/lightisheat.html
**LIGHT AND HEAT**
Create a link between light, energy, and heat with magnifying glasses.

http://imagers.gsfc.nasa.gov/
**ECHO THE BAT**
Click on teacher site for lessons on light.

http://library.thinkquest.org/
**SEE THE LIGHT**
Tutorial on light theory covering its properties, color and optics for middle and high schoolers. Log on and search for "See the Light" using the "exact match" format to find more about properties of light.

http://magma.nationalgeographic.com/ngm/data/2001/11/01/html/ft_20011101.3.html
**AURORAS – Earth's Grand Show of Lights**
Read about the Northern Lights and see a video

http://pbs.org/wgbh/nova/einstein/hotsciencelight/index.html
**THE LIGHT STUFF**
This web site is from a PBS Nova program on Einstein

http://pbskids.org/arthur/grownups/activities/play_learn1/shadow_play.html
**SHADOW PLAY**
Use a light beam to make hand shadows and engage students by exploring how hand shadows "work."

http://pbscyberschool.pbs.org/teach/lesson14_1.html
**OF LIGHT AND LENSES**
Conduct experiments on the properties of light and learn how light could affect downhill skiers.

http://pbskids.org/zoom/sci/mirrormaze.html
**MIRROR MAZE**
Try to get light to reflect off of three mirrors and then shine on the back of a book.

http://spanky.cc/shadow.shtml
**SPANKY'S HAND SHADOWS**
Click on the hand shadow to see what it will become on the wall!

http://whyfiles.org/003eye/normaleye3.html
**HOW DOES AN EYE REALLY WORK?**
See a diagram of how an eye works.

http://whyfiles.org/coolimages/index.html?id=1037657968
**PICTURE OF A FLUORESCING MICROSCOPE**

http://whyfiles.org/146sad/2.html
**PICTURE OF A MAN SITTING IN FRONT OF A GAS LAMP**

http://whyfiles.org/shorties/081firefly/
An article about how fireflies light up.

http://whyfiles.org/shorties/055darksky/index.html
**LIGHT POLLUTION**
Article about a type of pollution often neglected.

http://www.20kweb.com/hand_shadows.html
**HAND SHADOWS**
Lots of good hand shadows here.

http://www.acme.com/jef/science_songs/
**SONGS ABOUT LIGHT ENERGY**
Listen to these songs originally recorded several years ago and recently made available on the Web.
"Why Do I Have a Shadow?" from "Experiment Songs" LP
" Ultra Violet "Infra Red" from the "Energy and Motion Songs" LP
"Why is the Sky Blue" from the "More Nature Songs" LP
"What Makes A Rainbow?" from the "More Nature Songs" LP
"How Many Colors Are In The Rainbow?" from the "Experiment Songs" LP
"Why Do I Have A Shadow?" from the "Experiment Songs" LP

http://www.brainpop.com/science/light/light/index.weml?&tried_cookie=true
**A MOVIE ABOUT LIGHT**
Animated BrainPop mini-movie about light.

http://www.brainpop.com/tech/healthtechnology/laser/index.weml
**A MOVIE ABOUT LASERS**
Animated BrainPop Mini-movie about lasers.

http://www.clipart.com/
**LIGHT-RELATED CLIP ART**

http://www.creativeclassroom.org/jf01aplus/science.html
**LESSONS ABOUT SHADOWS**

http://www.exploratorium.edu/snacks/colored_shadows.html
**COLORED SHADOWS**
Shadows are not all black and white. When two different colored lights shine on the same spot on a white screen, the light reflecting from that spot to your eyes is called an additive mixture because it contains the colors from both lights. This activity explores human color perception by using colored lights to make additive color mixtures.

http://www.exploratorium.edu/learning_studio/lightsource/menu.html
**LIGHT ISLAND**
Based on an exhibit at the Exploratorium Science Center, The Light Island is an excellent teaching tool. It can help teach about shadows, reflection, refraction, and color. This section will provide you with all the information you need to build the shop version of the Light Island

http://www.exploratorium.edu/xref/phenomena/absorption_-_light.html
**LIGHT ABSORPTION**

http://www.fi.edu/color
**LIGHT AND COLOR**
From the Franklin Institute, nice overview and pertinent links on color and light for young students or physics.

http://www.gelighting.com/na/home/gela/students/index.htm
**LIGHT: A LEARNING UNIT**
Created by General Electric, this unit deals with filaments, prisms, wattage, and electricity. Hands-on activities and experiments are included. Focuses on the history of lighting and the current uses of electric lights. The content includes brief histories of the various inventions that resulted in the emergence of both the electric light and wiring the nation for electricity.

http://www.kie.berkeley.edu/KIE/web/hf.html
**THE "HOW FAR DOES LIGHT GO?" DEBATE**
This is a debate project in which students examine the scientific properties of light. The culminating activity is an informal classroom debate where groups present their arguments about how far light goes and respond to questions from other students.

http://www.lightlink.com/sergey/java/java/clens/index.html
http://www.lightlink.com/sergey/java/java/dlens/index.html
**IMAGES FORMED BY CONVERGING (CONVEX) and DIVERGING (CONCAVE) LENSES**
Interactive web sites that allow you to change the position of the object with respect to a converging or diverging lens in order to see the immediate effect on the size and location of the image.

http://www.mos.org/learn_more/ed_res/cheapbook/see3d/index.html
**SEEING 3-D Lesson Plan**

http://www.mtnbrook.k12.al.us/MBJH/webpages/science/Fiskj/webquest2.html
**SCIENCE ALLIANCE**
Here come the superheroes to save the day! This website was designed to engage students learning about the electromagnetic spectrum. Student teams create a super hero and sidekick using the powers of different waves of the spectrum.

http://www.pbs.org/wgbh/amex/edison/tguide/index.html
**EDISON'S MIRACLE OF LIGHT**
Learn how electricity changed American life, and the world through this film which is part of the PBS American Experience. Questions for the teacher to ask before the students view the film are also included at this site.

http://www.pbs.org/edens/tasmania/teacher.html
**TASMANIA: FIND THE FISH** (How Light Refraction Affects Where To Find The Big One)
Learn how the White Breasted Sea Eagle adjusts its predation to account for refraction of light in the water.

http://www.pbs.org/wgbh/nova/teachers/activities/2311_einstein.html
**EINSTEIN REVEALED**
Conduct experiments to detect different types of radiant energy.

http://www.pbs.org/safarchive/4_class/45_pguides/pguide_404/4544_ozone.html
**SCIENCE 911: FIGHT A FIRE, SAVE THE OZONE**
Simulate an ozone hole and learn about UV damage to living cells.

http://www.pbs.org/edens/tasmania/teacher.html
**TASMANIA: FIND THE FISH – HOW LIGHT REFRACTION AFECTS WHERE TO FIND THE BIG ONE**
Learn how the White Breasted Sea Eagle adjusts its predation to account for refraction of light in the water.

http://www.pbs.org/wgbh/nova/gamma/spectrum.html
**TOUR THE SPECTRUM**
Students can take this online tour which incorporates a Flash plug-in to provide users a tour that begins with radio waves and takes them through microwaves, infrared radiation, light, ultraviolet radiation, X-rays and Gamma rays.

http://www.pbs.org/saf/1207/teaching/teaching3.htm
**BENEATH THE SEA: LIGHT STICK CHEMISTRY**
Students explore how the temperature of the chemicals that combine affects a chemiluminescent reaction.

http://www.pbs.org/kqed/springboard/sb-surveil.pdf
**HERE'S LOOKING AT YOU, KID**
Compare and contrast functionality of the human eye with a video camera; discuss the social implications of the increasing presence of surveillance cameras in today's society.

http://www.physicsclassroom.com/Class/light/lighttoc.html
**LIGHT WAVES AND COLOR**
The behavior of light waves is introduced and discussed; polarization, color, diffraction and interference are introduced as supporting evident of the wave nature of light. Color perception is discussed in detail.

http://www.physicsclassrom.com/Class/refln/reflntoc.thml
**REFLECTION AND THE RAY MODEL OF LIGHT**
The ray nature of light is used to explain hot light reflects off of planar and curved surfaces to produce both real and virtual images; the nature of the images produced by plane mirrors, concave mirrors, and convex mirrors is thoroughly illustrated.

http://www.physicsclassroom.com/Class/waves/wavestoc.html
**WAVES**
The nature, properties and behaviors of waves are discussed and illustrated; the unique nature of a standing wave is introduced and explained.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/other/circoflt.html
**CIRCLES OF LIGHT: THE MATHEMATICS OF RAINBOWS**
How are rainbows formed? Why do they only occur when the sun is behind the observer? If the sun is low on the horizon, at what angle in the sky should we expect to see a rainbow? This lab helps to answer these and other questions by examining a mathematical model of light passing through a water droplet.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/beakman/illusions.html
**WHAT ARE OPTICAL ILLUSIONS?**
The explanation behind this phenomena and some examples of optical illusions.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/bubbles.html
**USING BUBBLES TO LEARN ABOUT LIGHT INTERFERENCE**
Explores the wave nature of light, focusing on interference

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/beakman/threed.html
**HOW DOES 3-D WORK?**
Careful! Studying the pictures might give you a headache.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/other/circoflt.html
**CIRCLES OF LIGHT: THE MATHEMATICS OF RAINBOWS**
How are rainbows formed? Why do they only occur when the sun is behind the observer? If the sun is low on the horizon, at what angle in the sky should we expect to see a rainbow? This lab helps to answer these and other questions by examining a mathematical model of light passing through a water droplet.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/infrared.html
**WHAT IS INFRARED LIGHT AND HOW DOES IT WORK**?
How do we detect infrared light? How is it produced and how does it compare with visible light? What are some of the technologies that take advantage of infrared radiation?

http://www.sandlotscience.com/Ambiguous/Ambiguous_frm.htm
**SANDLOT SCIENCE**
This site has lots of optical illusions and weird experiments that might teach you something unless you're careful.

http://www.si.edu/lemelson/edison/html/thomas_alva_edison.html
**THOMAS ALVA EDISON**
Examines several of his inventions – the telegraph, telephone, phonograph, and electric light bulb. Students learn about his life and how to create their own light bulb. (Smithsonian National Museum of American History)

http://www.smgaels.org/physics/home.htm
**WAVE THEORY**
Guide to sound and electromagnetic radiation including Sound, radio, microwave, infrared and ultraviolet light, lasers, X-rays, and Gamma rays.

http://www.sundials.co.uk/
**SUNDIALS ON THE NET**
Everything you want to know about sundials.

http://www.thetech.org/exhibits_event/noyce_center/topics/11a.html
**HEAT, LIGHT and MOTION**

http://www.thetech.org/exhibits_events/online/color/intro/
**LIGHT AND COLOR**
Light theory in three interactive sections: Talking About Color, the Lighter Side of Color, and an Eye on Color.

http:/www.unidata.ucar.edu/staff/blynds.rnbw.html
**ABOUT RAINBOWS**
Gives detailed and yet understandable information on the formation of rainbows. Links to demonstrations of experiments are also included

# SOUND ENERGY

*K.14.2  1.14.2  3.14.2*
*Recognize that sound is produced when objects vibrate*

*1.14.2a*
*Classify sounds according to the basic characteristics.*

*4.14.1*
*Know that energy exists in many forms.*

*4.14.2  5.14.2*
*Recognize the characteristics of light energy and sound energy*

*5.14.1*
*Know that energy exists in many forms*

*6.14.1*
*Identify and describe the characteristics of waves.*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# TUNING UP

**Materials Needed:**

Tuning fork
Dish of water
Styrofoam ball attached to a long string

**Procedure:**

1. Ask students to recall what causes sound. Strike the tuning fork against your hand or the table edge. Ask how we can tell it is vibrating. (We hear the sound, so there must be vibrations).

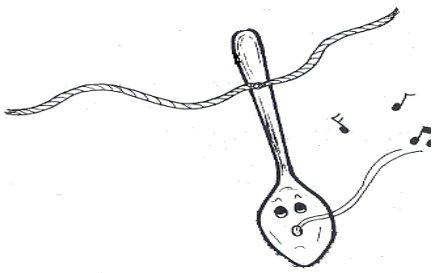
2. Strike the fork again then quickly stick it into the disk of water. How can we tell the fork was vibrating? (The water splashes!)

3. Suspend the Styrofoam ball from the ceiling or a doorway. Strike the tuning fork and hold it near the Styrofoam ball. The ball will swing away from the tuning fork. When it swings near the fork again, it will jerk away again. Ask the students why the ball doe this (The vibrations push the ball away from the tuning fork.

# BIG BEN SOUNDS

**Materials:**

Knife (or spoon) Old, heavy knives and spoons work best.
String



**Procedure:**

1. Attach middle section of the string to the spoon or knife

2 Place ends of strings into ears.

3. Strike spoon lightly against table. What pitch is the sound? Can you vary the pitch and volume? What would happen if you used some thin wire instead of string?

4. Now try wrapping one end of the string loosely around your index finger of one hand and placing that finger over the bone of your ear.

5. Hold the other end of the string with the other hand and pull the string taut.

6. Bend over and let the spoon hit the edge of a table or desk. The sound will be much like a loud, clear church bell. Keep the string stretched out for the best results.

**Note:**

You can purchase old knives very inexpensively at thrift stores and flea markets. You will find knives easier to find than spoons.

*From Creative, Hands-On Science Experiences Using Free and Inexpensive Materials. By Jerry DeBruin. (Good Apple, 1988)* ***ASIN:*** *0916456870. Out of print; limited availability at Amazon.com*

# PALM PIPES

*If you bang the open end of a piece of PVC pipe against the palm of your hand you'll make a musical sound. The frequency, or pitch, of the sound depends on the length of the pipe. Based on this simple but significant fact, you can make instruments for your own pipe band. You'll find it surprisingly easy to play some simple songs.*

**Materials Needed:**

PVC shears or hacksaw (inexpensive PVC shears are amazingly handy for cutting PVC pipe and can be bought at hardware or home improvement stores; if available, an electric band saw, chop saw, or table saw makes the job of cutting many pieces of PVC go even faster.)
½ inch PVC pipe, about 6 ½ feet long
Centimeter ruler
Sandpaper (if necessary
Permanent marker pen
Some friends

**Procedure:**

1. Cut a piece of PVC to each of the 15 lengths listed here.

| NOTE | LENGTH (cm.) | FREQUENCY (Hz) |
|---|---|---|
| F1 | 23.6 | 349 |
| G1 | 21.0 | 392 |
| A1 | 18.7 | 440 |
| Bflat1 | 17.5 | 446 |
| C1 | 15.8 | 523 |
| D1 | 14.0 | 587 |
| E1 | 12.5 | 659 |
| F2 | 11.8 | 698 |
| G2 | 10.5 | 784 |
| A2 | 9.4 | 880 |
| Bflat2 | 9.2 | 892 |
| C2 | 7.9 | 1046 |
| D2 | 7.0 | 1174 |
| E2 | 6.2 | 1318 |
| F3 | 5.9 | 1397 |

2. If the cutting process leaves sharp edges or fragments on the ends of any of the pipes, remove them with sandpaper.

3. Label each pipe with the musical note corresponding to its length. The subscripts in the list refer to the octave of the note. (The first note in the list is the F above middle C.)

4. Play the songs by gathering a group of people, distributing one pipe to each person, and having each player sound his or her pipe at the right time

**What's Going On?**

When you hit the open end of the pipe against your hand, air molecules in the bottom of the tube are squeezed together. This starts a process that takes four trips up and down the tube.

The molecules that have been squeezed together, in turn, squeeze the molecules next to them, and so on. In a sort of domino effect, the pulse of compression (high-pressure air) travels up the tube. When the pulse of compression reaches the top of the tube, it expands outward into the air around the tube. In the process, some air molecules overshoot the end of the tube, producing a region of expansion (low-pressure air) in the top of the tube.

Air molecules just below the area of expansion rush upward to fill it, creating a pulse of expansion that travels back down the tube. When this pulse reaches the bottom, it reflects off your palm and travels back up the tube as another pulse of expansion.

When it reaches the top, some air from outside the tube rushes into the low-pressure area, creating an area of compression, which travels as another pulse back down the tube. When this pulse of compression reaches the palm of your hand, it reflects, and at this point the whole process repeats itself. This four-part cycle corresponds to one wavelength of a sound, or one single vibration. A series of these repeated cycles is the source of the sound you hear when you "play" one of the pipes.

The length of the tube affects the note that the tube produces. Because the speed of sound waves is the same in all the tubes, the length of the tube has a direct effect on the time it takes for a compression-expansion pulse to make its four transits of the tube. The longer it takes for a pulse to complete its cycle and start over again, the fewer the cycles, or vibrations, per second. The fewer the vibrations per second, the lower the frequency of the sound, and the lower the musical note. Thus, long tubes produce lower notes, and short tubes produce higher notes.

***Mary Had a Little Lamb***
(Pipes C1, D1, E1 and G2; Four players)
E D C D E E E
D D D E G G
E D C D E E E
E D D E D C

***Twinkle, Twinkle, Little Star***
(Pipes F2 through D2; Six players)
F F C C D D C
Bflat Bflat A A G G F
C C Bflat Bflat A A G
C C Bflat Bflat A A G
F F C C D D C
Bflat Bflat A A G G F

***Jingle Bells***
(Pipes C1 through G2; five players)
E E EE E E
E G C D E
F F F F F E E
E E ED D E D G
E E E E E E
E G C D E
F F F F F E E
E E G G F C D

***My Country 'Tis Of Thee (America)***
(Pipes E1 though D2; 7 players)
F F G E F G
A A Bflat A G F
G F E F
C C C C Bflat A
Bflat Bflat Bflat Bflat A G
A Bflat A G F A Bflat C
D Bflat A G F

# MAKE A SQUAWKER

*How does the ear hear? In brief, sound waves are funneled into the ear. There, they pass through structures of the outer, middle and inner ear where sensors detect them and send signals to the brain, which interprets them as sounds. To illustrate, "play" a squawker, a noisemaker that isn't musical at all.*

**Materials:**

Styrofoam cup, a sturdy cardboard container, or a can
24" long piece of twine
metal washer
Sponge piece

**Procedure:**

To make a squawker, poke a hole in the bottom of a Styrofoam cup, a sturdy cardboard container, or a can. Thread the twine through the hole - from the bottom to the inside - and tie the end to a metal washer. Tape in place. Hold the squawker in one hand; pinch the string with a small damp piece of sponge; and pull down in quick jerks. *Did you know you have made an instrument similar to one played in Brazil called the cuica?*

Explain that the squawks happen when the string makes the bottom of the container vibrate and that makes the air inside vibrate.

*Sandra Markle. Creative Classroom online (http://www.creativeclassroom.org/)*

# DECIBEL SCALE

| | |
|---|---|
| 0 dB | minimum human hearing |
| 20 dB | falling leaves |
| 30 dB | whisper |
| 50 dB | inside an urban house |
| 60 dB | normal conversation |
| 90 dB | heavy traffic |
| 100 dB | loud shout |
| 117 dB | loud rock concert |
| 130 dB | human pain threshold |

One of the most challenging features of sound intensity is the logarithmic nature of the decibel scale. Work with students to help them understand that 60dB isn't twice as loud as 30dB, but more than 30 times louder!

*From EnergyWorks/Exploring Sound III booklet. (National Energy Education Day Project.) NEED has a kit, valued at $35, filled with all kinds of energy-related materials, games, activities, competitions, etc. You can request a kit for $5.00 from the Tennessee Energy Education network by calling 1-800-342-1340. Also from "How Noisy Is My World?" , DragonflyTV Guide in Science Scope (NSTA), Feb. 2003.*

# SOUND –
# FREE MATERIALS TO ORDER

**NASA SCIFiles**
NASA SCIFiles is a series of instructional programs designed to enhance the teaching of science, math, and technology concepts in grades 3-5. The series introduces students to scientific inquiry, scientific method, and problem-based learning through various problems that challenge six tree house detectives. Each program in the series has a 60 minute video, includes a resource-rich teacher guide, and is complemented by the NASA SCIFiles web site http://scifiles.larc.nasa.gov/treehouse.html) to support the national mathematics, science, and technology standards. The NASA SCIFiles are FREE to educators and the programs in the series are in the public domain. All you need to do is visit the web site below and register. The four programs in the series can be downloaded. Video copies of the programs can be purchased from CORE, NASA's Central Operation of Resources for Educators, .http://core.nasa.gov. for $5.00 for a year's worth of programming.

*NASA Resources for Educators*
*Web: http://scifiles.larc.nasa.gov*

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**NASA CONNECT video series.**
This series has a program on sound. It includes a 30-minute high energy program with young hosts, online activities, and lesson plans. This program is #5 in the 1998-99 series and the title is "Quieting the Skies." For a copy of the tape, contact the address below. The cost is $5 for the entire year's series. For a copy of just the lesson plan, go to http://connect.larc.nasa.gov/pdf/quieting.pm.pdf

*NASA ERC*
*University of Tennessee at Martin*
*Phone: 731-587-7572*

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**THE EARS HEAR: Show Children How Our Ears Work**
The mystery behind how our ear works becomes quite simple with The Science Spiders. And many children with mild hearing problems are not diagnosed until later in their school years. Try these traditional, simple experiments to show children how sound is heard by the ears and to screen children for hearing problems. A large diagram of the ear and its components is included for classroom use. For a copy of "The Ears Hear" experiment, send a #10 (business-size) self-addressed stamped envelope to the address below. One experiment is FREE; if you order more than one, the cost is $3.00 for up to 6 experiments.

**SOUND ACOUSTICS**
Poor classroom experiments can prevent children from learning. Researchers have found that students sitting in "dead spots" can miss entire lessons. And teachers' health suffers when they must yell to be heard. To evaluate your classroom acoustics, the Science Spiders have developed experiments to check the sound levels. Tips are included to improve classroom acoustics. For a copy of "Sound Acoustics" experiment, send a #10 (business-size) self-addressed stamped envelope to the address below. One experiment is FREE; if you order more than one, the cost is $3.00 for up to 6 experiments.

*The Science Spiders*
*Kain's Way – Ranch Works*
*PO Box 23565, Columbia SC 29224*
*Or sign up online at http://www.sciencespiders.com/afreeexperiments.htm*

**SOUND, LIGHT, EDISON! CELEBRATING 150 YEARS OF INVENTION**
This program celebrates the legacy of Thomas Edison, one of America's most prolific inventors, on the

occasion of his 150th birthday. The program demonstrates Edison's "tin foil" phonograph and highlights the invention of the incandescent light bulb and other milestones of the lighting revolution. VHS, closed captioned, 30 minutes, 1997**. FREE** copy of this video may be ordered through Video Placement Worldwide below. A teacher's guide can be downloaded at Lemelson Web site**.**

*Order video from*
*Video Placement Worldwide,*
*Dept. PR,*
*PO Box 58142,*
*St. Petersburg, FL 33715,*
*FAX 800-358-5218,*
*Web: http://www.vpw.com/educational/results.asp?SEARCH=MID*

*To download teacher's guide*
*http://www.si.edu/lemelson/lemelson/materials.html*

# SOUND – INEXPENSIVE MATERIALS TO ORDER

**SOUND (book)**
Grades 4-8. Children will enjoy learning at the speed of sound! Fascinating facts and hands-on experiments help explain why sound is a form of energy that we can hear and feel. History boxes feature amazing facts about scientists. Interesting concepts demonstrated include how doctors use sound to examine and treat patients, how some animals use sound to locate their prey, why the speed of sound is not always the same, what is inside the human ear and how we hear sounds. $15.95 hard cover; $7.16 paperback. Can be ordered at the web site below**. ISBN**: 0-7787-0608-7 (paperback).

*Crabtree Publishing*
*PMB 16A, 350 Fifth Avenue,*
*Suite 3308,New York, NY 10118*
*Tel: (212) 496-5040*
*Toll Free Tel: (800) 387-7650*
*Toll Free Fax: (800) 355-7166*
*Web: http://www.crabtree-pub.com/*

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**ENERGY: HEAT, LIGHT and SOUND (Downloadable book)**
80 pages. Grades 1-3. This book, designed with good science and easy teaching in mind, covers these concepts: energy can move and change things, energy exists in many forms, light is energy you can see, light moves in a straight line, light can pass through some materials and is stopped by other materials, light can be controlled by blocking a light source, heat is energy you can feel, heat can cause things to move and change, heat travels from warm objects to cold ones, heat can be controlled by containing it, sound is energy you can hear, sound energy is created by vibrating objects, sound travels at different speeds through different materials, sound can be controlled by changing the length of, or directing, sound waves, light, heat, and sound can move and change matter. Contains many reproducible, ready-to-go resources, such as record sheets, logbook forms, mini-books, and picture cards. Illustrated throughout with fun, helpful line art. All 80 pages perforated for easy removal. ISBN: 155-799-6903. $9.95

*Evan-Moor Educational Publishers*
*18 Lower Ragsdale Drive*
*Monterey, CA 93940-5746*
*Phone: 1-800-777-4362*
*Fax: 1-800-777-4332*
*Web: http://www.evan-moor.com/*

**SCIENTIFIC JAM CD**
A CD of 11 mostly elementary physics songs by a trio of Sacramento/ Bay Area elementary science teachers/musicians. Good, lively, upbeat music! Songs include "Sound Travels in Waves". A more complete

listing of songs on this CD can be found at http://www.tranquility.net/~scimusic/notochordsproducts.html - scientificjam Item #SJ01. $14.00. Add $2.00 for any order under $20.00. Send check or money order to address below.

**DR. CHORDATE: PARTS IS PARTS – MORE SONGS OF SCIENCE**
The songs on this CD blend science and music to make learning fun. Songs include "The Sounds of Silence", a parody of Paul Simon's Sounds of Silence. $12.00 (CD); $6.00 (cassette). Add $2.00 for any order under $20.00. Order from web site below. Item #CD CD01. Send check or money order to address below. A companion book with melody line, guitar chords and lyrics for many tunes is also available at the web site.

**AIR COLUMNS AND TONEHOLES: PRINCIPLES FOR WIND INSTRUMENT DESIGN** (book)
By Bart Hopkin. This 72-page book discusses the physics and mathematics of wind instrument design (for example, flues) and would make a good topic for a senior high school science class or special project. Item #BH01. Order from web site below.

*Dr. Jeff Moran,*
*c/o The Master Word Works,*
*2071 County Road 246,*
*Fulton MO 65251 USA*
*Email: Scimusic@tranquility.net*
*Web: http://www.tranquility.net/~scimusic/notochordsproducts.html*

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**SOUND TUBE**
Soft, plastic tube 29" long in assorted colors. When spun around, it produces a sound. Twirl fast or slow and it changes pitch. $1.75 each.

*Museum Products*
*84 Route 27, Mystic, CT 06355*
*Phone: 1-800-395-5400. FAX: 860-572-9589*
*Web: www.museumproducts.net*

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**WOODEN FROGS**
Run the wooden stick up and down the spine of your wooden animal and produce realistic sounds. The larger the wooden animal; the lower the pitch of the sound produced. 2" wooden frog – Item #SNG-190. $8.95 each/ 3" wooden frog – Item #SNG-200. $12.95 each/ 4" wooden frog – Item #SNG-220. $16.95 each/ 5" wooden frog – Item #SNG-240. $19.95 each

**SINGING ROD**
When your fingers are slid repeatedly along this 60-cm-long metal rod, an ear-piercing sound is generated. Use to demonstrate the difference between longitudinal and transverse waves. Each singing rod comes with instructions and a bag of crushed rosin to lightly coat your fingertips. Item #SNG-100. $13.95.

**SOUND TUBE**
When spun in a circular motion, these tubes produce a tone. As the Sound Tubes are spun faster, the tone steps up in frequency Item #SS-600. $1.90 each. Case of 12 tubes – Item #SS-600A. $19.95

**WAVE MODELING SPRING**
This 6-foot-long spring stretches to over 30 feet! Perfect for modeling standing and moving transverse waves as well as moving sound waves. Item #SPR-1. $14.95. Order from the website.

*Educational Innovations*
*362 Main Avenue*
*Norwalk, CT 06851*
*Phone: 203-229-0730 or 1-888-912-7474*
*Fax: 203-229-0740*
*E-mail: info@teachersource.com*
*Web: http://www.teachersource.com/catalog/index.html*

# SOUND –
# RELATED WEB SITES

http://askeric.org/cgi-bin/lessons.cgi/Science/Physics
**ASK ERIC LESSON PLANS: PHYSICAL SCIENCE**
Three of the lesson plans on this page (Sound Like Fun, Understanding sound, and Understanding Waves) deal with the concepts of sound but you'll have to scroll through the index to find them.

http://encarta.msn.com/guide/newschoolhouse.asp
**ENCARTA LESSON COLLECTION: PHYSICS**
From the Encarta index of lesson plans, select "Science" and then "physics" to find four lessons on sound: How Do Spring Things Vibrate (#861); How do Strings on Musical Instruments vibrate? (#862); Using a Weak Sound to Make a Loud Sound (#866); and Hooke's Law, Vibrations, Mechanical Waves and sound (#867).

http://hyperion.advanced.org/15060/
**MUSIC MAGIC**
An interactive, information-deluged ThinkQuest Web site focusing on the piano. Includes a reference section, where users can submit new data, information, thoughts and opinions. Take online lessons which uses an actual virtual keyboard to teach the piano over the web or play in the virtual concert hall while others can listen to you play.

http://hyperion.advanced.org/19537/
**THE SOUNDRY**
The Soundry is an exciting, interactive, and education web site about sound. Covering everything from the most basic concepts of what sound actually is to the specifics of how humans perceive it, the Soundry aims to promote enthusiasm and knowledge of sound.

http://scifiles.larc.nasa.gov/kids/Problem_Board/problems/sound/intro.html
Alternate Web address: http://quest.arc.nasa.gov/events/sci/2000/indexhtml
**THE CASE OF THE BARKING DOG: Turn Down the Volume**
One of the SciFiles (see Free Materials) that deals with noise. In this program, students are invited to actively join the tree house detectives a they investigate this case. The tree house detectives accept the challenge of determining why dogs in the surrounding neighborhoods have unexpectedly started barking early in the morning and late at night. Using scientific inquiry, our detectives discover what is causing the neighborhood dogs to bark. In determining the "why", the detectives learn about sound; what it is, how it is transmitted, and how humans and animals hear. While solving the case, the tree house detectives learn that determining the source of the barking requires the use of logic and "sound" reasoning.

http://sprott.physics.wisc.edu/demobook/chapter3.htm
**PHYSICS DEMONSTRATIONS: SOUND**
These nine demonstrations appropriate for high school students explore: the effects of breathing helium; the Doppler effect; the sound of a bell in a vacuum;, and the effect of intense sound waves on a beaker.

http://whyfiles.org/114music/3.html
**THE MUSIC OF NATURE**
The site explores the sounds in nature. Also, you can hear for yourself the sounds that alligators and crocodiles, lemurs, emperor penguins, and walruses make.

http://www.batcon.org/discover/echo.html
**SOUND SAMPLES FROM BAT SOUNDS TAPE**
An audio tape with a collection of bat sounds.

http://www.cln.org/themes/hearing.html
**THE HEARING SENSES PAGE**
Links to sites about the ear and hearing

http://www.cstone.net/~bcp/3/3MrSci.htm
**THIRD GRADE – SCIENCE – OVERVIEW**
In these six lesson plans, grade three teachers have students explore the concepts of sound, build a sound wave detector, construct and test a cup-and-string sound carrier, and create string, percussion and wind instruments for a class orchestra.

http://www.ed.uiuc.edu/YLP/96-97/96-97_mini_units/Bats_MClaeys/bat.html
**BATS: CREATURES OF THE NIGHT**
This grade 2 unit has several lesson plans/activities that introduce the concepts of sound within a multidisciplinary unit on bats.

http://www.glenbrook.k12.il.us/gbssci/phys/Class/sound/soundtoc.html
**PHYSICS CLASSROOM: SOUND WAVES AND MUSIC**
This section of the Physics Classroom contains a tutorial on sound which consists of 5 lessons with 19 sub lessons. Contents cover the nature of a sound wave, sound properties and their perception, behavior of sound waves, resonance and standing waves, and musical instruments. Lessons contain problems for students to check their knowledge and animated GIFs to teach concepts.

http://www.gmi.edu/~drussell/forkanim.html
**TUNING FORK SOUND WAVES**
See an animation of sound waves in action.

http://www.iit.edu/~smile/ph9416.html
**MAKING HOMEMADE INSTRUMENTS**

http://www.iit.edu/~smile/ph9301.html
**MAKING SOUNDS**

http://www.iit.edu/~smile/ph9110..html
**HOW SOUND TRAVELS**

http://www.iit.edu/~smile/physinde.html - p5
**LESSON PLANS ON THE SUBJECT OF SOUND**
Lessons, designed by teachers, on the subject of waves, sound and optics.

http://www98.phys.virginia.edu/classes/620/sound.html
**PHYSICS 620: SOUND**
This site is the home page for a university course on physics designed to help teachers to learn about the nature and characteristics of sound. Included within the site are sample teacher activities that could be used as classroom demonstrations and sample teacher investigations that could be used as classroom labs.

http://www.nationalgeographic.com/sound/speed.html
**THE SPEED OF SOUND**
Hear history relived as Chuck Yeager breaks the sound barrier.

http://www.nsf.gov/od/lpa/nstw/teach/activity/english.htm
**WEBS, WIRE, WAVES: THE SCIENCE AND TECHNOLOGY OF COMMUNICATION.**
This National Science Foundation website was designed to help children explore and understand the ways we communicate with one another. There are six units - each containing hands on explorations - which progress in sequence from simple forms of communication towards complex technological forms. In unit three, students (ages 7-14) learn about sound by building a rudimentary telephone and speaker

http://www.op97.org/%7Eerexford/base/index.html
**MUSIC INVENTIONS**
Elizabeth Rexford, a teacher with over 30 years of experience, developed this award winning site in which grade 4-6 students use the Internet to learn how sound is produced and then apply this knowledge to make a musical instrument. Suggested hands-on sound experiments are provided.

http://pbskids.org/jayjay/care.curr.cl.l4.act.html
**AIR CAN MAKE SOUNDS**
Blow up balloons and slowly let out the air by narrowing the opening of the balloons. Have students listen to the sounds.

http://www.pbs.org/safarchive/4_class/45_pguides/pguide_304/4534_flute.html
**ANCIENT FLUTES OF EGYPT**
At Cairo University, a computer and oscilloscope help decipher the sound produced by an ancient flute. Students will look at musical theory, and investigate sound by making their own pan flutes.

http://www.pbs.org/wgbh/nova/universe/moving.html
**MOVING TARGETS**
Interactive activity which examines the Doppler Effect.

http://www.pbs.org/wgbh/nova/subsecrets/sounds.html
**SUBMARINES, SECRETS AND SPIES: SOUNDS UNDERWATER**
Students may test how much they know about sound in water through a ten question interactive quiz.

http://pbskids.org/zoom/sci/stringphone.html
**STRING TELEPHONE**
Make a telephone using string. Then change variables to collect data such as what materials work best and how far apart the two ends of the phone can be and still work.

http://www.physics.uwo.ca/~harwood/sph4a1/u-sound.htm
**SOUND: A UNIT AND LESSON PLANS**
Nine lessons and topics tied to learning objectives for intermediate students.

www.physicsclassroom.com/Class/sound/soundtoc.html
**SOUND WAVES AND MUSIC**.
The nature of sound as a longitudinal, mechanical pressure wave is explained and the properties of sound are discussed. Wave principles of resonance and standing waves are applied in an effort to analyze the physics of musical instruments.

www.physicsclassroom.com/Class/waves/wavestoc.html
**WAVES**.
The nature, properties and behaviors of waves are discussed and illustrated; the unique nature of a standing wave is introduced and explained.

http://www.queendom.com/mindgames/quizdom/quiz138.html
**A QUIZ ABOUT SOUND**

http: www.reachoutmichigan.org/funexperiments/agesubject/lessons/beakman/myvoice.html
**INSIDE YOUR HEAD**
See an animation of how sound travels through your ear.

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/beakman/doppler.html
**DOPPLER EFFECT**
Read an explanation of the Doppler effect, see an animation of how the sound waves travel when sound is coming toward you and away from you and hear a sound sample.

www.sasked.gov.sk.ca/docs/physics/u5c22phy.html
**CHARACTERISTICS OF SOUND**
This site provides background information about pitch for the teacher. The information includes the normal range of human hearing, infrasonic sound (below human hearing), and ultrasonic sound (above human hearing.) it also describes the unique properties of tuning forks.

http://www.soundamerica.com/
**SOUND AMERICA**
An archive of 25,800 sounds, including sound effects, a sound FAQ and sound utilities for the computer.

http://www.spartechsoftware.com/reeko/MoreExperimentsSortCategory.htm
**REEKO'S MAD SCIENTIST LAB: SOUND**
There are at least three science experiments suitable for the home or classroom on sound at this site. The three that were on the site when it was reviewed are intended for young children and address the principles of sound, how sound waves are formed, and how to make a homemade hearing aid

http://www.stark.k12.oh.us/Docs/units/1996/sound.ls/
**SOUND SOLUTION**
This interdisciplinary teaching unit for senior high school students looks at these questions: How does sound affect a person's life? How is sound produced, recorded, and controlled? When is sound noise? and, What is it like to live in a silent world?

http://www.stomponline.com/percuss4.html
**PERCUSSION, KIDS AND STOMP**
Within this Performance Group's web site, there are two sets of activities and lessons to help elementary students learn about sound. *Older Students* offers four explanations and three student explorations. *Younger Students* offers nine lesson ideas and 10 student activities.

http://www.teachervision.com/lesson-plans/lesson-8189.html
**PATHS OF SOUND WAVES THROUGH THE EAR** – Printable worksheet
Print this free worksheet for grades 3-12 from this site.

http://www.uen.org/utahlink/lp_res/TRB045.html
**SOURCE**
This 6th grade science curriculum from Utah is one of two units which explore the fundamentals of heat, light and sound.

http://www.uen.org/utahlink/lp_res/TRB046.html
**MOVEMENT**
This 6th grade unit from Utah teaches students about the characteristics and movement of heat, light and sound. Two of the activities deal specifically with sound.

http://www.yahooligans.com/Downloader/Sounds/
**YAHOOLIGANS SOUND ARCHIVE**
The Yahoo site Yahooligans has lots of sounds and a way to search for a specific sound.

# CHEMICAL ENERGY

*K.12.1 1.12.1 2.12.1 3.12.1*
*Recognize that objects have observable properties that can change over time and under different conditions.*

*1.13.1 2.13.1 3.13.1 4.13.1 5.13.1a,b*
*Investigate the kinds of changes that occur when different types of matter interact.*

*4.14.1 5.14.1*
*Know that energy exists in many forms.*

*6.14.4*
*Understand that one form of energy can be transformed into another form of energy.*

*7.12.3*
*Understand that the periodic table is used as a tool for grouping elements*

*8.13.2*
*Differentiate between physical and chemical changes.*

*8.13.3c*
*Describe how temperature and pH affect the rate of a reaction*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# PLOP-PLOP, FIZZ-FIZZ

(Chemical potential energy into kinetic energy)

**Materials:**

Alka-Sletzer tablet
Empty film canister
Water

**Procedure:**

1. Break the Alka-Seltzer tablet into 4 pieces and place them into an empty film canister.

2. Pour approximately one ounce of water into the container, quickly place the film canister's cap on tightly and step back. Within a few seconds, the cap will blow off the canister and fly off. SAFETY NOTE: To do the above experiment, everyone must wear safety goggles and should get far away from the loaded film canister.

**IMPORTANT: Be sure all students are standing away and do not put directly under a light fixture**

*From "Fizzy Science" by John Cowens. Teaching K-8, January, 2002*

# LIGHT STICKS

*In this experiment, students can observe how chemical energy is converted into light energy and see the effect of temperature on reaction time*.

**Materials**:

Emergency Light stick
2 clear plastic cups – one with hot water and one with cold water

**Procedure:**

1. Bend the light stick until the glass ampoule within the plastic stick is broken.
2. When the stick starts to glow, put it in the cold water. What happens to the light?
3. Now put the stick in hot water. What changes to you see?

**Results:**

The stick glows when the glass ampoule is broken and the two chemicals in the stick combine. The stick glows brighter when put in hot water because the higher temperature speeds up the rate of chemical reaction.

**The Science Behind It:**

The light given off by an emergency light stick is energy released from a chemical reaction. These reactions in which light is given off are called chemiluminescent reactions. Light sticks are plastic rods that contain two solutions of chemicals. Enclosed inside a thin glass ampoule is one solution that is an oxidizing agent, and surrounding it in the rod is a second solution that contains a fluorescent dye. When the light stick is bent, the glass ampoule is broken and the two solutions mix. The reaction begins. Energy is given off when the two solutions react. The energy raises the energy level of the electrons of the dye molecules. When the electrons drop back down to their original energy levels, the extra energy is given off as light. This light is sometimes referred to as cool light because no noticeable heat is given off in the reaction. However, the temperature surrounding the chemical reaction affects the speed of the reaction.

*From Energy For Kids, presented by Peggy King.*

# CHEMICAL ENERGY
# FREE MATERIALS TO ORDER

**ADVENTURES WITH ATOMS AND MOLECULES VIDEO**

Free-on-loan video of science experiments by Dr. Rob Mebane. NOTE: Dr. Mebane has given permission for this video to be reproduced for teachers. For your own copy of this video, send a blank 90-minute tape to Anne Allen, TEEN C/O Roane State Community College, 132 Hayfield Road, Knoxville, TN 37922 Experiments include:

Do molecules move?
Do hot molecules move faster than cold molecules?
Are chemical changes faster in hot or cold water?
Are some molecules small?
Are gas molecules farther apart than liquid molecules?
Are there carbon dioxide molecules in your breath?
Are some molecules heavier than others?
Are some liquids heavier (denser) than others?
Is saltwater more dense than freshwater?
Do like charges attract or repel?
Are molecules attracted by a charge?
Is vinegar necessary to dye eggs?
Can acid rain hurt some buildings and statues?
Can stretching molecules make them give off heat?

**SCIENCE ACTIVITIES IN ENERGY: Chemical Energy**

This DOE publication from 1991 is no longer in print. If you would like a copy of the activities included in this activity guide, contact Anne Allen (allen_ac@roanestate.edu) or call the Tennessee Energy Education Network at 1-800-342-1340. The packet includes activity sheets for the following experiments:

1. How Long Does a Cell Made From Magnesium and Brass Light a Lamp?
2. How Much Electricity Do You Get Back When You Store It In Your Storage Cell?
3. Which Has More Heat Energy, A Peanut or a Walnut?
4. How Rapidly Does a Plant Make Starch?
5. How Long Do You Have to Expose Blueprint Paper to Make a Picture?
6. Which has more Energy – Wood or Paraffin?
7. How Long Will It Take For a Birthday Candle To Use Up The oxygen In A Glass?
8. How Does A Mixture of Ashes and Water Differ From Plain Water?
9. How Much Methane Can You Collect in 2 Days From ½ Cup of Coal?
10. Which Flows Fastest: Light Oil, Heavy Oil, or Water?
11. Which Reduces Friction More: #40 Oil, #10 Oil, or an Edible Oil?
12. Which Produces More Suds In Your Water – Soap or Detergent?
13. Which Soil makes Beets and Radishes Grow Best?
14. Are Small Amounts of Soap or Detergent Harmful To the Growth of Plants?
15. Will Nylon Disintegrate As Fast As Cotton?

*Tennessee Energy Education Network*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 or 615-674-2994 outside Tennessee*

*Eastern TN Representative: Anne Allen*
*132 Hayfield Road, Knoxville, TN 37922*
*865-531-8051*
*Email: allen_ac@roanestate.edu*
*Western TN Representative: Ramona Nelson*
*Lowell Thomas Bldg, Room 302A*
*225 Martin Luther King Dr., Jackson, TN 38301*

*731-426-0536*
*Email: Ramona.nelson@state.tn.us*

**GET COOKING WITH CHEMISTRY Grades K-6**
A booklet containing kitchen experiments. These simple activities focus on chemical reactions that occur during cooking. Each experiment can be done with ingredients from your own kitchen – cheese, yeast, vinegar, oatmeal, and baking soda. So go ahead and mix up some fun! Can be downloaded from the Web at http://www.acs.org/ncw/ FREE.

**A WORLD OF COLOR: AN INTERNATIONAL SEARCH FOR DYES. Grades 4-6**
This makes chemistry lots of fun. This free hands-on science activity kit contains intriguing and safe experiments that introduce kids to the relationship between chemicals and color. Teacher's Guide included. Call to order. FREE.

*American Chemical Society*
*1155 16th Street, N.W.*
*Washington, DC 20036*
*Phone: 1-800-227-5558 or 202-872-4590*
*Fax: 202-833-7732*
*Email: m_tinnesand@acs.org*
*Web: http://www.acs.org/ncw*

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**BUILDING BLOCK CHEMISTRY PROGRAM. (Grades 6-8)**
**Hands on materials designed to introduce basic chemistry and the periodic table to middle school students. By taking a look at one element – chlorine – teachers can help students understand the link between chemical "building blocks" and daily life without tackling the whole periodic table at once. This program was developed *by* teachers, *for* teachers. Can be downloaded from web site.**

**The Chlorine Chemistry Council**
**1300 Wilson Boulevard**
**Arlington, VA 22209**
**Phone: (703) 741-5829**

*Fax: (703) 741-6829*
*Email: info@science-education.org*
*Website: http://www.science-education.org/*

# CHEMICAL ENERGY
# INEXPENSIVE MATERIALS TO ORDER

**PHYSICS PHOLK SONGS, and OTHER SCIENTERRIFIC DITTIES**
This CD set, partly funded by the National Science Foundation, is a whimsical collection of songs about scientific theories, logic and pure fun. Associated activities for teachers, parents and students grade 5 through college level are downloadable for free on the internet from the website mentioned below. One of the songs included is "The Elements" by Tom Lehrer. Item #CD SE7130, 1998. $15.00

*Colonial Music*
*276 Oak Court*
*Severna Park, MD*
*Phone: 410-544-6149*
*http://www.colonialmusic.org/PPS-cd.html*
*For the activities to accompany this CD, go to*
*http://physics.dickinson.edu/~wp_web/Old_WP_Website/WP_Homepage.html*

**CHEMICAL LIGHT STICKS**
Chemical light sticks don't create heat or sparks when lit and are completely waterproof. Place one in warm water and one in cold water and observe the effect of temperature on the rates of chemical reactions. 4" chemical light sticks - $10.95 for a package of 12. Item #SS-450AST(for assorted colors.

*Educational Innovations*
*362 Main Avenue*
*Norwalk, CT 06851*
*Phone: 203-229-0730 or 1-888-912-7474*
*Fax: 203-229-0740*
*E-mail: info@teachersource.com*
*Web: http://www.teachersource.com/catalog/index.html*

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**VITAMIN C TESTING (Grades 4-8)**
Students are introduced to chemistry experiments, nutrition, and consumer science in this complement to the Paper Towel Testing booklet. Students perform a simple chemical test to compare the vitamin C content of different juices and gaph the results. Older students can experiment to examine the further effects of heat and freezing. 4 sessions. ISBN: 0-924886-31-5. $10.50

**INVOLVING DISSOLVING (grades 1-3)**
This guide creates a very positive early experience with chemistry. Here students explore the concepts of dissolving, evaporation, and crystallization. Using familiar substances, they create homemade "gel-o", colorful disks, and crystals that emerge on black paper to make a "starry night". 4 activities. ISBN: 0-924886-63-3. $10.50

**CHEMICAL REACTIONS (Grades 6-8)**
An ordinary zip-locking bag becomes a safe and spectacular laboratory as students mix chemicals that bubble, change color, and produce gas, heat and odor. A terrific introduction to chemistry, this guide is often adapted for lower grade levels. 2 sessions. ISBN: 0-924886-06-4. $9.00

**CRIME LAB CHEMISTRY (Grades 4-8)**
In this forensic-science primer, student detectives use paper chromatography to investigate solubility, pigments, and separation of mixtures. Several mystery scenarios are suggested and many teachers have also created their own. 2 sessions. ISBN: 0-924886-34-X. $9.00

*Great Explorations in Math and Science (GEMS)*
*University of California, Berkeley*
*Lawrence Hall of Science #5200*
*Berkeley, CA 94720-5200*
*Phone: 510-642-7771*
*Fax: 510-643-0309*
*Web: www.lhsgems.org*

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**PERIODIC TABLE OF THE ELEMENTS Wall Chart** (Grade 4-high school)
This 24" x 36" wall chart displays all 109 known elements. Item #ID-5982. $7.99

*Learning House*
*520 West Jefferson*
*Ft. Wayne, IN*
*Phone: 1-800-794-8454*
*Fax: 888-668-9380*
*Web: www.thelearninghouse.com*

**GLOW STICKS**
3" glow sticks: green, blue, pink and red. 25 pcs. Per box. $19.75 per box (.84 each). Item #128. This company carries all kinds of glow-in-the dark items – glow necklaces, bracelets, sticks, badges, keychains, beverage items, jewelry, stars and planets, etc. Call for a free printout of their materials.

*Night Magic*
*Phone: 1-888-303-GLOW*
*Fax: 1-937-968-7719*
*Email: sales@night-magic.com*
*Web: www.night-magic.com*

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**SCIENCE IN SONG**
The Science in Song CD is designed to help Middle School students remember major science terms by using easy to learn songs. One of the songs on this CD is the "Elements Song". It is an easy way to learn 19 of the most frequently used elements such as oxygen, potassium, and mercury. $12.95

*Science in Song*
*Robin Walling*
*1148 Dogwood Forest Drive*
*Marietta, GA 30068*
*email: Scienceinsong@yahoo.com*
*Web: http://scienceinsong.com/*

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**CHEMISTRY SONGBAGS I and II by Mike Offett**
Mike is a teacher in the Chicago area. He has made a number of special appearances at National Science Teachers Association conventions and many other conferences. He is a storyteller and has some excellent collections of science songs including these two on Chemistry.

Songs included in Chemistry Songbag I are:
Something Called SI, A Mole Is a Unit, H2O, The Stoichiometry Talking Blues, The Gas Laws, Mendeleev, Electron Configuration Polka, If It Isn't Love, Dynamic Equilibrium, Acids and Bases Have Two Different Faces, Redox Blues)

Songs in Chemistry Songbag II are
TRV Polka, Chemistry Nerd, Factor Label It, Significant . . . I Don't Think So, Change, Matter, Atomic Theory Polka, Quantum Number Rag, Amedeo Avogadro, Long Long Chains, Alpha Beta Gamma Radiation)

Chemistry II Songbag cassette MO04 - $7.00 CD MO08 - $14.00
Chemistry Songbag cassette MO03 - $7.00 CD MO07 - $14.00

*Science Songwriters Association*
*Web: www.tranquility.net/~scimusic/SSA/ourmusic.html*

**KREBS CYCLE PACKAGE**
Contains sheet music, a cassette recording, teaching outline, Black and white transparency print-outs and a CDROM of Color Transparency files. $19.00

*Sing-Smart CMC*
*Lynda J. Jones*
*P.O. Box 3531*
*Vista, CA 92085-3531*
*Phone: 1-760-639-3943*
*Email: Lynda@Sing-Smart.com*
*Web: http://sing-smart.com/inquiry.html*

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**ESSENTIAL CHEMISTRY by C. Gifford. (Ages 12-16)**
An ideal companion for anyone studying chemistry, this Essential Guide is both a concise examination revision aid and a valuable reference book. It defines the key facts, laws and concepts of chemistry clearly and simply, using colorful pictures and diagrams. Essential Chemistry looks at the properties and nature of substances that make up the world around us and how these substances react with one another. Paperback ISBN: 0-7460-0727-2. $7.95

**CHEMISTRY by J. Chisholm and M. Johnson (Ages 11 years and up)**
This Usborne Introduction to Chemistry explains simply the basic concepts of the subject. It sorts out atoms, molecules and what happens in chemical reactions. It also looks at chemistry in everyday life, including in your own body. Paperback ISBN: 0-86020-709-9. $7.95

**CHEMISTRY EXPERIMENTS by M. Johnson. (Ages 9 years and up)**
This Pocket Scientist series of colorful books is packed with experiments, projects and puzzles which help to explain basic scientific principles. With clear and simple instructions, these little pocketbooks provide a fun and exciting introduction to science. Chemistry experiments contains safe experiments to do at home using household equipment and ingredients.

**ATOMS AND MOLECULES by P. Roxbee-Cox and M. Parsonage**. (Ages 12-18)
Described by the Times Educational Supplement as a “remarkable achievement’< this easily readable and stunningly illustrated book reveals the inner workings of the atom, includes background to historic discoveries – such as the atom bomb – and looks at the latest scientific developments from “atomic art” to the atom’s role in the search for the cure for AIDS. Paperback ISBM 0-7460-0988-7. $7.95

*Usborne Books*
*Educational Development Corporation*
*10302 E. 55th Place*
*Tulsa, Oklahoma 74146-6515*
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# CHEMICAL ENERGY

## RELATED WEB SITES

http://198.110.10.57/ChemCom/Index.html
**CHEMCOM: CHEMISTRY IN THE COMMUNITY**
**ChemCom is a curriculum developed by the American Chemical Society to advance the science literacy of secondary school students in the U.S.**

**http://www.acme.com/jef/science_songs/**
**SINGING SCIENCE SONGS**
**Listen to the "What is Chemical Energy?" song at this site from an LP released in the 70's. (see Energy and Motion songs LP)**

**http://askeric.org/cgi-bin/lessons.cgi/Science**
**ASK ERIC LESSON PLANS**
**Click on the Science: Chemistry link for several lesson plans on chemistry.**

http://biochemlinks.com/bclinks/bclinks.cfm
**BIOCHEM LINKS**
Biology and chemistry sites in a dozen categories (including the regulars plus news, lab safety, ethics, and careers) are gathered here. They are not reviewed do include author and sponsoring institution.

http://bvsd.k12.co.us/~stanglt/per.html
**TAIT'S PERIODIC TABLE OF ELEMENTS**
An up-to-date and complete periodic table of elements on the Web. It's a snap to track down any number of metals, noble gasses, etc. This site's suitable for all types of browsers.

http://Calvacadepublishing.com
**FREE CHEMISTRY MATERIALS**
Free labs, activities and worksheets for chemistry teachers.

http://cc.oulu.fi/~kempmp/pyro.html
**PYROTECHNICS – THE ART OF FIRE**
Think chemistry is boring? Check out this page for the most exciting stuff on fireworks! Beautiful pictures; and it's a learning experience! Also find other sites on this subject.

http://chemlab.pc.maricopa.edu/periodic/lyrics.html
**LYRICS TO "THE ELEMENTS" BY TOM LEHRER**
Get the lyrics or listen to this song that is simply the names of the chemical elements set to a possibly recognizable tune.

http://chemistry.rsc.org/rsc/
**ROYAL SOCIETY OF CHEMISTRY**
If you are interested in science then you're in the right place. Visit these pages regularly to keep up to date with the latest chemistry news and best links to other science sites on the Web.

http://education.jlab.org
**SCIENCE LAB**
Make learning about atoms and elements elementary! Click on "Teacher Resources" for science-fair physics experiments, student handouts, and vocabulary lists. Then send kids to the "Student Zone" to play online science, math and word games, including "Element Hangman."

http://library.thinkquest.org/15384/
**FIREWORKS: THE SCIENCE BEHIND THE SPECTABLE**

This ThinkQuest entry offers a look at the physics and chemistry behind fireworks. There are sections on the history of pyrotechnics and their construction.
http://library.thinquest.org/2690/exper/exper.htm
**CHEMISTRY EXPERIMENTS YOU CAN DO AT HOME**
The title gives it all away, really. Divided into sections on gases, reactions with oxygen, solutions, tests for substances, and miscellaneous experiments. Each experiment contains a list of materials, procedure, what to observe, and discussion; as well as warnings about proper handling of materials when needed.

http://members.ozemail.com.au/~macinnis/scifun/index.htm
**SCIENCE PLAYWITHS**
The name of this site sums it up. You can find activities and ideas that can add excitement to anyplace you want to do science. Electricity, fluid flow and kitchen chemistry are just a few of the areas of science covered. Many thanks to the scientists from down under that have created this site.

http://minerals.cr.usgs.gov/gips/aii-home.htm
**UNDERSTANDING OUR PLANET THROUGH CHEMISTRY**
Thorough description of the use of chemistry in understanding how history is recorded in the Earth, in geologic processes, the environment; pollution and its prevention, plus the mapping of the chemistry of the Earth. By the U.S. Geological Survey, compiled by Joseph E. Taggart, Jr.

http://pbskids.org/zoom/sci/sodabottleboat.html
**SODA BOTTLE BOAT**
Fill a plastic soda bottle with baking soda and vinegar. Put it in water and watch it go!

http://pearl1.lanl.gov/periodic
**PERIODIC TABLE OF THE ELEMENTS**
This is a clickable image of the periodic table. Click on any element and you will link to information about that element: its history, where sources of the element can be found, the properties, cost, and use of the element. A great resource site!

http://periodictable.tsx.org/
**CHEMGLOBE**
Periodic Table of Chemical Elements. Click on an element.

http://teachers.teach-nology.com/themes/science/
**ELEMENTS, COMPOUNDS AND MIXTURES THEME UNIT**
For each of the themes listed at this site, you can find downloadable bulletin board pictures, resource materials, background information, webquests, activities, worksheets, etc.

http://the-tech.mit.edu/Chimicool/
**CHEMICOOL PERIODIC TABLE**
Searchable. David Hsu makes this educational bookmark a breeze to use. Simply click (or search for) an element and information is instantly furnished, including the element's atomic number, energies, reactions and weight.

http://web.buddyproject.org/web017/web017
**PERIODIC TABLE ADVENTURE**
Middle school teachers will love this website with 5 lessons and activities that introduce the periodic table. The Element Adventure Webquest allows students to research an element and create an advertisement for that element.

http://www2.ncsu.edu/ncsu/pams/science_house/learn/CountertopChem/index.html
**THE SCIENCE HOUSE COUNTERTOP CHEMISTRY**
Wow! Great Chemistry Activities that use chemicals you can find at the grocery or the hardware store like dancing spaghetti with online resources for teachers and pages for kids.

http://www.acme.com/jef/science_songs
**WHAT IS CHEMICAL ENERGY? song**
Listen to this song (from a 70's Energy and Motion songs album) at this site.

http://www.anachemumu.se/eks/pointers.htm
**CHEMISTRY TEACHING RESOURCES**
This impressive set of teaching resources comes from Sweden's Umea University. Aimed at secondary students, the site include curriculum material, demonstrations and experiments, mailing and resources lists, recommended software and suppliers. And each list is quite exhaustive! Click on Courses and Tutorials and load a page chocked full of links that include text materials, streaming video and downloads.

http://www.awesomelibrary.org/Classroom/Science/Chemistry/Chemistry.html
**AWESOME LIBRARY**
Tremendous number of links to books, lesson plans, lists, papers, and materials about Chemistry.

http://www.blm.gov/education/00_resources/articles/energy/energy_poster.html
**ON THE TRAIL OF ENERGY: Downloadable poster**

http://www.ceismc.gatech.ed/BusyT/chem.html
**CHEMISTRY SITES FOR BUSY TEACHERS**
Links to all things Chemistry.

http://www.ch.ic.ac.uk/GIC/
**GLOBAL INSTRUCTIONAL CHEMISTRY**
A new development in the teaching of chemistry, "hyperactive" molecules are on the net for you to rotate and measure with. This tool can help students to better understand concepts on paper. Great links! Keep an eye on this site in the future.

http://www.chemfiesta.com/ or
http://misterguch.brinkster.net/chemfiestanew.html
**MR. GUCH'S CAVALCADE O' CHEMISTRY**
Your one-stop chemistry shop. Students can check out the Helpdesk section for tips on how to solve problems. Teachers can check out the free stuff in the "For Teachers" Link.

http://www.cchem.berkeley.edu/ChemResources/temperature.html
**TERMPERATURE CONVERSION CALCULATOR**
Ready to move on to more advanced chemistry topics but you still have students stuck on temperature conversions? This online tool converts temperatures back and forth between Kelvin, Celsius, Fahrenheit and Reamuer. Just type in the temperature, select the desired scale from the drop-down menu, and you'll have the conversion done in an instant. This isn't so much an instructional tool, but imagine the convenience of having this link in your class bookmarks so students have the Temperature Conversion Calculator handy!

http://www.ChemCenter.org/
**CHEMCENTER**
This site is searchable. Strives to be the universal home page for Net explorers seeking chemistry-related information, be it an experienced researcher or simply someone with a chemistry question. ChemCenter combines extensive online resources from the American Chemical Society and provides a platform for new and developing services. A sample of what you'll find here includes ongoing discussions, electronic courses, a conference calendar, magazines and hot articles - plus unique database searching with Chemical Patents Plus and Lab Guide.

http://www.chem4kids.com/
**CHEMISTRY FOR KIDS**
Chemistry in easy-to-understand language. Designed for elementary students, covering topics such as Matter, Atoms, Elements, Reactions, Key Topics and Mathematics. The cartoonish graphics, succinct explanations and sound file pronunciations make it attractive to its target audience, and its tie-ins to the bigger concepts (e.g. the periodic table) make it a natural for teachers looking for new ways to expand on their instruction. Includes "tricks" for remembering aspects of atomic structure.

http://www.chem.leeds.ac.uk/delights/
**DELIGHTS OF CHEMISTRY**
A collection of three dozen experiments and demonstrations, two photo libraries (more than 500 images combined) and streaming chemistry video, all designed to augment the good work you already do in the

secondary classroom! The animations of chemical phenomenon are actual video clips from the Leeds' labs. This site is definitely worth your time.

http://www.chem.ucla.edu/chempointers.html
**VIRTUAL LIBRARY: Chemistry**
Includes links to academic institutions, nonprofit organizations, commercial organizations and WWW resources.

http://www.coolarchive.com/clipart.cfm?parameter=Science
**SCIENCE CLIP ART.**

http://www.freefoto.com/pictures/industry/chemical/index.asp
**FREE FOTO.COM**
Free pictures about Chemistry

http://www-hpcc.astro.washington.edu/scied/chemistry.html
**CHEMED: CHEMISTRY EDUCATION RESOURCES**
Includes links to chemical images and databases, chemical safety, periodicals, software, educational organizations, history of chemistry, and other chemical links.

http://www.knowledgebydesign.com/tlmc/tlmc.html
**THE LEARNING MATTERS OF CHEMISTRY**
What a wonderful chemistry site! Developed independently by two professors, it's a dream come true for chem. Students and anyone with an interest for chemistry! Lots of things to do, see and marvel at.

http://www.liv.ac.uk/Chemistry/Links/refbiog.html
**BIOGRAPHIES OF FAMOUS CHEMISTS**
A collection of links, arranged alphabetically by the last name of each subject, that provide rapid access to information about famous chemists throughout history.

http://www.miamisci.org/ph/
**phFACTOR**
An in-depth look at ph and its implications for chemistry. The Explore button takes you to a ph scale on which students can click to see the acidity of different common items . The Explain, Expand and Extend links offer elementary-level activities with links to lesson plans to help teachers integrate the site into their class instruction.

http://www.nationalgeographic.com/resources/ngo/education/plastics/index.
**POLYMERS: THEY'RE EVERYWHERE**
This site takes students through a tour of polymers and how they exist in our environment and within ourselves, both natural and man-made. Designed for upper elementary and middle school students, each section has an interactive component designed to keep kids involved in learning more. This is a great discussion starter for your chemistry studies.

http://www.pbs.org/saf/1207/teaching/teaching3.htm
**BENEATH THE SEA: LIGHT STICK CHEMISTRY**
Students explore how the temperature of the chemicals that combine affects a chemiluminescent reaction.

http://www.pbskids.org/zoom/kitchenchemistryf
**KITCHEN CHEMISTRY**
A virtual kitchen stocked with groceries and crawling with clues to help kids perform online experiments, solve puzzles and learn about chemistry along the way. This feature also helps kids become real life chemists by providing them with experiments that they can test out in their own kitchens, and then, by encouraging them to send their findings to ZOOM.

http://www2.shef.ac.uk/chemistry/web-elements/web-elements-home.html
**WEBELEMENTS: The Periodic Table on the WWW**
"Beta version of WebElements". You can select any element of interest to you.

http://www.stanford.edu/~glassman/chem/index.htm
**CHEMISTRY FUNCTIONS**

Here's a collection of engines designed to help make chemistry calculations easier. The periodic table allows you to place the cursor over any element and immediately view the name, symbol atomic number and atomic mass for the element. And the equation balancer requires you to simply type in an equation and click the "Balance" button to get results.
http://www.spusd.k12.ca.us/chemmybear/
**CHEMMY BEAR**
Contains animated GIF files of rotating molecules, lectures, reviews of AP Chemistry prep books, and more.

http://www.thecatalyst.org/
**THE CATALYST: CHEMISTRY RESOURCES FOR THE SECONDARY EDUCATION TEACHER**
Created by a high school chemistry teacher, the Catalyst is a useful, well-organized listing of WWW chemistry links for other high school chemistry teachers.

http://www.thinkquest.org/library/lib/site_sum_outside.html?tname=11226&url=11226/index.htm
**CHEMICAL CAROUSEL**
Here you can follow Captain Carbon through the carbon cycle, involving photosynthesis, digestion, and combustion, that allows the same atoms to be recycled for millennia. This extensive resource was researched and constructed by high school students as part of a Think Quest competition.

http://www.uky.edu/Projects/Chemicomics/
**COMIC BOOK PERIODIC TABLE**
Looking for a hook that will really get kids interested in the Periodic Table of the Elements/? The University of Kentucky offers this eye-catching contender. Click on any element on the virtual table and immediately open your browser to a listing of classic comic book issues that feature that element/hero! Click on the symbol in the upper-left-hand corner and go to the Web Elements table offering all kinds of basic information, audio and text descriptions, and a summary of the element in isolation.

http://www.webelements.com/index.html
**WEB ELEMENTS**
WebElements is the periodic table on the WWW. This page contains links to chemical data for the first 112 elements. Also contains other chemistry links.

# HEAT ENERGY

*K.14.1  1.14.1*
*Recognize that the sun is the main source of earth's heat and light energy.*

*6.14.2*
*Understand the difference between heat and temperature.*

*7.8.3*
*Explain how changes in oceanic and atmospheric conditions affect climate.*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# USING RUBBER BANDS TO LEARN ABOUT HEAT

**Materials:**

Rubber bands
Meter stick
Sufficient weight to stretch the rubber band 2 cm
Small flame

**Procedure:** (Exp. #1 and #2 to be done by class together)

**Experiment #1**

1. Place the rubberband on your lower lip and make a mental note of the temperature.
2. Holding the rubberband looped over both index fingers, quickly stretch it to almost its maximum length (do not break) and hold.
3. Immediately place the stretched rubberband to the lower lip to check temperature.
4. For improved effect, rapidly stretch and release five times, the last time keeping it stretched and place on the lip.

**Experiment #2**

1. repeat step #2 from experiment #1, excepts keep it stretched for at least ten seconds.
2. allow the rubberband to quickly return to its original length.
3. immediately touch it to your bottom lip.
4. repeat at least twice.

**Experiment #3** (done as a single demonstration)

1. fasten one end of the rubberband to one end of an upright meter stick.
2. suspend the weight from the other end of the rubberband. Note the mark where the weight hangs.
3. place the flame near the rubberband.

**Questions:**

What change in temperature did you note?
What caused the temperature change in experiment #1? In experiment #2?
What happens to the rubberband and weight when external heat is applied?

**Rationale:**

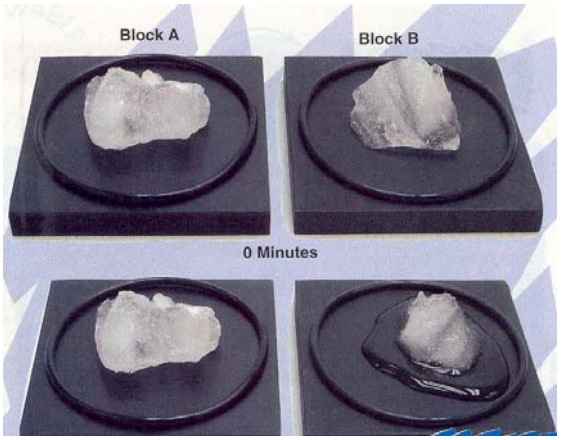
Whenever there is a rearrangement of atoms from one molecule to another energy is transformed. Part of this transformation is expressed in the production or absorption of heat. In experiment #1 you supply the energy required to rearrange the atoms making up the molecules of the rubberband. The rapid rearrangement causes atoms to collide, giving up energy in the form of heat (exothermic). Based on the conservation of energy, when an exothermic reaction is reversed, heat must be put into the reaction (endothermic).

In experiment #2, in order for the atoms to resume their original tight arrangement in the molecules of the rubberband, energy transformation in the form of absorbed heat must occur. A body in the process of absorbing heat will feel cool. Since contraction in the molecular structure of the rubberband is an endothermic reaction, in experiment #3 the application of heat produces contraction.

**Application:** tires on moving vehicle, energy production in cells, chemical reactions.

**From http://www.theteachersguide.com/moredemos.html#heat**

# USING ICE MELTING BLOCKS TO EXPLORE HEAT




When you place an ice cube on each of these two identical looking blocks at room temperature, one ice cube instantly begins to melt and it totally gone in about 90 seconds. The other ice cube shows no evidence of melting whatsoever.

You may have seen advertisements on TV where frozen foods can be thawed in a matter of minutes. Those products operate on the same principle as these blocks.

This set consists of two blocks of nearly the same appearance, but composed of different materials. One of these blocks seems somewhat cold to the touch, while the other seems slightly warm. How much longer would it take an ice cube to melt on the cold block, as compared to one put on the warm block?

In fact, it is a misleading question. The "cold" block and the "warm" block are both the same temperature, namely room temperature. And the ice cube on the "cold" block melts very rapidly-probably melting completely in less than two minutes. In the same period of time, the ice cube on the "warm" block has not melted an amount that can even be noticed.

There are two discrepant events here: 1. Things at the same temperature can feel as though they are at different temperatures. 2. The ice on the two blocks melts at extremely different rates, in a way that is completely unexpected.

Both of these events have the same explanation: The two materials have very different heat conductivities.

The "cold" block is aluminum, which has one of the highest heat conductivities of common materials. It feels cold because heat from your hand, which is much warmer than room temperature, is rapidly conducted into the aluminum. This cools your hand much than you would expect upon touching a room temperature object, and your brain tells you the block is cold.

The "warm" block is a rigid plastic foam. Plastic is a poor conductor of heat, and the air or gas bubbles in it make it especially so. Heat is conducted more slowly from your hand than experience would lead you to expect, and your brain tells you the block is warmer than room temperature.

An ice cube on the verge of melting is at DoC. Transferring heat to the ice cube is necessary to melt it. Both of the blocks are at room temperature, much warmer than DoC, and are able to conduct heat to the ice. However, the high heat conductivity of the aluminum block allows it to conduct heat rapidly to the ice, resulting in rapid melting. The low conductivity of the plastic makes melting very slow.

**ORDERING INFORMATION**

Educational Innovations, 362 Main Avenue,, Norwalk, CT 06851, Phone: 1-888-912-7474 or 203-229-0730, Fax: 203-229-0740, Email: **info@teachersource.com**, Web: www.teachersource.com Set of 2 blocks. Item #BLK-100. $19.95

# ENERGY BUCKET BRIGADE

*Play this game to show how energy is often wasted and given off in the form of heat.*

**Materials:**

Small Styrofoam packing chips to symbolize units of energy.

**Procedure:**

1. Have 5-10 volunteers stand in front of the class in a line. Each person represents a specific energy transformation or transfer which the energy must go through from source to use.

2. Give the first person a huge handful of chips and tell them to pass it down the line as carefully as possible. If they drop some they can't pick them up because energy which is wasted can seldom be retrieved.

3. By the end of the chain, the majority of the energy will be spilled on the floor where it becomes the center of a lesson about efficiency.

*From Energy Activities for Primary Children. Copies of this book (which contains a variety of activities, poems, etc. about energy) are available from the Tennessee Energy Education Network. Call 1-800-342-1340 to request a* copy.

# SNEAKY SNAKE

*The sun, in one way or another, creates up-drafts and air currents; it may be doing it locally or hundreds of miles away. Talk with the students about solar energy warming the earth's surface and causing winds. Draw a few blackboard illustrations of plains and mountains. Use this simple exercise to demonstrate, on a comparatively microscopic scale, the effects of the energy of heat as it warms the air and produces convection currents.*

**Materials:**

Cardstock with snake pattern (we've found regular copy paper works fine, too)
Scissors
Crayons or markers
Thread
Needle

**Procedure:**

1. Draw a spiral snake on heavy paper (or copy the pattern below on cardstock.) Cut along all solid lines.

2. Color your snake. Add some other patterns if you like –even a tongue

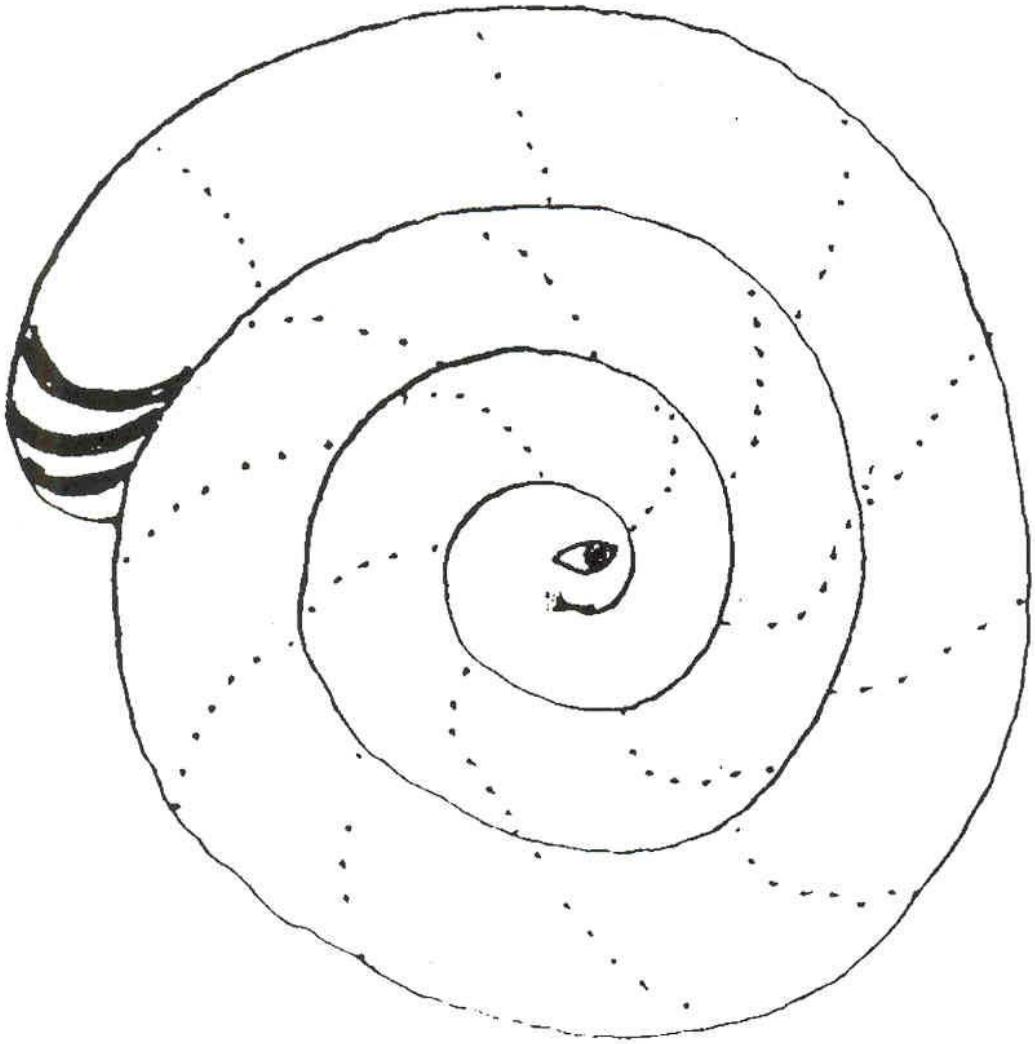
3. Cut out your snake

4. Use a needle to push a thread through the snake's head or balance the head of the snake on the point of your pencil.

5. Hang or hold the snake over a radiator, computer, candle or lamp (warm air) OR hang the snake from the ceiling in your room. Do not let the snake touch the heat source.

The rising air makes the snake move because the molecules of air move faster and rise when it is warm. The moving air spins the snake. Heat energy produces these convection currents.

*From Peggy King, "Get Your Hands On Energy", and Science Try Its at*
*http://www.ktca.org/newtons/tryits/13/sci_try.htm*
*From http://www.bpa.gov/corporate/kr/ed/sold/energy/energy.htm*



# MAKING ICE CREAM

*(Use Variation 2 if you are making enough for a whole class)*

**Materials:**

½ cup whole milk
1 Tbl. Sugar
1 teaspoon vanilla or strawberry extract, or any other flavor you like
1 spoon

**Procedure:**

1. Combine the above ingredients together in a small Ziploc baggie, seal it and shake it a few times so everything is well mixed.

2. In a bigger zip lock baggie, add
   1 cup of crushed ice
   6 Tbl. of regular table salt

3. Seal the little baggie and put it into the bigger baggie that has the salt and ice in it. Seal the bigger baggie

4. Gently squish the two baggies together for about 5-10 minutes.

5. As you do this, watch how the milk mixture is binding together. It is up to the ice cream creator (you) to decide o how thick the ice cream will be. The longer you squish it, the thicker it will be. So, you can decide when the ice cream is ready.

**The Chemistry of Ice Cream:**

The salt we add to the ice cream creates a salt water which is actually colder than ordinary water. In other words, salt water has to get colder than 32 degrees F (or 0 degrees C) before it will freeze. In this case, the milk is like regular water in temperature, and so it freezes when surrounded by the colder salt water. This allows the ice cream to form.

*By Dana Harper, Lied Discovery Children's Museum,*
*http://www.mos.org/learn_more/ed_res/cheapbook/icecream/IceCream.html*

# Making Ice Cream – Variation 2

*Heat is a form of kinetic energy that moves from one substance to another when there is a temperature difference between the two substances. Heat always flows from hot to cold. Heat is usually measured in calories, which are metric units of heat energy. The "calories" you usually hear about from people who watch their weight are actually kilocalories, or one thousand of the calories we use to talk about heat energy.*

1 kilocalorie
= 1000 calories
=3.97 BTUs

**Materials:**

For the class

Prepared ice cream mixture

For each team

About 1 quart of crushed ice
Table salt or rock salt
Spoons and cups
Pint zip-lock bag (one for each 2 students)
Gallon zip-lock bag (one for each 2 students)
Measuring cups
Thermometer
1 cup of ice cream mixture

**Procedure:**

1. Try to get at least 2 parent volunteers to help with this activity.

2. This activity should be done in pairs. After pairing students, divide the pairs into:
   Team A No salt (control group)
   Team B ¼ cup salt
   Team C ½ cup salt
   Team D 1 cup salt

**Note:** Teacher may want to act as "Team A" so that the other teams have edible results!

3. Prepare this ice cream mixture with your class, one batch per team:
   1 cup of homogenized milk
   2-3 tablespoons of sugar
   ¼ teaspoon of vanilla

   For 12 batches:
   12 cups milk
   2 cups, 4 Tbsp sugar
   3 tsp. Vanilla

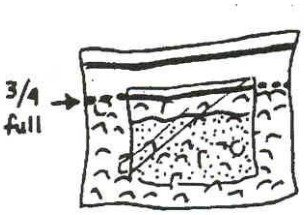
   or prepare enough for the whole class the night before.

NOTE: You can add some chocolate syrup to the mixture to make chocolate ice cream.

4. Have students measure 1 cup of mixture and pour into the pint bag.

5. Measure the temperature of the ice cream mixture and record. Carefully seal the bag. (Make sure thermometers are CLEAN).

6. Fill the gallon bag ¾ of the way with the crushed ice. Place the bag with the ice cream mixture into the bag with ice.




7. All A teams should add no salt to the ice; all B teams add ¼ cup salt; all C teams add ½ cup salt; and all D teams add 1 cup salt. Seal the large bag carefully.

8. Shake (churn) the ice cream. The ice should continually move around the ice cream mixture. Take turns shaking the bag with your partner.

9. Check the consistency of the ice cream mixture at 5 minutes and at 10 minutes. The mixture should be frozen around 10 minutes of shaking. If it isn't, keep shaking.

10. Keep track of the time you begin shaking and the time the ice cream freezes. Record the data.

11. When the ice cream is frozen, place it in cups and enjoy. Be careful not to drip any salty water into the ice cream!
Was there a temperature change in the ice cream mixture from the time you started shaking the mixture to the time the ice cream froze?
Was there a freezing time difference between the groups that added more salt and those that added less?
Where did the energy to make the ice cream come from?

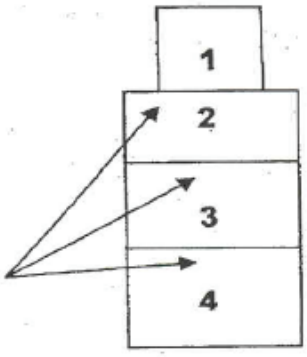
TYPICAL RESULTS

| Amount of salt used | None | ¼ cup | ½ cup | 1 cup |
|---|---|---|---|---|
| Shaking time start | 2:30 p.m. | 2:30 p.m. | 2:30 p.m. | 2:30 p.m. |
| Shaking time finish | 2:40 p.m. | 2:40 p.m. | 2:36 p.m. | 2:36 p.m. |
| Temperature start | 10 degrees C | 10 degrees C | 10 degrees C | 10 degrees C |
| Temperature finish | 8 degrees C | -2 degrees C | -1 degree C | -1 degree C |

# MAKING A HOT AIR BALLOON

**Materials Needed:**

32 pieces of tissue paper
Glue or glue stick
8 flexible neck straws or wire
Metal clamps or large clips
Balloon pattern




**Directions:**

1. Glue 4 pieces of tissue paper together, overlapping and gluing 1/2”
2. Allow to dry. Fold glued sheets in half lengthwise
3. Repeat Steps 1 and 2, creating eight glued and folded sheets.
4. Stack all 8 folded sheets with folded edges matching.
5. Place butcher paper pattern* along the folded edges with narrow point overlapping the #1 sheet.
6. Clamp all eight folded sheets under the pattern.
7. The pages from top of stack to bottom will be #1 to 316.
8. Cut through the stack along the edge of the butcher paper pattern. Keep clamps in place.
9. Starting at the bottom of the stacked pages, separate #16 from #15 with something that will not allow sheets to stick together.
10. Glue sheets #15 and #14. The strip of glue should be no more than 1/2” wide and should extend from top to bottom along the edge. Separate these from other sheets to prevent sticking.
11. Glue sheets #18 and #12. The strip of glue should be no more than 1/2” wide and should extend from top to bottom along the edge. Separate these from other sheets to prevent sticking.
12. Glue sheets #11 and #10. The strip of glue should be no more than 1/2” wide and should extend from top to bottom along the edge. Separate these from other sheets to prevent sticking.
13. Continue this process until #3 is glued to #2. Allow to dry.
14. Remove clamps. Fold top sheet #1 to line up with the bottom sheet #16. This will wrap and close the balloon.
15. Glue sheets #16 to #1. Separate these from other sheets to prevent sticking.
16. Allow to dry.
17. Cut one circle about the size of a dinner plate from remaining tissue.
18. With help from team members – to form the top of the balloon – fold pointed edges of glued sheets into center. It’s OK if they overlap.
19. Glue circles to these overlapping pointed edges to seal the top of the balloon. Make sure there are no open spaces.
20. To form the bottom, use 8 flexible neck straws. Push one straw into a second straw. Do this with all eight straws until a circle is formed.
21. Wrap tissue paper around the straw circle and glue to the inside of the balloon to form the bottom base. Make sure that the opening is no bigger than 18 inches in diameter. Pleat the tissue while gluing, if necessary.
22. Allow to dry
23. Use hot air popper to inflate and fly.
24. If a tear occurs, glue issue into place, overlapping slightly. Or, use regular tape to repair.

**ORDERING INFORMATION:**

Pitsco has a kit for making hot air balloons like this one. The Balloon Construction Paper (20” x 30” sheets) is $15 for a package of 100 assorted colors (Item P7519934-085) and $59 for a package of 480 sheets/ assorted colors (Item P753749-085) They also have a video to give step-by-step instructions for making a 10-gore balloon. The narrator takes the viewer through the entire process, from making a design on paper, to cutting and gluing the gores, to launching the balloon. Time: 15 minutes. $29. Item #P9900006-085.

***NOTE: If you make this balloon, contact Ramona Nelson or Anne Allen through the Energy Hotline (1-800-342-1340) to get a copy of the butcher paper template mentioned in the instructions**.

*From NASA Center, University of Arkansas*

# HEAT

# INEXPENSIVE MATERIALS TO ORDER

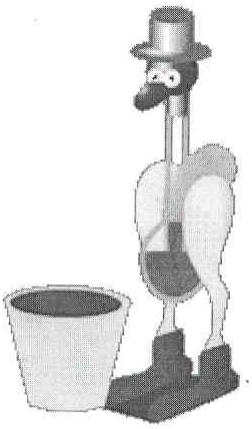
**LAVA LIGHT**

Watch the eye-riveting liquid light show for hours. Simply switch on the light and a bulb illuminates and heats two chemically insoluble liquids to create blobs that rise as they warm and fall as they cool. The ultra–slim glass lamp has a brushed and coated metal tip and base. (Careful, the base can get hot!). It is 110 VAC, UL listed, 16" tall with a 4–3/8" diameter base and a 6–ft cord with an in–line switch. Choose undulating amorphous globules of blue, purple or red. Item #34543 for blue. $14.95

*American Science & Surplus*
*P.O. Box 1030*
*Skokie, IL 60076*
*Phone: 1-847-647-0011*
*Web: http://www.sciplus.com/*

**********

**AMAZING DRINKING BIRD**

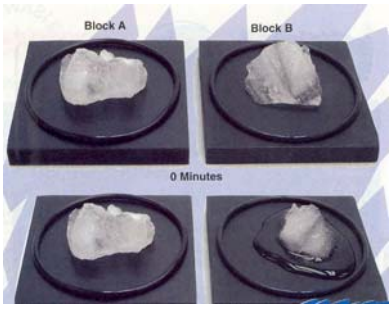


Fill a glass with cold water, make sure the room temperature is above 65 degrees F, soak his head in water briefly, and Drinking Happy Bird is ready to perform. Item #CR30536-17. $7.95 for two birds.

For those who have never seen this toy, the bird consists of two hollow glass chambers (head and body) which are joined together by a double-walled glass tube. The outer tuber provides mechanical support while the inner tube extends into the body chamber below the surface of a colored non-flammable liquid. The bird's head is coated with some sort of fuzzy materials, and is initially soaked in water so that it will begin to cool by evaporation. This then provides a temperature difference from head to tail, which is necessary for it to function. As the head cools, the colored liquid fluid rises up from the body of the bird through the neck. This shifts the center of gravity of the bird toward its head, causing the bird to swivel down and dips its bill into a glass of water. This keeps its head wet, making it cooler than its body. The liquid continues to rise into the head, and the level of the liquid in the body eventually drops below the end of the connecting tube, allowing vapor to be pulled back up through the neck to equalize the pressure. The liquid then runs back down into the body of the bird, it stands up again and the cycle keeps repeating as long as there is water in the glass. Explaining it simply, this action illustrates the conversion of thermal into mechanical energy. But students will only care that it is fun. *Explanation from http://www.anykeynow.com/diversions/drinky_bird.htm*

*Edmund Scientific*
*60 Pearce Ave.*
*Tonawanda, NY 14150-6711*
*Phone: 800-728-6999 •*
*FAX: 800-828-3299*
***www.scientificsonline.com***

**MELTING BLOCKS**




**P**lace an ice cube on each of these two identical looking blocks at room temperature. One ice cube instantly begins to melt and it totally gone in about 90 seconds. The other ice cube shows no evidence of melting whatsoever. Great for showing the difference in heat conductivity in different materials. Set of 2 blocks. Item #BLK-100. $19.95

*Educational Innovations*
*362 Main Avenue,*
*Norwalk, CT 06851*
*Phone: 1-888-912-7474 or 203-229-0730*
*Email: info@teachersource.com*
*Web: www.teachersource.com*

**GIANT HOT AIR BALLOON**

Students will never forget the idea that hot air rises when they watch in awe as a 6'x8' hot air balloon ascends effortlessly into the sky. All you need is a cool, windless day, a relatively open space, a hairdryer, and a string to tether your balloon. Can be launched again and again. Item #SB15152. $24.95.

*Mindware*
*1-800-999-0398*
*Web: http://www.mindwareonline.com*

**RADIOMETER**
A radiometer is a good device to demonstrate how radiant energy is converted into mechanical energy (the energy of motion) or how the sun's energy leads to the formation of winds NOTE: A radiometer will work in bright sunlight or using the light from the overhead projector. $8.95 each.

**FINGER BOILER PEN**
A fun and popular toy. Heat from your finger causes liquid in the chamber to "boil." Packed with a pen stand. Item #929. $4.00 each

**DUAL SCALE THERMOMETER**
An inexpensive plastic backed alcohol thermometer calibrated in 2 degree increments. Fahrenheit and Celsius scales (-30 C to +120F). (-35C to +50C) Hole for hanging. Item #246. $1.50 each.

**HOT AIR BALLOON**
Launch this huge 8' x 6' Hot Air Balloon again and again! It arrives ready for take-off. No assembly required. All you need is a hair dryer or fan heater. Item #939. $20.00

**SOLAR BAG**
Fill this 50 foot long bag with air, wait a few minutes and this large black bag will rise into the sky. This is the largest Solar Bag on the market today. Item #161. $16.00

*Museum Products*
*1-800-395-5400.*
*Fax: 1-860-572-9589.*

*Email: museumprod@aol.com*
*Web: www.museumproducts.net*

**HOT AIR BALLOON**

Grade level 2-6. Make a giant 5 feet tall, high flying hot air balloon. Launch with hair dryers or a popcorn popper. Item #SCE-401. $19.95

**OVERHEAD THERMOMETER**

Grades 1-8. 10" dual –scale transparent model with adjustable red bar indicates temperatures ranging from-40 degrees to 50 degrees C and –40 to 120 degrees F. Item #LER-0395. $5.95

**OVERHEAD THERMOMETER**

Grades 1-high school. Features scales from -40°F to +212°F and -40°C to +100°C. Item #ID-4600

**DEMONSTRATION THERMOMETER**

Grades Kindergarten – 6. Sliding band mounted on plastic. Features Celsius and Fahrenheit scales. Activity sheet. 6" x 251/2". Item #ID-7563. $11.50

**GIANT CLASSROOM THERMOMETER**

(Grades K & up). Largest working thermometer available for class display! 30" wall-mounted thermometer has 23" tube on wooden base. Shows both Fahrenheit and Celsius scales from -40°C to 50°C and -40°F to 120°F. Item #LER-0399. $39.95

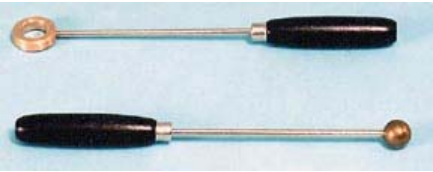
**DEMONSTRATION THERMOMETER**

(Grades 1-3). A great way to teach Fahrenheit, Celsius and negative numbers. The sturdy cardboard thermometer measures 21" x 61/2" (53cm x 17cm) with sliding red and white elastic mercury bar. Item #W-MB9385H. $7.99

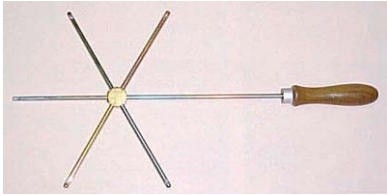
*Parent Teacher Aids*
*5000 Smithridge Drive, Suite A-21*
*Reno, Nevada 89502*
*Phone: 775-825-3328*
*Fax: 775-825-3348*
*Web: http://www.zteacher.com/main.asp (to order)*
*http://www.zteacher.com/pta-nv/ (home)*

**RADIOMETER**
See a description of the uses of a radiometer above. This company refers to it as a Solar Engine. Item #07323W2. $9.95.

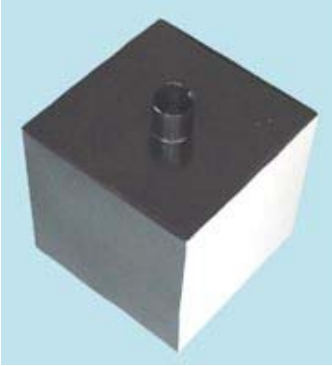
**BALL AND RING**
Demonstrates expansion of metals with heat.
Item #11737W2. $9.95



**CONDUCTOMETER**



Demonstrates the difference in thermal conductivity of different metals. Consists of five metal rods stainless steal, brass, copper, iron and aluminum connected to a center metal, brass, hub which is mounted on a rod with wooden handle. The five rods have depressions on the ends to hold wax. When the center hub is heated, heat is conducted through the rods and conductivity of heat can be ascertained by the melting of wax. Item # 14695W2. $6.95



**LESLIE'S CUBE**
To show the heat absorption of different surfaces. Tin plate, 125mm side. With surfaces dull black, bright black, white, and bright tin. Item 14697W2. $11.95

**HEAT TRANSFER KIT**
Students fill one container with water at room temperature and the other with boiling water...A thermometer is placed in each container and the water temperature in both cups read before heat transfer...The metal bar is then immersed in the cups, and students observe heat lost by boiling water and heat gained in the cooler water...Each kit includes: 2 insulated containers: 2 insulated lids with slots; 1 U-shaped aluminum transfer bar; 1 thermometer 20° to 110°...Additional materials required: low-temperature thermometer. Item 15230W2. $24.50

**HEAT, LIGHT and SOUND Reproducible Book**
Curriculum-oriented worksheets that provide a focused unit of information on each subject. Cleverly illustrated puzzles, games and activities give hands-on experiences to students. Each book contains an illustrated certificate of achievement. Grades 1-3.
Item #13871. $4.95

**HEAT Wall Chart**
20 x 30 inch beautiful, full-sized chard which can serve as vivid classroom decorations as well as a versatile teaching aid. Color on front with black and white exercises on the back suitable for either write-on/wipe-off activities, or for use as black line worksheets. Grades 5-12. Laminated both sides. Item 14127-2. $5.95

*Schoolmaster Science/School-Tech, Inc*
*745 State Circle Box 1941*
*Ann Arbor, MI 48106*
*Phone: (734)761-5072 or 1-800-521-2832*
*Fax: (734)761-8711 or 1-800-654-4321*
*Email: service@school-tech.com*
*Web: http://www.wolverinesports.com/*

# HEAT
# RELATED WEB SITES

http://pbskids.org/zoom/phenom/bottlefountain.html
**BOTTLE FOUNTAIN**
Discover how warm air can expand and push water to create a fountain.

http://pbskids.org/zoom/sci/thermometer.html
**THERMOMETER**
Watch what happens to water in a straw when it is cooled or heated.

http://wwwbhs1.bham.wednet.edu/squalweb/departments/Cap/ScienceProjects/projheat.htm
**SCIENCE ACTIVITIES FOR THERMAL ENERGY AND HEAT**
Links to these lessons are available on this site:
Give and Take - Lesson plan activity to show how dark materials both absorb and emit energy more readily than light-colored materials. (Lesson 1 and Issues in Science)
Chill Out! - Find out how insulation can keep heat in and out
Smoke-A-Rising" – create a convection cell to show why smoke travels upward. (Lesson 3)

http://www.brainpop.com/science/seeall.weml
**MOVIE: TEMPERATURE**
You can see a wide assortment of animated movie clips at this site.

http://www.exploratorium.edu/xref/phenomena/absorption_-_heat.html
**HEAT ABSORPTION**

http://www.kidwizard.com/Spells/BottledHeat.asp
**BOTTLED HEAT.**

http://www.mos.org/learn_more/ed_res/cheapbook/balloons/index.html
**UP IN SMOKE – INVESTIGATING HOT AIR BALLOONS**
Lesson plan from Liz Claud, Montshire Museum of Science.

http://www.pbs.org/safarchive/4_class/45_pguides/pguide_405/4545_sm.html
**SCIENCE OF SPORTS: SPRING MAN**
Investigate the transformation of muscle energy to heat energy with simple activities.

http://www.rockitscience.com/catalogue/energy.html
**ROCK-IT SCIENCE.**
Potential and Kinetic energy.

http://www.srh.noaa.gov/FTPROOT/FFC/html/metcalc.shtml
**TEMPERATURE CONVERSIONS**
If it's 75 degrees Fahrenheit, what is it in Celsius degrees? Students can compute the answer at this site.

http:// www.spartechsoftware.com/reeko/Experiments/ExpSteelWoolGeneratingHeat.htm
**REEKO'S MAD SCIENTIST LAB.**
Steel wool generating heat.

# ELECTRICAL ENERGY

*4.14.1  5.14.1*
*Know that energy exists in many forms.*

*4.14.4a*
*Construct and explain a simple electrical circuit*

*5.14.4a*
*Construct and explain a parallel circuit*

*6.14.3*
*Understand the basic principles of electricity*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# STATIC TUBES

**Materials:**

Clear plastic tubes with end caps. (Home Depot sells 4' fluorescent tube covers for approx. $3.00 each). If you buy these long tubes, they can be cut with a box cutter into smaller, more manageable sizes of approximately 24" long.
Styrofoam peas (filling from bean bag chairs) or tiny broken-up pieces of Styrofoam pellets or puffed rice. You will need 2 Tbl. of pellets for each tube. (Styrofoam peas and even beanbag chairs can be difficult to find. Puffed rice works fine.)
Empty bowl, shoe box, or large can
Wool cloth

**Procedure:**

1. Give each student a clear plastic tube and two end caps. (If you don't have two end caps, you can put duct tape over the end.). Have them insert one cap into one end of the tube.

2. Place all of the Styrofoam peas inside a large container such as a bowl, shoe box, or can. Challenge the students to get about two tablespoons of Styrofoam peas inside their static tubes through the end that they have left uncapped. This is not always easy, because the plastic tubes take on a charge with minimal handling and will attract and repel the Styrofoam peas.

3. When the students have placed their peas inside the tube, have them insert the other end cap, and remove any Styrofoam clinging to the exterior of the tube with a cupped hand. Rub the exterior of each tube with the wool cloth.

4. Let the students experiment with their closed static tubes. Can they pour all of the peas from one end to the other? How can they move any peas along that seem to be stuck? Using terms they have learned through other activities, such as attract, repel, static charge, and induction, can they describe what happens when they bring a finger close to the outside of the tube?

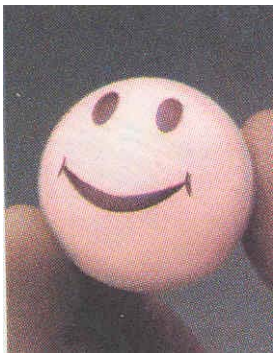
**THE SCIENCE BEHIND IT**

The plastic tube, when rubbed with wool, picks up electrons and becomes negatively charged. This induces a positive charge in the Styrofoam peas which will cling to the plastic, pick up electrons, and later leap away. When your finger approaches the negatively charged tube, the finger becomes positively charged by induction, just like the Styrofoam peas. Therefore, your finger and the Styrofoam have like charges, and you will find that you can chase the peas around inside the tube by moving your finger on the outside.

*From http://www.mos.org/sln/toe/statictubes.html*

# USING AN ENERGY BALL

*An Energy Ball is a white ball that looks like a ping-pong ball with two metal strips underneath. When someone touches both metal strips, a light turns on and the ball makes a spooky noise. This toy can be used to teach circuits. See ordering information below.*



1. Activate the Energy Ball by holding it in the palm of your hand. **Ask: What do you think makes the ball flash and hum?** (Answer: Electricity from a small battery inside activates a light and a small noisemaker.)

2. Show the metal contacts. First touch just one contact to show that the ball will not activate. Then touch both contacts to demonstrate the technique for activating the ball.
**Ask**: **Why do I have to touch both contact points to make the ball work?** (Answer: Electricity must be given a complete path, or circuit, in order to flow. When you touch both contacts your body is completing the circuit. A small amount of electricity passes through your body to activate the ball.)

**3.** Connect the two contacts with a small piece of paper to show that some materials will not complete the circuit. (The ball will not light up.) Say: As you can see, the Energy Ball won't light up when paper is used to complete the circuit. **Can you think of any materials that might work?** Try out any feasible ideas. Use aluminum foil, paper, cloth, etc.

**4.** **Ask: What kinds of materials were able to complete the circuit?**
(Answer: Only materials that conduct electricity, such as metals, will work to complete the circuit. Interestingly enough, our bodies also conduct electricity.)

**5.** **Ask: If I touch one metal contact and someone else touches the other will the ball light?** Try this, but make sure your hands are not touching.
(Answer: The energy ball will not work since the electricity does not have a complete circuit through which to flow.)

**6.** **Ask: Will the ball light if we hold the ball *and* hold hands?** Use your free hands to hold hands. (Answer: Yes. Electrical current passes through your bodies and activates the ball.)

**7.** **Ask: Will the ball light if we add a third person?** Add a third person to form a circle.
(Answer: Yes. Current passes through all three people.)

8. Ask: **How many people can we add and still activate the ball?**
Keep adding students until the entire class has joined the circle. (Answer: The ball will light up with the whole class holding hands.

*Activity developed by Laura Candler for Teaching Resources at http://home.att.net/~teaching*

**ORDERING INFORMATION**
Energy Balls can be ordered from Museum Products. Phone 1-800-395-5400. Fax: 860-572-9589. Item #926. $4.50 each. 12/$4.00 each.

# MAKING SIMPLE CIRCUITS

*You can make wire for electricity experiments very quickly and inexpensively. Give each child a sheet of aluminum foil and some Scotch tape. Turn the shiny side down and have the students lay strips of tape across the dull side of the foil. (The tape gives the foil wire some rigidity). Cut out the strips and then fold in half lengthwise. Instant wire!*

**Materials:**

1 C or D battery
Scotch tape (or masking tape)
Strip of aluminum foil 12” long and 1.5” wide
1 flashlight bulb

**Procedure:**

1. Prepare some “wire” with aluminum foil and tape. (see the introductory paragraph above)

2. Using the “wire”, bulb and battery, create a circuit so the bulb will light. (HINT: There is more than one way.)

**The Science Behind It**

If a flashlight bulb is placed correctly in a complete circuit so that electricity passes through it, it will light. In order for current (electrons) to flow through the bulb, it must be connected to the circuit at two points, the *tip contact* (the metal button at the bottom of the bulb) and the *base contact* (the metal side of the bulb's base). To make the bulb light with the materials above, either the base contact or the tip contact of the bulb must touch one terminal of the battery. The wire must connect the battery's other terminal to the remaining contact.

*From Energy For Kids presentation by Peggy King, 1999*

# ELECTRIC PUZZLES

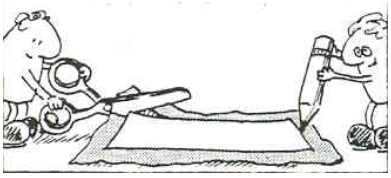
*Construct a circuit puzzle and find, by trial and error, those holes that are connected by foil and those that are not.*

**Materials:**

3 Index cards per person
Aluminum foil
Tape
Hole puncher

**Procedure:**

The purpose of this activity will not be completely clear to your students until they reach step 8. It is helpful, therefore, to make a circuit puzzle yourself and show your class its principal parts.

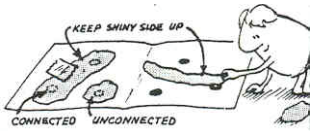


1. Cut some foil the size of an index card.

2. Sandwich the foil between 2 index cards.

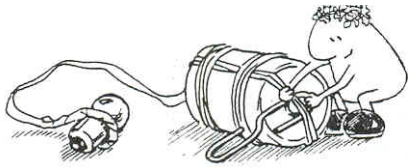
3. Fold a NEW card in half. Punch 3 holes in it.

4. Unbend the card. Randomly cover all holes with foil so some are connected and some are not.

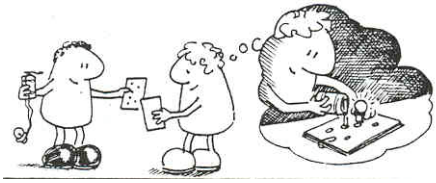



5. Paper clip your sandwich over the foil patches to hide them.

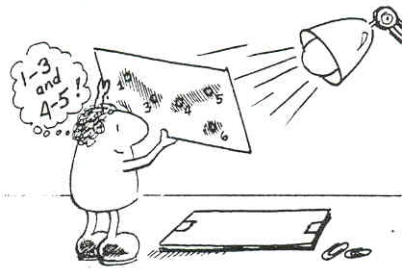
6. Turn your puzzle over. Number the holes and write your name on it.



7. Unbend a paper clip. Secure it to a battery using a rubber band. Make sure the paper clip slides between the bump end of the dry cell and the rubber band.



8. Trade your puzzle for a friend's. Use your bulb and dry cell to find out which holes are connected with foil.




9. Find out if you are right. Remove the back sandwich and hold the puzzle up to some light.

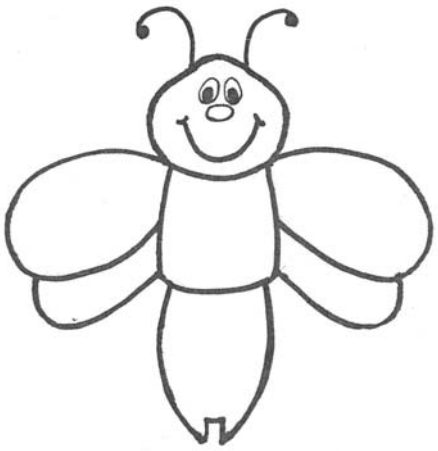
*From TOPS Learning Systems Electricity Module (#32) Activity #7. $15.00 Available from TOPS Learning Systems, Inc., 10970 S. Mulino Rd., Canby OR 97013, Orders Only: 888.773.9755; Customer Service: 503.263.2040*

# LIGHTNING BUG, LIGHT!

*Construct a complete circuit in order to produce a light for the lightning bug model.*

**Materials:**

1 Miniature Christmas tree light with 2" of wire on each side
Lightning bug pattern (at right)
Masking tape
1 AA battery (1.5 volts)
1 small metal paperclip
Pipe cleaners for antennae and wiggly eyes – optional



**Procedure:**

1. Copy the lightning bug pattern on cardstock.
2. Color and decorate your bug.
3. Tape the light bulb to the back of the bug so the bulb fits into the tail opening.
4. Tape the end of one wire to the flat end of the battery.
5. Twist the other wire end to a paper clip.
6. Tape the battery to the back of the bug.
7. Touch the paperclip to the bump end of the battery (This acts as a switch).
8. Tap the battery with the paperclip to make your bug flash.

The lightning bug will light if the circuit is complete. To flash, break the circuit, and then complete the circuit by tapping the paperclip on the positive terminal of the battery.

**The Science Behind It**

When the bulb lights, the circuit is complete. It is broken, or open, when the paperclip is removed from the tip of the battery. Switches open and close circuits to turn motors, lights, and other electrical appliances off and on. (Lightning bugs do not use electricity to produce their lights. They use chemicals that their bodies make.)

*From Energy For Kids presentation by Peggy King, 1999*

# MAKE AN ELECTROMAGNET

**Materials Needed**:
For 20 students.

10--20 inch strips of insulated copper wire, 1/2 exposed on each end
10--40 inch strips of insulated copper wire, 1/2 exposed on each end
15--size "D" batteries
1--battery holder for 2 "D" batteries
10--compasses
25--iron nails, 4" long
1--box of paper clips, approx. 300
Masking or transparent tape
Iron filings
5" x 7" index card or clear transparency

**Activity #1:**
Give each pair of students one battery, iron nail, 40" copper wire, and about 30 paper clips. Have them, using only the nail, try to pick up as many paper clips as possible. Instruct them to wrap the copper wire around the nail ten times leaving 5-6 inches of wire free on each end of the nail. Attach one end of the wire to the negative pole of the battery. Tape securely and then touch the other end of the wire to the positive pole of the battery while their partner uses the nail to pick up paper clips.
Then release the wire from the positive pole of the battery. Discuss methods and results. Record the number of paper clips picked up by the magnetized nail by each group.

**Activity #2:**
Elicit ideas and suggestions from students on how they can make the nail pick up more paper clips. Possible ideas are to: 1) use more wire; 2) use more batteries; 3) use more nails. Break students into groups of four and let one group test the idea of using more batteries; another group using 2-3 nails; a third group using more wire, wrapping the nail 15-20 times; and another group wrapping the nail 30-40 times. Reconnect the circuit and pick up as many nails as possible. Record the results of each group and discuss results.

**Activity #3**:
This is a teacher demonstration in which the students will observe what happens when iron filings are sprinkled over an electromagnet. Place two batteries in a battery holder and connect the end wires to the end wires of an electromagnet (nail wrapped with copper wire). Place them on the overhead projector and place the clear transparency over the electromagnet. Slowly sprinkle iron filings over the transparency and observe what happens to the iron filings. Discuss observations.

**Assessments:**
At the conclusion of the lesson, the students will be able to answer thee following questions:

1. Name 3 ways in which magnets and electromagnets are alike.
(Have poles, attract metals, have lines of force)
2.Name 3 ways electromagnets differ from magnets.
(Electromagnets need electricity to work, the poles of electromagnets can be reversed, the strength of electromagnets can be increased)
3. List 2 ways to increase the strength of electromagnets. (More batteries, more wire)

*By Tanya English, O'Keeffe Elementary School at http://www.iit.edu/~smile/ph9528.html*

# ELECTRICAL ENERGY RELATED WEB SITES

fly.hiwaay.net:80/~palmer/motor.html
**BEAKMAN'S ELECTRIC MOTOR**
This Web site clearly explains, with diagrams, hot to build a simple electric motor using just a few household items

http://ippex.pppl.gov/
**IPPEX INTERACTIVE.**
Learn about electricity and magnetism through this interactive feature!

memory.loc.gov/ammem/ndlpedu/lessons/99/edison/intro.html
**THANK YOU, MR. EDISON: ELECTRICITY, INNOVATION and SOCIAL CHANGE**
A lesson in which students learn about the invention of the phonograph, the impact of electricity on Americans, and Thomas Edison's role in the electrification of America. (Library of Congress).

http://webhome.idirect.com/~jadams/electronics/circuit.htm
**BASIC ELECTRONIC CIRCUITS.**
Learn all about circuits

http://www.actewagl.com.au/education/electricity/basics/default.cfm
**THE BASICS OF ELECTRICITY.**
Diagrams help explain how atoms and electrons are used to produce electricity.

http://www.adobemontessori.com/biographies/Franklin.html
**THE LIFE OF BENJAMIN FRANKLIN.**
Learn about the man as well as his experiment with electricity.

www.alliantenergy.com/residential/basics/elecmade.php
**HOW ELECTRICITY IS MADE**
From the coal mine to your home – how electricity is made and used in homes.

http://www.apocalypse.org/pub/u/gilly/Schoolhouse_Rock/HTML/science/electricity.html
**LYRICS TO SCHOOLHOUSE ROCK ELECTRICITY SONGS**
Schoolhouse Rock is one of many artifacts from the 1970s that still is in existence today. In the mid-70s, ABC TV aired these short cartoons, which taught a generation about government, history, grammar, science, and math. Here are the lyrics to some of the songs. The video itself can be ordered from such sites as Amazon.com

www.azsolarcenter.com/technology/cellwk.html
**HOW A PHOTOVOLTAIC CELL WORKS**
Diagram of a photovoltaic (solar) cell produces electricity.

www.azstarnet.com/anubis/zaphome.htm
**KIDS' LIGHTNING SAFETY**
Meteorological experts insist we're more likely to be struck by lightning than win a big lottery, and while we may have never met anyone who's scored the big one, we can all visit someone who's been hit by the big one. Young Sabrina Harwood was with her family in the Grand Canyon when a lightning bolt shattered their reverie. They all survived and have created this web page in an effort to help others avoid suffering the same fate. This is a wonderful site, filled with courage and tips for everyone, young or old.

http://www.brainpop.com/science/seeall.weml
**MOVIE: BATTERIES/ ELECTRICITY**
**MOVIE: ELECTROMAGNETIC SPECTRUM**
**MOVIE: STATIC ELECTRICITY**

**MOVIE: CURRENT ELECTRICITY**
You can see a wide assortment of animated movie clips at this site.

http://www.dukepower.com/educationalresources/Kids-Home/kids/understanding/electricity.htm
**UNDERSTANDING BASIC ELECTRICITY.**
Ever wonder why birds don't get shocked when they sit on power lines? Find out on this page.

www.co-opliving.com/kids/games/quiz/quiz.htm
**ELECTRICITY QUIZ**
See how well you score on this electricity quiz.

www.dom.com/about/safety/kidsafety/index.html
**SAFETY FOR KIDS**
A fun page with all kinds of safety games and tips for kids.

www.dukepower.com/educationalresources/Kids-Home/kids/understanding/electricity.htm
**UNDERSTANDING BASIC ELECTRICITY**
Ever wonder why birds don't get shocked when they sit on power lines? Find out on this page.

www.freefoto.com/pictures/industry/hydro_electric/index.asp
**FREE FOTO.COM**
Pictures of hydro electric facilities

www.freefoto.com/pictures/industry/coal_power_station/index.asp
**FREE FOTO.COM**
Pictures of electrical generation

www.fwee.org/timeline.html
**HYDRO-ELECTRIC TIMELINE**
How was electricity discovered?

http://www.howstuffworks.com/battery.htm
**HOW BATTERIES WORK.**
Complete with diagrams, learn about how batteries work.

www.lignite.com/tour/powertrip.htm
**POWER TRIP: HOW ELECTRICITY IS MADE**
A diagram of a power plant. Click on a part of the plant to get details or take a virtual tour.

www.miamisci.org/af/sln/frankenstein/
**FRANKENSTEIN'S LIGHTNING LABORATORY**
Check out the Atoms Family to learn about electrical safety, static electricity and try an experiment.

http://www.mos.org/sln/toe/toe.html
**THEATER OF ELECTRICITY (Grades Pre-K-12).**
This site, which is supported by Boston's Museum of Science, includes a variety of topics that are important in the study of electricity. Watch a video of Franklin's kite.

www.newi.ac.uk/buckleyc/electric.htm
**INTRODUCTION TO ELECTRICITY**
Great background information for teachers!

http://www.pbs.org/saf/1107/teaching/teaching.htm
**THE BIONIC BODY: COORDINATED CONTROL**
Students construct a circuit as they study electromagnetism.

http://www.pbs.org/saf/1201/teaching/teaching.htm
**PET TECH: LOCATING LAND MINES**
With this hands-on experiment, students will construct an electric circuit in order to learn an appreciation of the difficulty in uncovering model land mines

www.planetzoom.com/worldworks/industry/electricity.html
**HOW IS ELECTRICITY PRODUCED?**

http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/burglar.html
**MAKE YOUR OWN BURGLAR ALARM ACTIVITY**

http://www.rp-1.com/RPLKids.htm
**ELECTRICITY FOR KIDS.**
Explains Lightning, Making Electricity, and Electrical Safety.

www.sciencemadesimple.com/static.html
**WHAT IS STATIC ELECTRICITY?**
Background and projects to try.

www.sdge.comVPPT/vppt_0.html
**VIRTUAL POWER PLANT TOUR**
Take a trip into the heart of a real power plant. Complete with interactive 3D models, panoramic motion images, sights and sounds, and lots of surprising information.

www.si.edu/lemelson/edison/html/thomas_alva_edison.html
**THOMAS ALVA EDISON**
Examines several of his inventions – the telegraph, telephone, phonograph, and electric light bulb. Students learn about his life and how to create their own light bulb. (Smithsonian National Museum of American History)

http://www.teachtsp.com/classroom/scicourt/scsongs.html
**SCIENCE COURT SONGS AND LYRICS.**
Enjoy songs about electric current.

www.tec-rec.com/kids/electric.html
**HOW ELECTRICITY IS MADE**
Describes how electricity is made from steam, fossil fuels, nuclear, water, etc. and is then transported.

www.thetech.org/exhibits_event/noyce_center/topics/11a.html
**HEAT, LIGHT and MOTION**

www.uinet.com/ui-kids/
**UNITED ILLUMINATING COMPANY KIDS PAGE**
Games of skill and games for fun to teach kids about electrical safety. Coloring pages to print out, mazes and simulations for Grades 3-8.

# ELECTRICITY
# FREE MATERIALS TO ORDER

**ELECTRICITY DODECAHEDRON. (Grades 5-8).**
Students put together a twelve-sided figure that explains the process of turning coal into electricity. FREE in classroom sets to Tennessee teachers

**HINES POSTER SERIES**
This set of black and white pictures depict life in the Tennessee Valley in the early 1930's before the advent of electricity. Discussion questions and teaching suggestions are on the back of each photograph. Great for social studies class, too! (If you would like to make these photographs into a filmstrip so the entire class can view the pictures at once, request Energy Filmstrip Instruction Sheet when you call or write). One set per classroom. FREE to Tennessee teachers.

**SCHOOLHOUSE ROCK.**
Academy Award winner Cloris Leachman and a group of young friends share a lively half hour of catchy songs and sketches that make learning about science, grammar, math and history fun and easy! FREE on loan to Tennessee teachers. Titles on Science Schoolhouse Rock video includes one on ELECTRICITY.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 inside Tennessee*
*or 615-674-2994 outside Tennessee,*
*Web: http://www.tnenergy.com*

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**WHAT EVERYONE SHOULD KNOW ABOUT ELECTRICITY FROM COAL**
**(Grades 4-12)**
15-page illustrated booklet that explains how electricity is generated from coal and delivered to homes. (Single copy FREE; additional copies: $.42)

*American Coal Foundation,*
*1130 17th Street, N.W., Suite 220,*
*Washington, DC 20036-4604,*
*Phone: (202) 466-8630,*
*Fax: (202)466-8632,*
*E-mail: acf-coal@mindspring.com*

**********

**ALL ABOUT ELECTRICITY AND 10 WAYS KIDS CAN SAVE IT pamphlet**
(Grades 6-8) This new informational brochure highlights how electricity is generated and the reasons everyone must use energy wisely. Kids will learn about the history of electricity and what they can do to help conserve it. Includes a vocabulary section, as well as important safety rules. FREE.

*American Public Power Association,*
*2301 M Street, N.W., Suite 300,*
*Washington, DC 20037*
*Phone: 202-467-2900 ,*
*Fax: 202-467-2910,*
*Email: mrufe@appanet.org,*
*Web: http://www.appanet.org*

**THE BEST OF EDISON TEACHING KIT Grades 5-10.**
3 ring plastic binder containing 8 how-to booklets based on the experiments of Thomas Edison and other scientists. The kit including all booklets is FREE but you must pay $1.00 for postage and handling. Titles Include: Alternative Energy Sources, Energy Conservation, Environmental Experiments, Energy For the Future, Nuclear Experiments You Can Do, Selected Experiments and Projects, Useful Science Projects, Lewis Howard Latimer - A Black Inventor, Static Electricity - It's a Snap

*Charles Edison Fund,*
*One Riverfront Plaza,*
*4th Floor, Newark, NJ 07102,*
*Phone: (973) 648-0500,*
*Fax: 974-638-0400,*
*Email: info@charlesedisonfund.org,*
*Web: http://www.charlesedisonfund.org*

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**ENERGY INFORMATION SHEETS**
21 information sheets. These one-page capsules cover such energy topics as petroleum, natural gas, coal, electricity, and renewable energy. FREE

**ELECTRICITY INFOCard**
Features recent electricity data in graphic form. Available on web site which also features the EIA Kid's Page (www.eia.doe.gov/kids/) and hundreds of links to other energy-related sites.

*National Energy Information Center,*
*U.S. Department of Energy,*
*Energy Information Administration, EI-30*
*1000 Independence Avenue,*
*S.W., Room 1 F-048, MS EI-30,*
*Forrestal Building,*
*Washington, DC 20585*
*Phone: (202) 586-8800,*
*FAX: (202) 586-0727,*
*E-mail: INFOCTR@EIA.DOE.GOV.,*
*Web site: http://www.eia.doe.gov*

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# ELECTRICAL ENERGY
# INEXPENSIVE MATERIALS TO ORDER

**ELECTROWORKS**
Hands-on activities exploring magnets, batteries, circuits, and static electricity. Available as part of the National Energy Education Day kit available from TEEN (1-800-342-1340) for $5.00 to Tennessee teachers.

*Tennessee Energy Education Network*
*Phone: 1-800-342-1340 inside Tennessee*
*or 615-674-2994 outside Tennessee*
*Web: http://www.tnenergy.com*

**STAY SAFE AROUND ELECTRICITY** Scriptographic fact booklet.
(5 ½" x 8", 2-color, 16 pages. $1.15)

**MY BOOK ABOUT ELECTRICITY**
(Grades K-1) (8 ½" x 11", 16 pages $1.60 each)

**MY BOOK ABOUT ELECTRICAL SAFETY**
(Grades K-1) (8 ½" x 11", 16 pages $1.60 each. )

**LET'S LEARN ABOUT ELECTRICITY Coloring and Activity Book.**
Grades 1-3 (8 ½" x 11", 2-color, 16 pages. $1.60 each)

**HISTORY OF ELECTRICITY Coloring and Activity Book.**
Grades 1-3 (8 ½" x 11", 2-color, 16 pages. $1.60 each)

**ABOUT ELECTRICAL SAFETY Coloring and Activity Book.**
Grades 1-3 (8 ½" x 11", 2-color, 16 pages. $1.60 each**)**

**LET'S EXPLORE ELECTRICITY Information and Activity Book.**
(Grades 4-6. $1.60 each.)

**LET'S TALK ABOUT ELECTRICAL SAFETY Information and Activity Book.**
Grades 4-6. (8 ½" x 11", 2-color, 16 pages. $1.60 each.)

**WAY TO GROW! Electrical Safety Growth Chart**
This unique chart helps parents protect their child from electrical hazards as kids watch themselves grow taller! Colorful, playful characters, a wealth of safety tips and space for a child's name guarantee a special place in the house. 8 5/8" x 56". # 94218. $2.60 each

*Channing L. Bete Company, Inc.,*
*200 State Road,*
*South Deerfield, MA 01373-0200*
*Phone: (413 ) 665-7611 or 1-800-628-7733,*
*FAX: 1-800-499-6464,*
*Email: custsvc@channing-bete.com*
*Web: http://www.channing-bete.com*

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**STATIC TUBE**
Discover the wonders of static electricity as you cause the static spheres to dance inside the tube. Uncover hidden static charges everywhere! Ages 7 and up. #1231 $3.50 each

**ENERGY BALL**
Fascinating and fun. By touching two me1tal strips simultaneously your body becomes a path to complete a circuit. Result: the ball flashes brightly with an eerie sound. Even works with several people creating the path. Blister packed. #926. $4.50.

**LIGHTNING BALL**

Place your hand on the lightning ball and immediately see a dazzling display of electrically charged particles leap harmlessly about your PALMS AND FINGERS AS YOU CREATE patterns of light and energy. Switch to sound mode and the lightning responds to voice or music. No batteries needed-plugs into wall socket. Great for energy and light experimentation.

*Museum Products*
*84 Route 27*

*Mystic, CT 06355*
*1-800-395-5400*
*FAX: 860-572-9589*
*Web: www.museumproducts.net*

**ELECTRICAL SAFETY poster**
($3.00. Orders under $50.00 must be prepaid.)

**ELECTRICAL GENERATION poster**
($3.00. Orders under $50.00 must be prepaid.)

**ELECTRICITY SERVES OUR COMMUNITY poster**
($3.00. Orders under $50.00 must be prepaid.)

**ELECTROTECHNOLOGY poster**
($5.00. Orders under $50.00 must be prepaid.)

*National Energy Foundation,*
*ATTN: Etta Stephens,*
*3676 California Ave., Suite A117,*
*Salt Lake City, UT 84104,*
*Phone: (801) 908-5800,*
*FAX: (801) 539-1451,*
*E-mail address: info@nef1.org*

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**ELECTROWORKS**
Hands-on activities exploring magnets, batteries, circuits, and static electricity. Available as part of the National Energy Education Day kit available from TEEN (1-800-342-1340) for $5.00 to Tennessee teachers.

*National Energy Education Development (NEED) Project,*
*8408 Kao Circle,*
*Manassas, VA 20110*
*Phone: 1-800-875-5029 or 703-257-1117,*
*FAX 703-257-0037,*
*Email: info@need.org,*
Web: *http://www.need.org*

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**RECHARGEABLE BATTERY KIT** (For Grades 3-8)
Includes a Teacher's guide, a poster, a lesson plan which uses batteries as the basis for developing student's math, science and history skills and a little something extra for your students. By offering a series of interactive experiments and thought-provoking exercises, the program teaches students about the merits of battery power, safety tips in using batteries, and how to properly recycle batteries. Order from the Web site below.

*Rechargeable Battery Recycling Corporation,*
*1000 Parkwood Circle, Suite 450,*
*Atlanta, GA 30339,*
*Phone: 678-419-9990 or 678-419-9886.*
*Email: corporate@rbrc.com.*
*Web: www.rbrc.org*

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**ELECTRICAL GENERATION (poster)** 35 x 23.
You can see a picture of this poster on the Web site. $3.00.

*Society for Mining, Metallurgy and Exploration, Inc. (SME),*
*PO Box 277002,*
*Littleton, CO 80127*
*Phone: 1-800-SME-3132,*
*Fax: 303-973-3845,*
*mail: sme@smenet.org,*
*Web site: http://www.smenet.org*

**ENERGY BALL**
By touching two metal strips simultaneously your body becomes a path for charged molecules to complete a circuit. Result - the ball glows brightly and generates sound. Even works with several people creating the path. When opened, the Energy Ball reveals a working circuit. Item S10048. $4.50 each.

**BATTERY HOLDER**
Plast5ic holder for one "D" size battery. Can be connected in series for multiple voltage. Item S3725. $.95 each. 10 or more $.85 each.

**LAMP SOCKET**
Plastic base with brass screw type receptacle, and two terminals. Item S10002. Each $.75

*Southern Scientific*
*PO Box 368*
*McKenzie, TN 38201*
*Phone: 1-800-748-8735*
Web: *www.southernscientific.com*

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**ELECTRICAL SAFETY TIPS WITH SAFETY MAN (video)**
Targeted to 7-14 year olds, this videotape and accompanying activity package teach electrical safety principles and provide safety tips to students. The accompanying activity package includes a lesson plan, poster and exercises. Activity package distribution is limited to teachers. 13 minutes. FREE for you to keep. Limit one per person. Allow 6 weeks for delivery.

**OPERATION DECORATION WITH SAFETY MAN (video)**
Also targeted to 7-14 year olds, this videotape and "Holiday Home Safety Checklist" show how electric lights and decorations can help brighten the holiday season. It explains how misuse of these products could lead to fire. Activity package distribution is limited to teachers. 13 minutes. FREE for you to keep. Limit one per person. Allow 6 weeks for delivery.

*Video Placement Worldwide*
*Phone: 727-823-9595*
*FAX: 1-800-358-5218*

# NUCLEAR ENERGY

*4.12.1 5.12.1*
*Recognize that matter has predictable properties and is composed of basic units, some too small to be seen with the naked eye.*

*4.12.2 5.12.2*
*Recognize conditions that are associated with different states of matter*

For background information on this topic, see

**http://www.need.org/infobooks.htm**

# TWINKIE WITH AN ONION
# (DOWN THE DRAIN –NEVER!)

*This activity was originally intended as part of a hazardous waste activity but it also illustrates the problems connected with containing nuclear radiation. Do the following demonstration to see how radioactive material may contaminate soil and groundwater.*

**Materials:**

Twinkie or cream-filled cupcake
Tsp. of chopped onion
Plastic Wrap
Knife

**Procedure:**

1. Use a Twinkie or cream-filled cupcake to represent the earth (the cream filling will represent the groundwater supply).

2. Carefully cut a piece out of the middle of the cake and put a teaspoon of chopped onion (representing radioactive material) on the exposed cream filling. Cover the onion with the piece of cake that was removed. Tightly seal the cake in plastic wrap. Let the experiment sit for a day.

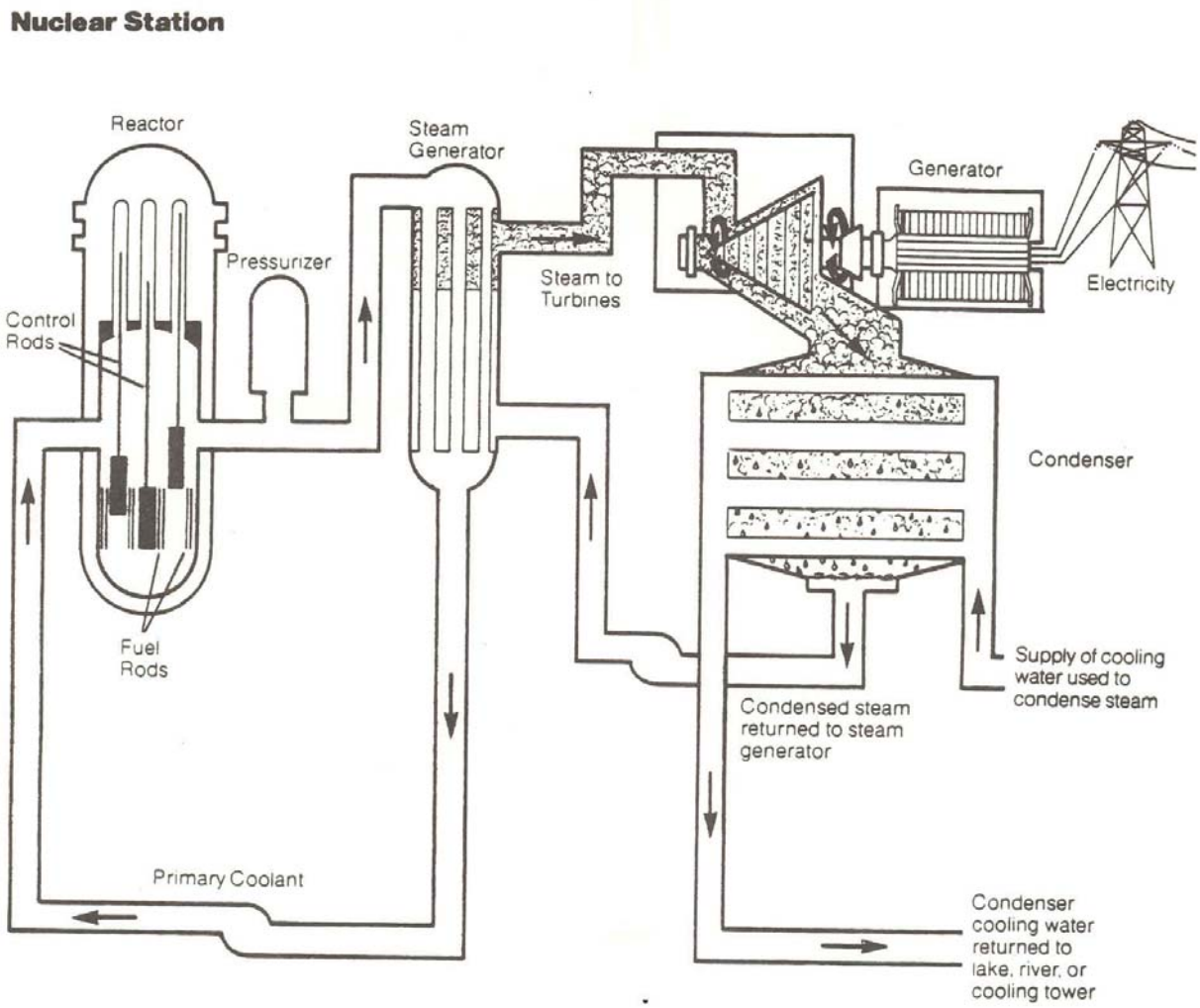
3. Remove the plastic wrap and cut a section from the edge of the cake. Have the students smell the section. Can the odor of the onion be detected in the cream filling (groundwater?) The onion pieces did not move through the cream filling. How did the odor get to the edges of the cake? (The strong smell permeated the cream filling, much as radiation could eak from improperly stored waste materials.)

**Background:**

The disposal of radioactive wastes from nuclear power plants presents a particular problem. Currently they are being stored temporarily at the power plants while scientists are trying to find the best way to dispose of these materials. Eventually they may be buried in thick layers of granite rock, in underground salt mines, or under ocean basins. The wastes may remain radioactive for thousands of years.

*From The Energy Sourcebook. Elementary Level. This Sourcebook, which covers many energy-related topics, is available in pdf format on a FREE CD-ROM from the Tennessee Valley Authority. The CD-ROM is available in three levels – Elementary, Junior High and High School. To request a free copy of the CD-ROMs, contact Catherine Mackey, TVA, Phone: 865-632-2101 Ext. 4077 Email: csmackey@tva.gov or go to the TVA web site http://www.tvakids.com/teachers/resources.htm to download a pdf version.*

# NUCLEAR GENERATION OF ELECTRICITY




*From Educational Services, Duke Power Company, PO Box 33189, Charlotte, NC 28242*

# NUCLEAR
# FREE MATERIALS TO ORDER

**ADVENTURES WITH ATOMS AND MOLECULES VIDEO**
Free-on-loan video of science experiments by Dr. Rob Mebane. NOTE: Dr. Mebane has given permission for this video to be reproduced for teachers. For your own copy of this video, send a blank 90-minute tape to Anne Allen, TEEN C/O Roane State Community College, 132 Hayfield Road, Knoxville, TN 37922
Experiments include:

Do molecules move?
Do hot molecules move faster than cold molecules?
Are chemical changes faster in hot or cold water?
Are some molecules small?
Are gas molecules farther apart than liquid molecules?
Are there carbon dioxide molecules in your breath?
Are some molecules heavier than others?
Are some liquids heavier (denser) than others?
Is saltwater more dense than freshwater?
Do like charges attract or repel?
Are molecules attracted by a charge?
Is vinegar necessary to dye eggs?
Can acid rain hurt some buildings and statues?
Can stretching molecules make them give off heat?
Are there water molecules in the air?
Can water be purified by freezing?

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North,9th floor,*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 inside Tennessee*
*or 615-674-2994 outside Tennessee,*
*http://www.tnenergy.com*

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**RE-ACTIONS NEWSLETTER (for teacher (K-12)**
Issued 5 times a year, with classroom activities on nuclear energy,articles on uses of the atom in everyday life and an "activity card" with a project for classroom use. FREE if requested on school letterhead**.**

**PERSONAL RADIATION DOSE CHART.**
Single copy FREE. Reproducible.

**SIMULATED PELLET OF URANIUM (card)**
ANS Order Number 750027. Single copy FREE. $0.75 each up to 100.

**NUCLEAR ENERGY FACTS Q&A (10th Grade)**
This 56-page booklet contains the answers to 37 of the most common questions about nuclear energy. Public concerns about need, cost, safety and waste disposal are discussed briefly but factually. 4 x 7 booklet. Single copy FREE. ANS Order #7750020.

*American Nuclear Society*
*Contact: Tony Bishop , Outreach Department,*
*555 North Kensington Avenue,*
*La Grange Park, IL 60526*
*Phone: (708) 352-6611, Fax: 708-352-0499*
*Email: outreach@ans.org*
*Web: http://www.ans.org*

**"YOU MEAN I'M RADIOACTIVE?" ARTICLE**
This article takes a look at the common sources of radiation that we face every day. Single copies are available FREE.

*Connecticut Yankee Atomic Power Co.*
*Haddam Neck Plant,*
*362 Injun Hollow Road,*
*Haddam Neck, CT 06424-3099*
*Contact: Kristine Paul/ Information Center*
*Phone: (860)267-3526,*
*Fax (860)267-3603*

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**FACT SHEETS ON NUCLEAR WASTE and SAFETY**
Single copies are available FREE. Additional materials can be ordered from the NIRS Toolbox, which can be accessed on the web site or requested in print.

*Nuclear Information and Resource Center,*
*1424 16th St. NW, Suite 404,*
*Washington DC 20036*
*Phone: (202) 328-0002, FAX: (202) 462-2183*
*E-mail address: nirsnet@nirs.org,*
Web site: *http://www.nirs.org*

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**SCIENCE, SOCIETY, AND AMERICA'S NUCLEAR WASTE (Curriculum) Grades 8-12**
The FREE four-unit curriculum contains materials for both students and teachers. Student materials include readings, review exercises and activities. For teachers, supplemental teaching aids include videotapes, computer software and viewgraphs**.**

*U.S. Department of Energy*
*Office of Civilian Radioactive Waste Management, National Information Center*
*600 Maryland Avenue, S.W., Suite 695,*
*Washington, DC 20024*
*Phone: 1-800-225-NWPA or (202) 488-6720,*
*FAX: (202) 488-6721*
*Web: http://www.rw.doe.gov*

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**SIMULATED PELLET OF URANIUM (card)**
ANS Order Number 750027. Single copy FREE. $0.75 each up to 100.

*Westinghouse Electric Company*
*Communications Department, PO Box 355,*
*Bay 575, Pittsburgh, PA 15230-0355*
*Phone: (412) 374-6803, FAX: (412) 374-3272*
*E-mail: kendr1lm@westinghouse.com*
*Web: http://www.westinghouse.com*

# NUCLEAR
# INEXPENSIVE MATERIALS TO ORDER

**ENERGY CHASE BOARD GAME (ages 11 and up)**
Enables players to learn about or review energy sources – especially nuclear – while they discover how electricity is made and race to have the biggest energy supply. Players then see how many things in their town they can run with wise use of their "energy supply." Special price to teachers - $3.00 single copy. ANS order #750035.

*American Nuclear Society*
*Contact: Tony Bishop , Outreach Department,*
*555 North Kensington Avenue,*
*La Grange Park, IL 60526*
*Phone: (708) 352-6611, Fax: 708-352-0499*
*Email: outreach@ans.org*
*Web: http://www.ans.org*

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**THE BEST OF EDISON TEACHING KIT**
Grades 5-10. Binder containing 8 how-to booklets based on the experiments of Thomas Edison and other scientists. FREE ($1.00 s/h) Two of the titles included are: Energy For the Future, Nuclear Experiments You Can Do

*Charles Edison Fund*
*One Riverfront Plaza, 4th Floor, Newark, NJ 07102*
*Phone: (973) 648-0500, Fax: 974-638-0400*
*Email: info@charlesedisonfund.org*
*Web: http://www.charlesedisonfund.org*

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**NUCLEAR REACTOR Booklet**
Grades 9-11. This title reviews the structure of the atom, how energy is stored in the nuclei of large atoms, and how fission releases that energy to generate electricity. Other sections deal with the pressurized-water reactor, radioactivity, safety statistics and more. Each section ends with questions that challenge the students' higher-order thinking skills. Student booklet $1.24 each; teacher's guide, $.78.

**THE NUCLEAR FUEL CYCLE Booklet**
Grades 9-11. Explains the operation of a nuclear reactor, then illustrates the fuel cycle, from mining uranium to storing radioactive wastes. Student booklet, $1.05 each; Teacher's guide, $.59 each.

**THE ATOM AND RADIATION Booklet**
Grades 7-11. This booklet addresses why some substances are radioactive and explains how radiation is produced when a nucleus changes. One hands-on activity helps students understand the concept of half-life; students also compute their own annual radiation dose from human and natural sources. Student booklet, $1.05 each; Teacher's guide, $.78 each.

*Enterprise for Education*
*1316 Third Street, Suite 103*
*Santa Monica, CA 90401*
*Phone: (888) 300-9864 or (310) 394-9864*
*Fax: Fax (310) 394-3539.*
*Email: service@entfored.com*
*Web: http://www.entfored.com*

**NUCLEAR ENERGY POSTER**
Part of Sources of Energy poster series. Orders under $50.00 must be prepaid. Quantity discounts available. $3.00

*National Energy Foundation*
*ATTN: Etta Stephens, 3676 California Ave.,*
*Suite A117, Salt Lake City, UT 84104*
*Phone: (801) 908-5800; FAX: (801) 539-1451*
*E-mail address: info@nef1.org*

**********

**NUCLEAR ENERGY ACTIVITIES Grades 7-10.**
Seven activities on nuclear basics, technologies and economics. May be reproduced. $4.00. Check or money order must be made out to the Research Foundation of SUNY

*New York Science, Technology and Society*
*c/o W. Peruzzi, 89 Washington Avenue,*
*Rm 674 EBA, Albany, NY 12234*
*Phone: (518) 473-9471; FAX: (518) 473-0858*
*Website: http://www.nysed.gov*

**********

**THE ATOM Poster**
26 x 38 inch poster on heavy stock with a special matte finish to eliminate poster shine. Item #13814-2. $6.95

*Schoolmasters Science*
*745 State Circle, Box 1941*
*Ann Arbor, MI 48106*
*Phone: 1-800-521-2832; FAX: 1-800-654-4321*
*Web: http://www.wolverinesports.com/*

**********

**ATOMS AND MOLECULES Book by P. Roxbee-Cox and M. Parsonage**. (Ages 12-18)
Described by the Times Educational Supplement as a "remarkable achievement" this easily readable and stunningly illustrated book reveals the inner workings of the atom, includes background to historic discoveries – such as the atom bomb – and looks at the latest scientific developments from "atomic art" to the atom's role in the search for the cure for AIDS. Paperback ISBM 0-7460-0988-7. $7.95

*Usborne Books*
*Educational Development Corporation*
*10302 E. 55th Place*
*Tulsa, Oklahoma 74146-6515*
*Phone: 1-800-475-4522 ; Fax 1-800-747-4509*
*Email: ubah@ubah.com*

**********

**SIMULATED PELLET OF URANIUM (card)** Item Number 750027. Single copy FREE. $0.75 each up to 100**.**
**ELECTRICITY FROM NUCLEAR ENERGY (Booklet)** $1.00
**NUCLEAR ENERGY GLOSSARY** $.75
**RADIATION (Booklet)** $.75
**COMPONENT ILLUSTRATIONS (color prints)**

*Westinghouse Electric Company*
*Communications Department, PO Box 355,*
*Bay 575, Pittsburgh, PA 15230-0355*
*Phone: (412) 374-6803, FAX: (412) 374-3272*
*E-mail: kendr1lm@westinghouse.com*
*Web: http://www.westinghouse.com*

# NUCLEAR
# RELATED WEB SITES

http://education.jlab.org
**SCIENCE LAB**
Make learning about atoms and elements elementary! Click on “Teacher Resources” for science-fair physics experiments, student handouts, and vocabulary lists. Then send kids to the “Student Zone” to play online science, math and word games, including “Element Hangman

http://nuke.westlab.com/
**NUKE HOME PAGE**
This is the Nuclear Information world Wide Web Server. Everything you wanted to know about nuclear energy: the government, medical applications, life time of nuclear power plants, world list of plants, and U.S. list of commercial plants.

http://www.brainpop.com/science/light/light/index.weml?&tried_cookie=true
**MOVIE: ATOMS**
Animated BrainPop mini-movie about atoms

http://www.fnal.gov/
**FERMI NATIONAL ACCELERATOR LAB**
Fermilab is a U.S. Dept. of Energy national laboratory for research exploring the fundamental nature of matter and energy. It includes the Tevatron, the world’s most powerful particle accelerator, and the Main Injector, a new accelerator that will begin operating in 1999.www.lhs.berkeley.edu

http://www.iclei.org/efacts/fission.htm
**NUCLEAR FISSION**
Be sure to check out the Radioactive Wastes factsheet.

http://www.miamisci.org/af/sln/
**ATOM’S FAMILY**
Imaginative approach to matter, energy and atomic properties brought to you by the Miami Muscum of Science. Geared for middle school.

http://www.mines.edu:8080/Outreach/Cont_Ed/desp.shtml
**DENVER EARTH SCIENCE PROJECT**
This is a K-12 curriculum development effort coordinated by the Colorado School of Mines. A series of educational “modules” on various earth science topics have been developed. One for Grade level 7-10 is entitled “Do You Know Your 3R’s? Radiation, Radioactivity and Radon?

http://www.nea.fr/html/
**NUCLEAR ENERGY AGENCY**
Has general information about nuclear science, development, law, safety and radiation.

http://www.nea.fr/html/rp/chernobyl/chernobyl.html
**CHERNOBYL**
A report on the effects of the Chernobyl nuclear accident.

http://www.uic.com.au/
**URANIUM INFORMATION CENTRE**
This pro-nuclear energy site is rich in information on the uranium industry and nuclear power.

# NUCLEAR ORGANIZATIONS

**American Nuclear Society**
Outreach Department
555 North Kensington Avenue
LaGrange Park, Ill. 60526
Phone: (708)-352-6611 / Fax: (708)-352-0499
Web: http://www.ans.org

**Energy Source Education Council**
Program Distribution Office
5212 Katella Avenue, Suite 206
Los Alamitos, CA. 90720
Phone: (562)-799-6002 / Fax: (562)-799-6006
Web: http://www.edspecialists.com

**General Atomics Sciences Education Foundation**
3350 General Atomics Court
San Diego, Ca. 92121-1194
Phone: (858)-455-3335 / Fax: (858)-455-3379
Web: http://fusioned.gat.com

**Nuclear Energy Institute**
1776 I Street, NW, Suite 400
Washington, DC 20006-3708
Phone: (202)-739-8000 / Fax: (202)-739-4019
Web: http://www.nei.org
.

**Nuclear Information and Resource Service**
1424 16th Street, NW. Suite 404
Washington, DC 20036
Phone: (202)-328-0002 / Fax: (202)-462-2183
Web: http://www.nirs.org

**US Department of Energy**
**Argonne National Laboratory**
Division of Educational Programs
9700 South Cass Avenue
Argonne, IL. 60439 (630)-252-4114
Fax: (630)-252-3195
Web: http://www.dep.anl.gov

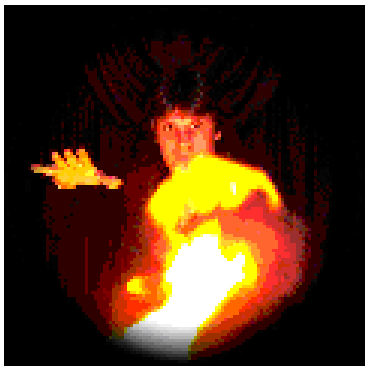
**US Department of Energy**
**Office of Civilian Radioactive Waste Management**
Yucca Mountain Science Center
4101B Meadows Lane
Las Vegas, NV 89107
Phone: (702) 295-1312 or 1-800-225-6972 / Fax: 1(702) 295-5222
Web: http://www.crw.doe/gov or http://www.ymp.gov

**US Dept. of Energy**
**Office of Nuclear Energy, Science**
NE Public Information Office, NE-30
19901 Germantown Road
Germantown, MD. 20874
Phone: (301)-903-1536 / Fax: (301)-903-7020
Web: http://nuclear.gov

# NON-RENEWABLE SOURCES OF ENERGY

*4.10.3*
*Realize the difference between renewable and non-renewable resources.*

## USING FLASHPAPER



Use flash paper to illustrate how "once non-renewable resources are gone, they're gone forever." While striking a match, tell students that "we have traditionally used fossil fuels – coal, oil, and natural gas – for our energy. The problem is that - touch the paper with the match – once they are gone, they'll never be back." (The paper will flame and then disappear.

Some student will always say "Do that again!" at which time you explain you can't do it again because the paper was non-renewable and "once it's gone, it's gone forever."

**Ordering information:**
Flash pads are available in pads of about 20 small sheets at local magic stores. Also available online from various magic supply stores such as:

http://www.magicsupply.com/cgi-bin/web_store.cgi. Item #K6805. $7.00

# OIL

*1.10.1 2.10.1 3.10.1*
*Recognize that there are a variety of earth materials which have basic observable and measurable properties.*

*1.10.2 2.10.2*
*Realize that earth materials can be recycled or conserved.*

*1.14.1 2.14.1 3.14.1*
*Realize that the sun is the main source of earth's heat and light energy.*

*2.12.1 3.12.1*
*Recognize that objects have observable properties that can change over time and under different conditions.*

*4.6.1*
*Realize that fossils show connections between organisms that lived in the past and those that live in the present.*

*4.10.1 5.10.1*
*Recognize that earth material have a variety of practical uses*

*4.10.3 5.10.3*
*Realize the difference between renewable and non-renewable resources.*

*4.14.1 5.15.1*
*Know that energy exists in many forms*

*6.14.4*
*Understand that one form of energy can be transformed into another form of energy*

*8.10.3*
*Investigate how human activities affect the earth's land, oceans, and atmosphere*

*8.10.4*
*Examine different types of energy resources and their importance to man.*

*8.10.5*
*Analyze approaches to conserving energy and natural resources.*

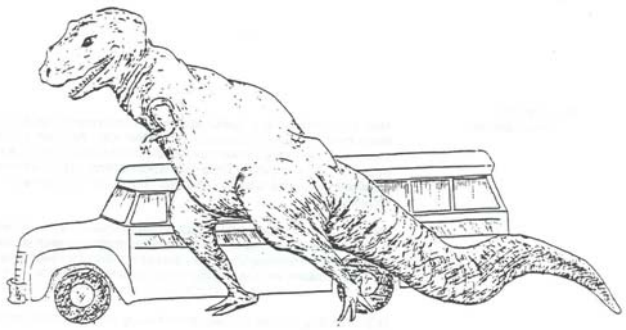
For background information on this topic, see

**http://www.need.org/infobooks.htm**

# MEASURING A DINOSAUR

Children are fascinated with dinosaurs. However, pictures of these creatures do little to convey their actual size. Some were longer than the average house while others were small enough to fit under a bed.

For example. have students mark each of these measurements of the Tyrannosaurus on the playground or on the sidewalk using a yard stick, ball or string, chalk and masking tape.



**Tyrannosaurus-**
Length 13 m (43 feet) long
Weight 6.3 t (7 tons)
Height 6m (18.5 feet)
Teeth 15 cm (6 inches) long
Talons 20cm (8 inches) long
Head 1.2 m (4 feet) long
Jaws 9Ocm (3 feet) long
Arms 76cm (30 inches) long

Tell the students that there were other dinosaurs eight times as large as the Tyrannosaurus. (The Ultrasaurus, for example, weighed 80 tons and measured 72 feet long).

*From "Construction and Measurement," Mudpies to Magnets, page 57.*

# MAKE YOUR OWN DINOSAUR TOOTH

**TYRANNOSAURUS REX TOOTH MOLDS**

Imagine the excitement of making an exact replica of a Tyrannosaurus Rex tooth! For just the cost of some plaster of Paris or other casting materials, your students can make as many T-Rex teeth as they like. Finished casts may be painted, varnished or shoe polished to look absolutely authentic.

Item #FSL-100 3" Tyrannosaurs Rex Tooth Mold $6.95
Item #FSL-105 Large 4" T-Rex Tooth Mold $7.95

*Educational Innovations*
*362 Main Avenue*
*Norwalk, CT 06851*
*Phone: 1-888-912-7474*
*Fax: 203-229-0740*
*e-mail: info@teachersource.com*
*Web: www.teachersource.com*

# THINGS MADE FROM OIL

The following list may be helpful in preparing bulletin boards or displays about some of the 6000 products made using petroleum.

Antenna cable
Credit cards
Perm.Press Clothes
Heart valves
Crayons
Disposable Diapers
Parachutes
Telephones
Enamel
Transparent tape
Antiseptics
Vinyl siding
Safety flares
Overcoats
Bubble bath
Bookends
Planters
Deodorant
Panty hose
Tubs
Shag rugs
Lunch boxes
Jerseys
Windshield wipers
Phonographs
Car sound insulation
Dresses
Track shoes
Pond liners
Protractors
Earphones
Whistles
Dune buggy bodies
Checkers
Soap dishes
Syringes
Shoes
Volley balls
Synthetic rubber
Sleeping bags
Electrician's tape
Paneling
Sweaters
Bread boxes
Bubble gum
Coasters
Stoppers

American flags
Aspirin
Oxygen masks
Hair spray
Steering wheels
Food wraps
Stretch pants
Rubber Duckies
Seed tape
Card tables
Golf cart bodies
Slips
Warm-up suits
Ping-pong paddles
Purses
Weed killers
Football pads
Puzzles
Mattress pads
Dish drainers
Crabgrass kill
Puppets
Pajamas
Upholstery
Hearing aids
Racks
Cassettes
Dominoes
Luggage
Antifreeze
Flashlights
Motorcycle helmets
Clotheslines
Chessboards
Carpet sweepers
Yardsticks
Slip covers
Patio screens
Exercise mats
Refrigerator linings
Floor wax
Garden hoses
Sneakers
Earrings
Sandwich bags
Raincoats
Tennis balls

Eyelashes
No-wax floors
Golf balls
Attaché cases
Wet suits
Laxatives
Trash cans
Bras
Wall coverings
Acrylic paints
Vacuum bottles
Shoe trees
Bearing grease
Rafts
Sockets
Flippers
Tiles
Air conditioners
Backpacks
Rubbing alcohol
Epoxy paint
Oil filters
Mailboxes
Welcome mats
Uniforms
Pacifiers
Garment bags
Fences
Kitchen counters
Windbreakers
Pillows
Pillows
Antibiotics
Shower doors
Shorts
Sugar bowls
Decoys
Darkroom trays
Tobacco pouches
Pencils
Model cars
Lawn sprinklers
Playing cards
Dolls
Microfilm
Floor polish
Tires

Tablecloths
Ring binders
Extension cords
Combs
Stadium cushions
Flea collars
Glycerin
Hair curlers
Laminates
Electric blankets
Ear plugs
Drinking cups
Computer tape
Styrofoam coolers
Jugs
Venetian blinds
Audio tape
Insect repellent
Hiking boots
Water softeners
Denture adhesive
Shampoo
Sunglasses
Film
Pacifiers

Measuring cups
Reclining chairs
Unbreakable dishes
Watchbands
Plastic varnish
Finger paints
Bird feeders
Lamps
Visors
Laundry softeners
Tennis rackets
Canisters
Roller skate wheels
Gaskets
Ammonia
Digital clocks
Car battery cases
Fishing nets
Hair coloring
Guitar strings
Soft contact lenses
Perfume
Umbrellas
Antifreeze
Lamp shades

Rulers
Tote bags
Toothbrushes
Darts
Toothpaste
Badminton birdies
Foot pads
Lipstick
Swimming pool liners
Shirts
House paint
Cough syrup
Movie film
Brake fluid
Eyeglasses
Life jackets
Measuring tape
Fertilizers
Knitting yarn
Rubber cement
Shoe polish
Lipstick
Nail polish
Upholstery
hairbrushes

# OIL
# FREE MATERIALS TO ORDER

**"NRG ART" POSTERS: Grades 3-10.**
Large 24x38 black and white posters that can be colored or painted. The following titles are available: Coal, Oil, Natural Gas, and Solar. One of each title per classroom available FREE to Tennessee teachers.

**"OIL" STUDENT ACTIVITY NEWSPAPER: Grades 4-10.**
Includes background information and activities. Available in classroom sets FREE to Tennessee teachers. Teachers in other states will be charged a nominal fee.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor,*
*Nashville, TN 37243-0405*
*Phone: 1-800-342-1340 inside Tennessee or 615-674-2994 outside Tennessee*
*Web site: http://www.tnenergy.com/*

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**OIL COLORING BOOK (Primary grades)**
For a copy of this 4-page coloring book on oil, you may request it using one of the methods below.

*Email request to Anne Allen allen_ac@roanestate.edu*
*Fax a request to 865-539-6907;*
*Call 1-800-342-1340 or 865-531-8051*

**********

**The following videos are FREE - one per classroom. Letters from teachers on school letterhead are required; please do not have each student write individual letters.**

**FUEL-LESS, YOU CAN'T BE COOL WITHOUT FUEL (Video) (middle school)**
17 min. VHS. Educational and entertaining video that illustrates with pop music and dance the often invisible role that petroleum products play in our lives. This is being distributed by the National Science Teachers Association. One free video per classroom.

**ALL ABOUT PETROLEUM**
An industry overview booklet available free in classroom sets of 25. Comes with a brief colorful brochure on what products come from a barrel of crude oil.

*American Petroleum Institute,*
*Public Relations Department,*
*1220 L Street, N.W.,*
*Washington, D.C. 20005*
*Phone: (202) 682-8118;*
*Web: http://www.api.org/*

**HANDS ON PLASTICS: A SCIENTIFIC INVESTIGATION KIT.**
The online version of this curriculum can be found at http://www.handsonplastics.com/
The curriculum features background information on plastics and polymers, multi-media examples of classroom activities, and ties to eh national Science Education Standards. The information is also available on a CD-Rom, which is included in the free kit of supplemental materials that can be ordered, along with other APC publications, online.

*American Plastics Council,*
*1300 Wilson Boulevard,*
*Suite 800,*
*Arlington VA 22209*
*Phone: 1-800-2-HELP-90 or (703) 253-0700,*
*Fax: (703) 253-0701,*
*Web: http://www.plastics.org/*

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**IT'S THEIR WORLD, TOO.**
Includes tips on how to protect marine wildlife, and a poem warning against throwing plastic rings into the ocean. Requests should include a self-addressed, stamped envelope. Single copy FREE.

*Humane Services,*
*Contact: Edwina Barnes, Chairperson,*
*1550 Hardeman Ave., Macon, GA 31201*
*Phone: (478) 745-4099, FAX: (478) 745-2024,*
*Email: edbarnes@aol.com,*
*Web site: www.humaneservices.org*

**********

**GIANT COLORING POSTERS.**
In a "colorful" partnership between the NEED project, the National Ocean Industries Association, and the U.S Department of Energy, giant coloring posters for young students are available FREE of charge to all NEED teachers. (If you are not a NEED teacher, call the Tennessee Energy Education Network, (1-800-342-1340) and ask how you can join for $5.00). These posters highlight many components of the offshore oil and gas industry. NEED has developed a companion teacher guide to use with the posters to teach the students abut offshore resources. To order a class set of posters, email the address below or call. The teacher guide is at http://www.need.org/energyawarenessmonth

*National Energy Education Development*
*Phone: 1-800-875-5029*
*Email: mailto:info@need.org*

**********

**"PRODUCTS OF OIL AND GAS" POSTER** A poster 11 x 17 of products produced by oil. FREE.

*Ohio Oil and Gas Association,*
*1718 Columbus Road, SW, PO Box 187, Granville, OH 43023-0535*
*Phone: 740-587-0410, Fax: 740-587-0446,*
*Email: tstewart@ooga.org,*
*Web: http://www.ooga.org*

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**OIL (Booklet)**
Describes the origin of oil and its production, conversion to thousands of products and distribution to customers around the world. You can download this booklet in pdf format at this address http://www.countonshell.com/

*Shell Oil Company*
*Corporate Communications,*
*PO Box 2463,*
*Houston, TX 77252-2463*
*Phone: 713-241-6161,*
*Fax: 713-241-6988,*
*Web: www.countonshell.com*

**HANDS-ON PLASTICS KIT: A SCIENTIFIC INVESTIGATION KIT**
A unique kit designed to help middle level science teachers and their classes explore the world of plastics through a variety of lessons about chemical structures, resin identification codes, different forms of plastics and recycling. Be sure to include street address when ordering. Order online. FREE.

**HANDS ON PLASTICS JR. KIT**
A unique kit designed to help K-4 parents and teachers and their classes explore the world of plastics through a variety of basic lessons about the uses of plastics in everyday life. Order online. FREE.

*Teaching Plastics.org*
*in conjunction with American Plastics Council.*
*Web: www.handsonplastics.com/*

**********

**ENERGY INFORMATION SHEETS (Booklet)**
One-page capsules on such energy topics as petroleum, natural gas, coal, and renewable energy. Available on the EIA Kid's Page (http://www.eia.doe.gov/kids/).

*U.S. Department of Energy,*
*National Energy Information Center (NEIC),*
*Energy Information Administration*
*1000 Independence Avenue, S.W., EI-30 - Room 1E-238, Washington, DC 20585,*
*Phone: (202) 586-8800,*
*FAX: (202) 586-0727,*
*E-mail: infoctr@eia.doe.gov,*
Web: http://www.eia.doe.gov/
*Kids Page: http://www.eia.doe.gov/kids*

# OIL

# INEXPENSIVE MATERIALS TO ORDER

**TYRANNOSAURUS REX TOOTH MOLDS**
Imagine the excitement of making an exact replica of a Tyrannosaurus Rex tooth! For just the cost of some plaster of Paris or other casting materials, your students can make as many T-Rex teeth as they like. Finished casts may be painted, varnished or shoe polished to look absolutely authentic.
Item #FSL-100 3" Tyrannosaurs Rex Tooth Mold $6.95
Item #FSL-105 Large 4" T-Rex Tooth Mold $7.95

*Educational Innovations*
*362 Main Avenue*
*Norwalk, CT 06851*
*Phone: 1-888-912-7474*
*Fax: 203-229-0740*
*e-mail: info@teachersource.com*
*Web: www.teachersource.com*

**OIL (Sources of Energy poster).** $4.95

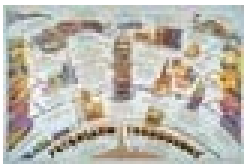
Poster that tells all about oil. Order at web site below. Item #40OIL

**PETROLEUM EXPLORATION AND DEVELOPMENT (Sources of Energy poster**) $4.95

Depicts the steps involved in petroleum exploration and production on land and in the ocean. Detailed art illustrates fault lines in the earth and ocean, the layers in the earth, and where oil reserves can be located. The poster back has information pertaining to history, safety, drilling, production, careers, and exploration. Grades 4-9. Order at web site below. Item #40PEP

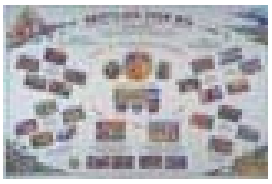
**PETROLEUM TECHNOLOGY: FROM REFINERY TO HOME, BUSINESS, AND INDUSTRY**

(Sources of Energy poster) $4.95



This poster traces the technological stages of petroleum production from drilling site through the refining processes and streams that make possible the products demanded by up-to-the-minute industrial, commercial, and residential customers. Besides student activities, the back contains processing details, and highlights vital contributions of industry's research and development. Grades 4-12. Order at web site below. Item #40PT

**RECYCLING OIL – poster** (Grades 6-12)



This poster provides a colorful depiction of the used oil management cycle. The poster encourages wise used oil recycling practices and shows what happens as motor oil is recycled into new products. The role of collection centers, re-refineries, and re-processors is discussed, and the benefits of used oil recycling are clearly demonstrated. The reverse side contains additional information and classroom activities. 23" x 35". Full color. Grades 6-12 $4.95. Order at web site below. Item #40RUO

*National Energy Foundation,*
*3676 California Ave., Suite A117,*
*Salt Lake City, UT 84104,*
*Phone: 1-800-616-8326 or (801) 908-5800,*
*FAX: (801) 908-5400,*
*E-mail address: info@nef1.org,*
*Web: http://www.nef1.org/*

# OIL

# RELATED WEB SITES

http://broadcast.forio.com/pro/oil/index.htm?FD_rand=6913
**OUR DEPENDENCE ON FOREIGN OIL Simulation Game**
After Saudi Arabia, the U.S. is the second largest oil producer in the world. But the United States also happens to be the largest consumer of oil. Oil consumption in the United States and Canada is almost three gallons per person per day, twice as high as in Europe. As a consequence more than 50% of U.S. oil must be imported. These oil imports are expensive and have complex political and security consequences. What would it take to reduce United States dependence on foreign oil? Play this game and find out

http://news.nationalgeographic.com/news/2001/05/0507_arcticrefuge.html
**ARCTIC OIL DRILLING DEBATE ESCALATES**
A National Geographic article that presents arguments on both sides of this issue.

http://response.restoration.noaa.gov/photos/ships/ships.html
**PHOTOS OF MAJOR OIL SPILLS**

http://whyfiles.org/168oil_spill/index.html
**OIL SPILLS AGAIN**
An oil spill article for grades 5-8.

http://whyfiles.org/100oil/index.html
**OIL PRICES UP: PINCH AT THE PUMP**
A 1999 article about rising oil prices

http://whyfiles.org/005electcar/
**HIGHLY BRED**
An article explaining hybrid cars (ones that combine the best of electricity and gasoline)

http:// www.ashland.com/education/oil/
**WHAT'S OIL AND WHAT DO YOU DO WITH IT?**
An in-depth look at the refining process. Intended for high school students.

http://www.bp.com/downloads/1227/US_Stats_Review_2002.xls
**LATEST OIL FIGURES FOR US ENERGY**

http:// www.chevroncars.com/know/index.html or http://www.chevron.com/about/learning_center/
**KNOW-IT-ALL ENERGY INFORMATION FOR KIDS**
At this site learn "How gasoline makes its trip from deep in the ground all the way into your gas tank" as well as the ABC's of Oil, A History of the Gas Station, An Historic Oil Discovery, what is Crude Oil, What is a refinery? And What's in a Service Station?

http://www.citgo.com/CommunityInvolvement/Classroom/VirtualTours.jsp
**VIRTUAL REFINERY TOUR**
In this education area of Citgo's website, kids can learn how the black goop that comes from the ground is turned into the golden fuel that makes their cars go.

http://www.consrv.ca.gov/DOG/kids_teachers/index.htm
**CALIFORNIA OIL, GAS and GEOTHERMAL Kids and Teachers RESOURCES**
Comic-book style introduction to oil and gas in California, from formation and extraction to refining and distribution. For 4th-to 8th-grade level students or anyone wishing a 5-minute overview of the subject.

http://www.eia.doe.gov/oil_gas/petroleum/info_glance/petroleumnjava.html
**LATEST FACTS ON PETROLEUM**
Here's where you go to find out everything from the current price of a barrel of oil and all kinds of other statistical data.

http://www.fe.doe.gov/
**DOE'S FOSSIL ENERGY WEB SITE**
Provides educational information on topics such as Energy, Oil and its history; Coal, our most abundant fuel; Natural Gas and its history; and an energy Glossary.

http://www.freefoto.com/pictures/industry/oil/index.asp
**FREE FOTO.COM**
Pictures of the oil industry.

http://www.gaspricewatch.com/
**GAS PRICE WATCH**
A website that will help you find the lowest price of gas in your neighborhood. (U.S./Canada)

http://www.oilhistory.com/
**OIL HISTORY JOURNAL**

http://www.reachoutmichigan.org/funexperiments/quick/plastic.html
**HOW PETROLEUM BECOMES PLASTIC**

# PETROLEUM ORGANIZATIONS

**American Petroleum Institute**
Communications Department
1220 L Street, N.W.
Washington, DC 20005
202-682-8118
Fax: 202-682-8115
Web: http://www.api.org/
http://www.classroom-energy.org/
http://www.recycleoil.org/

**BP**
535 Madison Avenue
New York, NY 10022
Phone: 212-451-5010
Fax: 212-451-8088
Web: http://www.bp.com/

**Independent Petroleum Association of America**
Information Services Dept.
1101 16th Street, N.W.
Washington, DC 20036
Phone: 202-857-4722
Fax: 202-857-0444
Email: flawrence@ipaa.org or govrel@ipaa.org
Web: http://www.ipaa.org/

**Offshore Energy Center**
200 North Dairy Ashford, Suite 6220
Houston, TX 77079
Phone: 281-679-8040
Fax: 281-544-2441
Email: oecstar@aol.com
Web: http://www.oceeanstaroec.com/

**Shell Oil Company**
Corporate Communications
PO Box 2463
Houston, TX 77252
Phone: 713-241-6161
Fax: 713-241-6988
Web: http://www.shellus.com/

# COAL

*1.10.1 2.10.1 3.10.1*
*Recognize that there are a variety of earth materials which have basic observable and measurable properties.*

*1.10.2 2.10.2*
*Realize that earth materials can be recycled or conserved.*

*1.14.1 2.14.1 3.14.1*
*Realize that the sun is the main source of earth's heat and light energy.*

*2.12.1 3.12.1*
*Recognize that objects have observable properties that can change over time and under different conditions.*

*4.6.1*
*Realize that fossils show connections between organisms that lived in the past and those that live in the present.*

*4.10.1 5.10.1*
*Recognize that earth material have a variety of practical uses*

*4.10.3 5.10.3*
*Realize the difference between renewable and non-renewable resources.*

*4.14.1 5.15.1*
*Know that energy exists in many forms*

*6.14.4*
*Understand that one form of energy can be transformed into another form of energy*

*8.10.3*
*Investigate how human activities affect the earth's land, oceans, and atmosphere*

*8.10.4*
*Examine different types of energy resources and their importance to man.*

*8.10.5*
*Analyze approaches to conserving energy and natural resources.*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# MINING FOR DIFFERENT TYPES OF COAL IN COOKIES

*In this activity, students will compare removal of chips or raisins from a variety of cookies to simulate removing a variety of types of coal from different types of land.*

**Materials:**

Books, encyclopedias and pamphlets about coal
Graph paper
Toothpicks
Chocolate chip cookies (represents medium hard coal – bituminous)
Raisin oatmeal cookies (soft coal – lignite)
Cookies with chocolate candy pieces (hard coal – anthracite)

**Procedure:**

1. Discuss the three types of coal with the students.

2. Give each student one of each type of cookie

3. Place the cookies on graph paper and trace around each cookie

4. Label the type of cookie and the type of coal it represents on the graph paper

5. Count the number of squares each cookie covers and write this down.

6. Have students use toothpicks to remove the chips, candy pieces and raisins from each cookie. Allow 5-7 minutes for this.

7. Have students keep track of the number of chips removed from each cookie. They should also make observations about the type of "land" the coal is in and compare the difficulty or ease of removal. Also, the effects "mining" had on the "land".

8. Have students reclaim their property by replacing the crumbs.

9. Students should then trace the outline of their cookies after mining. Have them again count the number of spaces the cookie covers on the graph paper.

10. Ask
    " What effect did mining have on the land?"
    "What are some ways to improve the land after mining?"
    "Which type of coal was easiest to mine? Why?"
    "What were some problems you encountered during the mining process?"
    "How do you relate those problems to mining in the real world?"

11. Discuss their observations and eat the cookies!

*From Power Posse (The American Coal Foundation). 101 Constitution Avenue, N.W, Suite 525-East, Washington, DC 20001-2133, Phone: 202-466-8630, Fax: 202-466-8632, Email: acf-coal@mindspring.com, Web: http://www.acf-coal.org/*

# BUILDING A POWER PLANT SONG

*Have students act out the process of producing electricity from coal. As you sing the song, each time you come to an asterisk, tap the next student's head and have him/her begin to "work." Workers should continue to "work" until the end of the song.*

Student 1 - (Coal miner) Student pretends to run a coal-mining machine by making a "machine" sound.

Student 2 - (Train that takes the coal to the power plant) Student pretends to be a train by making the sound of a train whistle

Student 3 - (Coal crushing machine) Student pretends to crush a piece of coal. The piece of coal could be a piece of foam painted black or crumpled black construction paper.
Student 4- (Furnace) Student pretends to be a fire.

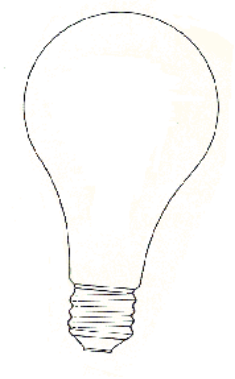
Student 5 - (Steam) Student holds a tea kettle and makes the "whooshing" sound of steam coming out.

Student 6 - (Turbine) Student turns a pinwheel

Student 7 - (Generator) Student turns around and around holding a picture of a magnet

Students 8 -12 (Electric lines) Students hold a phone cord, yam or wire above their heads and make a "buzzing" sound as they are touched.

Student 13 (Light bulb) Student lights a “magic” light bulb (available at magic stores under the name Atomic Light Bulb) or perhaps holds a picture of a light bulb while “lighting up the room” with their best smile!

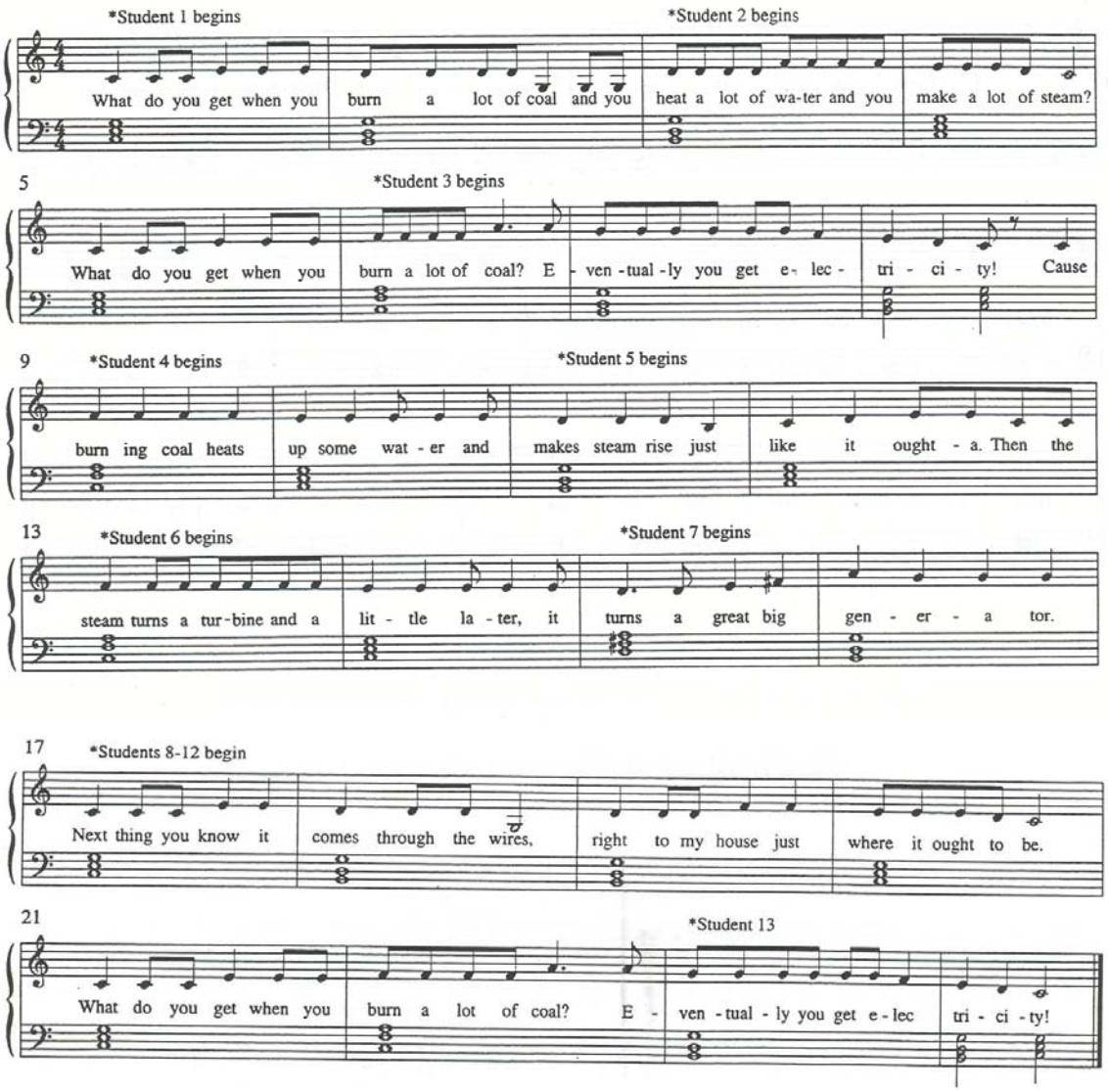


**ORDERING INFORMATION:**
You can get a Magic Lightbulb at any magic store or order from online stores such as
Brianrichardsmagic.com.
Tollfree 1-877-753-4599.
Fax: 1-856-753-4607.
The average price is $5.50-$6.00 per magic lightbulb

# 2. Building A Power Plant

Words by Anne Allen

Tune similar to "Beverly Hillbillies" theme



## LONGEST WORD IN THE ENGLISH LANGUAGE

The longest word in the English language is
**Pneumonoultramicroscopicsilicovolcanoconiosis**.
It is the medical term for black lung disease.

## PRODUCTS MADE FROM COAL

Electricity
Aspirin
Caffeine
Flavorings
Lacquer
Paint pigments
Photographic chemicals
Rubber cement
Synthetic rubber
Sulfa drugs
Vanillin
Varnish
Wallpaper

# COAL-
# FREE MATERIALS TO ORDER

**ELECTRICITY DODECAHEDRON ACTIVITY CARD**
(Grades 5-8) Students put together a twelve-sided figure that explains the process of turning coal into electricity. FREE in classroom sets to Tennessee teachers, but out-of-state teachers will be charged.

**COAL "NRG ART" POSTER** (Grades 3-10) Large 24x38 black and white poster that can be colored or painted. FREE to Tennessee teachers, but out-of-state teachers will be charged.

**COAL STUDENT ACTIVITY NEWSPAPER** (Grades 4-10) Includes background information and activities on coal. Available FREE in classroom sets to Tennessee teachers, but out-of-state teachers will be charged.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor, Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 or 615-674-2994*
*Web: http://www.tnenergy.com/*

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**TEACHERS PACKET ABOUT COAL KIT** (Grades K-6 or 6-12) How is coal formed? What are the three main kinds of coal? What careers are available in the coal industry? Teachers and students can explore these questions with this packet. You'll receive samples of peat, lignite, bituminous coal, and anthracite coal; colorful posters, and booklets with activities about the formation, exploration and transportation of coal. First packet FREE; Additional copies available for $18.75 each. Call 1-800-325-8677 or visit http://www.wgcn.com/acf.htm or email your name, school name, address, phone number and grade you teach to coal@westglen.com

**COAL: AN INTRODUCTION** Instructions for conducting nine science and social science activities. Includes teacher's guide and coal samples. (Grades 5-12). First copy FREE; additional copies available for $7.50.

**WHAT EVERYONE SHOULD KNOW ABOUT ELECTRICITY FROM COAL** (Grades 4-12)
Booklet that explains how electricity is generated from coal and delivered to homes. Single copy FREE; additional copies: $.75

**WHAT EVERYONE SHOULD KNOW ABOUT COAL** (Grades: 4-12). Booklet which describes the types of coal, the basic ways to mine coal, how coal is used, how it affects the environment and new technologies. Single copy FREE; additional copies each $.75

**COAL SAMPLE KIT** (Grades: K-12). Samples of types of coal in resealable bags, including a brief description of the formation and different types of coal. Single copy FREE; additional copies each $2.00

**COAL POSTER** (Grades K-12). 23" x 25" poster is used to convey information on the formation, exploration, extraction, transportation and use of coal. Single copy FREE; additional copies each $2.00

**MINE RECLAMATION POSTER (Grades 6-12).** Colorful poster with a technical focus on the process of reclamation from pre-mining activities to future beneficial use of the reclaimed land. Teaching information and activities on back. First copy FREE; Additional copies $2.00 each.

*American Coal Foundation,*
*101 Constitution Avenue, N.W, Suite 525-East,*
*Washington, DC 20001-2133,*
*Phone: 202-466-8630, (800) 325-8677 to order materials ;*
*Fax: 202-466-8632, Email: acf-coal@mindspring.com,*
*Web: http://www.acf-coal.org/*

**AMERICA'S FUEL (Video) Grades 7-adult**. This video demonstrates the importance of coal to the American economy and overall quality of life. A utility executive, a businessman, a former mayor and an economist/physicist each describe the benefits they have found from using coal as the source for their electricity. 11 minutes. FREE.

*Center for Energy and Economic Development,*
*1800 Diagonal Road, Suite 370,*
*Alexandria, VA 22314*
*Phone: 703-684-6292 or 703-684-6297,*
*Website: http://www.ceednet.org/*

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**COAL IS COOL ACTIVITY BOOK** (Grades K-4). 60 coal-related puzzles. Activities and background on origin, and use of coal, mining and safety. FREE

**LET'S LEARN ABOUT COAL** (Grades 3-6). Puzzles and word games explaining coal formation and use in the United States. 16 pages. FREE

**POWER FROM COAL (Grades 6-9).** Describes history, production, transportation and use of coal; includes and activity book and teacher's guide. 16 pages. FREE

**COAL TECHNOLOGY: THE FUTURE IS NOW (poster)** Grades 4-12. Follows the story of coal's technology from exploration and mining to preparation, transportation, combustion and environmental protection. FREE

**GETTING TO KNOW COAL (poster)** (Grades K-8). Illustrates the formation, mining, transportation, clean coal technologies and use of coal. FREE

**COAL SAMPLES.** Individually wrapped samples. Limit 6. FREE

**DINOSAURS AND POWER PLANTS** (Grades 5-8). Explains history, mining, transportation, use, environmental issues of coal and future of fossil energy; includes student booklet, teacher's lesson plan/activity guide and teacher's supplement of reproducible graphics. FREE

**WHAT DOES COAL HAVE TO DO WITH YOU?** Poster (Grades K-4). Follows dinosaur footprints on a timeline of coal formation through modern day uses of coal. FREE**.**

**KIDS, COAL AND THE ENVIRONMENT (video )** (Grades 1-8). Describes the formation, mining, transportation and use of coal. 9 min. FREE

*Illinois Department of Commerce and Community Affairs,*
*Office of Coal Development and Marketing,*
*620 East Adams,4th floor,*
*Springfield, IL 62701,*
*Phone: 217-524-3820, Fax: 217-558-2647,*
*Email: bantonin@commerce.state.il.us*
*Web: http://www.commerce.state.il.us/*

**********

**COAL PEOPLE: A CENTURY OF PRIDE - Video** (Elementary – adult). A tribute to coal mining people. A cinematic journey that celebrates a proud workforce and its contributions to American progress. 23.5 minutes. FREE.

*Peabody Group,*
*Public Relations Department,*
*701 Market Street, Suite 825,*
*St. Louis, MO 63101,*
*Phone: 314-342-7768*

# COAL

# INEXPENSIVE MATERIALS TO ORDER

**ACID RAIN**

Grades 6-8. ISBN: 0-924886-14-5. This unit fosters substantial scientific inquiry skills as students learn about acids and the pH scale through a number of hands-on/minds-on activities. Students analyze sophisticated environmental issues and consider the complexity of environmental decisions. $18.00

*GEMS*
*University of California, Berkeley*
*Lawrence Hall of Science #5200*
*Berkeley, CA 94720-5200*
*Phone: (510) 642-7771 Fax: (510) 643-0309*
*Email: gems@uclink.berkeley.edu*
*Web: http://www.lhs.berkeley.edu/gems/*

**********

**BULK COAL.**

For teachers outside Kentucky, fill out the online request form, print it out and then mail your check or money order to the address below.

1- pound Bag of Bituminous Coal- $13.00 2-pound Bag of Bituminous Coal - $17.00
5-pound Bag of Bituminous Coal - $25.00 10-pound Bag of Bituminous Coal - $35.00

*Mining Internet Services, Inc.*
*340 South Broadway, Suite 200*
*Lexington, Kentucky 40508*
*Fax: 859-259-3394*
*Web: http://www.miningusa.com/store/coal/order_form.html*

**********

**COAL (poster) .**

This colorful poster describes the formation, exploration, extraction, transportation and use of coal. This is one of NEF's "Sources of Energy" posters. Its black and white reverse supplies background information and suggestions for student learning activities. Grades K-8, 23" x 35", Full Color, B/W back Order from Web site address below. Item #40COAL. $4.95

**COAL TECHNOLOGY (poster).**

Having the look of high-technology, the vertical poster's statement rises from a coal bed base to reclaimed land and clean air of the environment at its top. The story of coal's technological coalescence - from exploration to reclamation - evolves through artist's illustration and full color photographs. Its black and white reverse supplies background information, technological data, and suggestions for student learning activities. Grades 4-12, 35" x 23", Full Color, B/W back. $4.95 Item #40CT.

*National Energy Foundation,*
*3676 California Ave.,*
*Suite A117, Salt Lake City, UT 84104*
*Phone: (801) 908-5800,*
*FAX: (801) 539-1451,*
*E-mail address: info@nef1.org*
*Web: http://www.nef1.org/*

# COAL
# RELATED WEB SITES

http://www2.nature.nps.gov/ard/lessons.html
**ACID RAIN LESSON PLANS**
These activities are for grades 6-8.

http://www.acf-coal.org/pages/FAQ.html
**AMERICAN COAL FOUNDATION**
Frequently asked questions and answers about coal and the coal industry. After you read through them, take the coal quiz.

http://www.angelfire.com/ks/boredwalk/
**ACID RAIN ONLINE PROJECT**
This is a wonderful online project in which students take the perspective of the environment, history, chemistry, economics, health and government to examine the global issue of this ongoing problem, and it can all be done with just your class right in the classroom.

http://www.bp.com/downloads/1227/US_Stats_Review_2002.xls
**LATEST STATISTICS ABOUT COAL**
Click on the tabs at the bottom to get to the page you need

http://www.coal.ca/class.htm
**COAL ASSOCIATION OF CANADA**
This introduction to coal is a good overview of this fossil fuel. Includes an online walk through tour of a power plant.

http://www.coaleducation.org/
**KENTUCKY COAL COUNCIL EDUCATION WEB SITE**
Presents factual, useful information about coal in a fun and productive way for students and teachers.

http://www.cohums.ohio-state.edu/history/projects/Lessons_US/Gilded_Age/
**COAL MINING IN THE GILDED AGEA AND PROGRESSIVE ERA**
Report with pictures and texts.

http://www.coolguitars.com/coalinks.html
**LIST OF COAL MINING LINKS**
Hundreds of links to coal related topics from several countries as well as the U.S.

http://www.fe.doe.gov/
**DOE'S FOSSIL ENERGY WEB SITE**
Provides educational information on topics such as Energy, Oil and its history; Coal, our most abundant fuel; Natural Gas and its history; and an energy Glossary

http://www.fortunecity.com/tinpan/parton/2/mines.html
**HISTORY IN SONG: SONGS FROM THE MINES**

http://www.freefoto.com/pictures/industry/coal/index.asp
**COAL PICTURES**
Download free coal pictures from this site.

http://www.history.ohio-state.edu/projects/lessons_us/gilded_age/coal_mining/leslie1877/
**PICTORAL ESSAY ON COAL MINING**

http://www.ket.org/Trips/Coal/ACF.html
**AMERICAN COAL FOUNDATION**
An electronic field trip to a coal mine.

http://www.msichicago.org/
**MUSEUM OF SCIENCE AND INDUSTRY, CHICAGO**
This museum is one of the best! Online: The Coal Mine

http://www.nrel.gov/data/pix/
**PHOTOGRAPHIC INFORMATION EXCHANGE**
Search this National Renewable Energy Laboratory site for good pictures relating to coal.

http://www.sourcesofelectricity.com/info.html
**SOURCE OF ELECTRICITY**
A brief description of coal.

http://www.tnonline.com/coalcracker/
**THE COAL CRACKER**
The history of coal mining through the eyes and pictures of coal miners themselves.

http://www.uky.edu/KGS/coal/webcoal/pages/coal3.htm
**KENTUCKY GEOLOGICAL SURVEY**
Basic coal information

http://www.ultracleanfuels.com/
**ULTRACLEAN FUELS**
The Dept. of Energy is helping to fund a new project to convert anthracite coal waste into ultraclean diesel fuel. The facility near Frackville, PA will convert culm (coal dust) and silt into a zero-sulfur liquid fuel.

# COAL ORGANIZATIONS

**American Coal Foundation**
101 Constitution Avenue, N.W, Suite 525-East
Washington, DC 20001-2133
Phone: 202-466-8630
Fax: 202-466-8632
Email: acf-coal@mindspring.com
Web: http://www.acf-coal.org/

**Women In Mining**
PO Box 260246
Lakewood, CO 80226-0246
Phone: 303-298-1535
Email: wim@womeninmining.org
Web: http://www.womeninmining.org/

**U.S. Dept. of Interior**
Office of Surface Mining Reclamation and Enforcement (OSM)
1951 Constitution Avenue, N.W., SIB-262
Washington, DC 20240
Phone: 202-208-2719
Fax: 202-501-0549
Email: getinfo@osmre.gov
Web: http://www.osmre.gov/

# NATURAL GAS

*4.10.3*
*Realize the difference between renewable and non-renewable resources*

*5.10.3*
*Explain the implications of society's dependence on non-renewable resources.*

*8.10.4*
*Examine different types of energy resources and their importance to man.*

*8.10.5*
*Analyze approaches to conserving energy and natural resources.*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# SCRATCH AND SNIFF CARDS

We get our Scratch N Sniff cards from

**Print-A-Scent**
6031 Morning Glory Drive
Harrison TN 37341
423. 326.1010 voice
423. 344.3200 fax
scratch@chattanooga.net
Contact: Missy

The price is $5.00 plus shipping for a set of 35 cards. Ask for the "What Smells? " Natural Gas cards.

# PRODUCTS MADE USING NATURAL GAS HEAT

Aerosols
Aluminum
Antifreeze
Carbonated beverages
China
Clothing
Containers
Copper
DDT
Explosives
Fertilizers
Films
Food
Gasoline
Glass
Indigo Dyes
Iron
Motor oil
Oil and water based paints
Paper
Paper coatings
Plastic
Steel
Synthetic Rubber
Vinegars

# NATURAL GAS
# FREE MATERIALS TO ORDER

**NRG ART (Posters) Grades 3-10.**
Large 24" x 38" black and white posters that can be colored or painted. The following titles are available: Coal, Oil, Natural Gas, and Solar. One of each title per classroom available **FREE** to Tennessee teachers. Teachers in other states will be charged a nominal fee.

**NATURAL GAS (Student Activity Newspapers) Grades K-10.**
Includes background information and activities on natural gas. Available **FREE** in classroom sets to Tennessee teachers. Teachers in other states will be charged a nominal fee.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor,*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 inside Tennessee*
*or 615-674-2994 outside Tennessee*
*Web site: http://www.tnenergy.com*

**********

**FACTS ABOUT NATURAL GAS BROCHURE**
An 8-panel brochure offering a brief history and facts about the natural gas industry in the U.S. **FREE.**

**THE ENERGIST NEWSPAPER - GETTING TO KNOW NATURAL GAS**
An 8 pages publication offering information on what natural gas is, the components and origins of natural gas, how it is located, produced, processed, distributed and student activities**. FREE.**

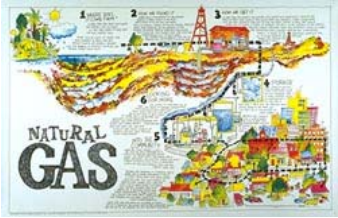
*Ohio Oil and Gas Association,*
*Attn. Rhonda Reda*
*PO Box 187,*
*Granville, OH 43023-0535*
*Phone: 740-587-0444*
*Fax: 740-587-0446*
*Email: tstewart@ooga.org,*
*Web: http://www.ooga.org*

# NATURAL GAS
# INEXPENSIVE MATERIALS TO ORDER

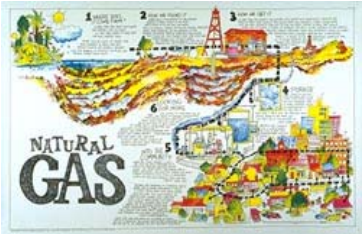
**NATURAL GAS SAFETY (Coloring and Activity Book) Grades 1-3**
8 ½" x 11", 2-color, 16 pages $1.60 each.

*Channing L. Bete Company, Inc.,*
*200 State Road, South Deerfield, MA 01373-0200,*
*Phone: (413 )665-7611 or 1-800-628-7733,*
*FAX: 1-800-499-6464,*
*Email: custsvc@channing-bete.com,*
*Web: http://www.channing-bete.com*

**NATURAL GAS AND THE ENVIRONMENT Poster**

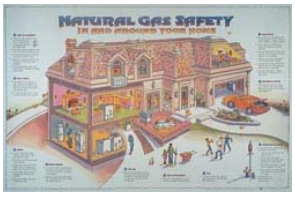



Natural gas, its use and the environment. The black and white reverse side features six learning activities, each usable at many levels, and a reproducible black and white, line art miniature of the poster. Grades K-8, 23" x 35", Full Color, B/W back. Item #40NGE $4.95

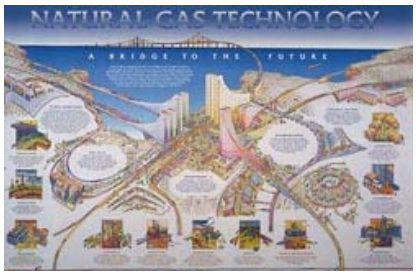



**NATURAL GAS poster**

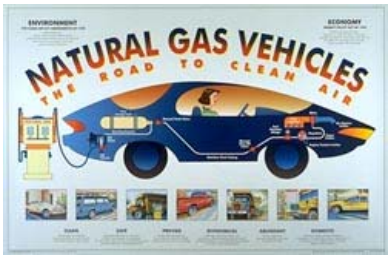
Its black and white reverse supplies background information and suggestions for student learning activities. It is one of NEF's "Sources of Energy" posters. K-8, 23" x 35", Full Color, B/W back. Item # 40NGAS. $4.95




**NATURAL GAS SAFETY IN AND AROUND YOUR HOME poster**
This poster emphasizes discovery and importance of using natural gas safely. It includes a 'scratch 'n-sniff' sticker that produces the 'rotten egg' smell of mercaptan, the odorant added to natural gas so that a natural gas leak may be detected. Its black and white reverse supplies background information and suggestions for student learning activities. K-8, 23" x 35", Full Color, B/W back. Item #40NGSAFE. $4.95




**NATURAL GAS TECHNOLOGY: A BRIDGE TO THE FUTURE poster**
This poster describes the role of natural gas as a "bridge" fuel, or a fuel with the potential to connect today's fossil fuel era to a future of new energy sources and technologies. Themes include power generation, co-generation, fuel cells, environment, transportation, cooling & heating, exploration, extraction, treatment, research, marketing, distribution, safety, laws & regulations, residential, commercial, and industrial. The black and white reverse supplies background information and suggestions for student learning activities. Grades 6-12, 23" x 35", Full Color, B/W back. Item #40NT. $4.95




**NATURAL GAS VEHICLES poster**
Illustrates a contemporary automobile powered by natural gas fuel. The art presents a simplified, but accurate, view of the fuel line and combustion components of the engine. Also depicted are types of vehicles presently using natural gas engines. The black and white back of the poster develops educational information and student activities that can be adapted for appropriate 4-12 applications. The poster introduces students to the environmental advantages of using clean burning fuel. Grades 4-12, 23" x 35", Full Color front, B/W back. Item #40NGV. $4.95

*National Energy Foundation*
*3676 California Ave. Suite A117*
*Salt Lake City, UT 84104*
*PHONE: (801) 908-5800*
*FAX: (801) 908-5400*
*email: info@nef1.org*
*Web: http://www.nef1.org/*

# NATURAL GAS
# RELATED WEB SITES

http://www.abix.com/
**ILLUSTRATED STEPS IN DRILLING FOR OIL and GAS**

http://www.bge.com/cmp/CDA/subsection/0,1665,4685,00.html
**NATURAL GAS SAFETY TIPS**

http://www.bp.com/downloads/1227/US_Stats_Review_2002.xls
**LATEST STATISTICS ON NATURAL GAS**
Click along the tabs at the bottom of the page to find the page you need.

http://www.bydesign.com/fossilfuels/links/
**LINK CENTER FOSSILFUELS.ORG**
This site is a starting point for anyone who wants to learn more about how North America uses its fossil fuel resources.

http://www.energyquest.ca.gov/wattsthat_flash/wattsthat_1.html
**WATT'S THAT?**
A very cool site. It's an online quiz game, sort of like "Jeopardy" for energy buffs.

http://www.northwesternenergy.com/coolstuff/educators/Molly/mollypage9.htm
**A NATURAL GAS SAFETY PICTURE STORY**
You may want to color this page emphasizing natural gas safety tips.

http://www.northwesternenergy.com/coolstuff/educators/Molly/mollypage7.htm
**COLORING SHEET –THINGS THAT USE NATURAL GAS**

http://www.scienceonline.co.uk/energyrenewable
**DIAGRAM OF POCKETS OF OIL BETWEEN LAYERS OF NON-POROUS ROCK**

http://www.northwesternenergy.com/coolstuff/educators/Molly/mollypage10.htm
**NATURAL GAS WORD FIND PUZZLE**

http://www.northwesternenergy.com/coolstuff/educators/Molly/mollypage11.htm
**NATURAL GAS CROSSWORD PUZZLE**

http://www.nrel.gov/data/pix/searchpix.cgi
**PHOTOGRAPHIC INFORMATION EXCHANGE**
Do a "text search" for natural gas pictures.

http://www.scienceonline.co.uk/energy/nonrenewable.html - oil
**NON-RENEWABLE ENERGY RESOURCES (Ages 14-16)**
A tutorial on oil, natural gas, coal and nuclear fuel.

# RENEWABLE SOURCES OF ENERGY

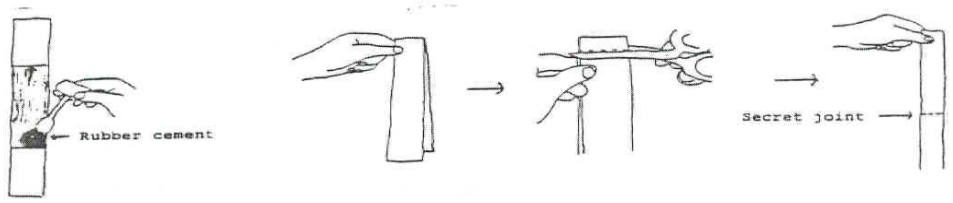
*4.10.3*
*Realize the difference between renewable and non-renewable resources.*

## RENEWABLE PAPER STRIP

To illustrate renewable sources of energy, cut a strip of newspaper from the classified section or the stock market section of the newspaper (it's harder to detect a cut when the print is tiny and close together). Put a thin coat of rubber cement on one side of the paper. Make sure it's not too thick but that it covers all of the paper. Dust with a coat of baby powder (cover it all) and let it dry. Fold the paper in two so the powdered portions are touching.

You can then cut the strip and open the strip gently. Because the cut will expose just enough fresh rubber cement to hold the ends together, it will appear that the strip has been cut and restored.

You could explain to students "Some sources of energy are non-renewable (once they're gone, they won't come back again) but other sources – *cut the top off the strip h*ere – are renewable. That means we can use them today and, tomorrow – *let the end fall her*e – they are as good as new.




*From Magic and Showmanship for Teachers by Alan McCormick.*

# BIOMASS

*1.10.2*
*Identify ways that earth resources benefit man.*

*K.14.1 1.14.1*
*Identify the sun as the source of earth's heat and light energy.*

*Describe the effect of the sun's energy on different materials.*

*2.2.1 3.2.1*
*Categorize objects as living or non-living*

*2.2.4 3.2.4*
*Recognize different types of pollutants*

*2.3.1 5.3.1*
*Compare how plants and animals satisfy their basic requirements for life.*

*3.3.2 7.3.2*
*Examine the major parts of plants and determine their functions.*

*2.10.2*
*Identify various methods to conserve earth resources*

*3.10.3 4.10.3 5.10.3 8.10.3*
*Identify materials and resources that can be reused.*

*8.10.4.a*
*Describe the different sources of energy used by man.*

*8.10.4.b*
*Analyze aspects of energy consumption by society.*

*8.10.5.a.1*
*Evaluate the effectiveness of various conservation strategies on the earth's energy and natural resources.*

*5.14.1*

*Demonstrate and explain how energy can change form.*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# IT'S A GAS!

*Showing how the decay of organic materials can produce biogas (methane takes a few simple ingredients. This activity is best performed as a demonstration that can be prepared in advance.*

**Materials:**

Empty 1 liter plastic bottle
Standard party balloon.
10g raw ground beef
2 lettuce leaves
Sand
Water

**Caution:** Students should not touch materials in this demonstration because of bacterial growth.

**Procedure:**

1. Using rubber gloves, put about 10 g of raw ground beef and 2 lettuce leaves torn into small pieces into the plastic bottle. Wash your hands thoroughly with soap and water.

2. Pour about 2 tablespoons of sand into the bottle so that it covers the meat and lettuce. Do not shake the bottle.

3. Slowly pour about 2 teaspoons of water into the bottle, making sure that the water runs down the side of the bottle and not directly onto the sand

.

4. Stretch the neck of the balloon over the mouth of the bottle. Tie tightly with string and then place masking tape over the string.

5. Place the bottle in a warm location where your students can observe the balloon and the material in the bottle for the next three days.

**Questions**

*What happened to the material at the bottom of the bottle over the three-day period? (The material began to decay.) What happened to the balloon? (It inflated.) What substance inflated the balloon? (Gas that formed during the decomposition.)*

**Note:** When the demonstration is over, puncture the balloon in a well-ventilated place and put everything in a large plastic bag for immediate disposal.
*From: National Energy Education Development Project.*

# BIOMASS

# INEXPENSIVE MATERIALS TO ORDER

**RENEWABLE ENERGY ACTIVITIES. Grades 7-10**

Seven activities on solar, wind and biomass energy, as well as energy values and attitudes. may be reproduced . $4.00. Check or money order must be made out to the Research Foundation of SUNY

*New York Science, Technology and Society,*
*c/o W. Peruzzi,*
*89 Washington Avenue,*
*Rm 674 EBA, Albany, NY 12234*
*Phone: (518) 473-9471, FAX: (518) 473-0858,*
*Website: http://www.nysed.gov*

# BIOMASS
# RELATED WEB SITES

http://solstice.crest.org/
**CENTER FOR RENEWABLE ENERGY AND SUSTAINABLE TECHNOLOGY**.
THE definitive site for alternative energy sources.

http://veggievan.org
**FRENCH FRIES AS FUEL**
Natural, renewable resources such as vegetable oils and recycled restaurant greases can be chemically transformed into clean-burning biodiesel fuels. As its name implies, biodiesel is like diesel fuel except that it is organically produced. It is also safe for the environment and biodegradable and produces significantly less air pollution that diesel fuel. It even smells better than diesel fuel—it smells like French fries, donuts, or barbecue. Ever thought of making a cross-country road trip?

http://www.bera1.org/about.html
**BIOMASS ENERGY RESEARCH ASSOCIATION**
Has good detailed background information

http://www.eere.energy.gov/biopower/miscellan/bp_america.htm
**BIOPOWER**

http://www.eere.energy.gov/biopower/pictures/biomass.htm
**PICTURES OF DIFFERENT BIOMASS SOURCES**

http://www.nrel.gov/data/pix/
**PHOTOGRAPHIC INFORMATION EXCHANGE**
Pictures and images pertaining to biomass. A search for “biomass” pictures will yield such pictures as a sugarcane gasifier facility, woodchip-burning paper plant, eucalyptus trees growing at Hawaiian tree farm, corn for ethanol production, an Ethanol 95 fuel pump, etc.

http://www.ott.doe.gov/biofuels/
**BIOFUELS**

http://www.sourcesofelectricity.com/info.html
**SOURCES OF ELECTRICITY**

Info on the major sources of electricity generation.

# BIOMASS ORGANIZATIONS

**American Forest Foundation Project Learning Tree**
1111 19th Street, NW., Suite 780
Washington, DC 20036
Phone: (202)-463-2462
Fax: (202)-463-2461
Email: information@plt.org
Web: http://plt.org

**Midwest Renewable Energy Association**
7558 Deer Road
Custer, WI 54423
Phone: (715) 592-6595
Fax: (715) 592-6596
Email: info@the-mrea.org
Web: http://www.the-mrea.org

**U.S. Department of Energy**
**Bioenergy Feedstock Development Program**
Oak Ridge National Laboratory
PO Box 2008
Oak Ridge, TN 37831-6422
Phone: 865-574-7364
Fax; 865-576-8143
Email: bfdp@ornl.gov
Web: http://bioenergy.ornl.gov/

**U.S. Department of Energy**
**National Alternative Fuels Hotline**
9300 Lee Highway
Fairfax, VA 22031
Phone: 1-800-423-IDOE or (703) 934-3183
Fax: 703-934-3183
Email: hotline@afdc.nrel.gov
Web: http://www.afdc.doe.gov

# GEOTHERMAL

*1.9.1 2.9.1 3.9.1*
*Identify the earth's major geological features.*

*2.10.1 3.10.2*
*Realize that earth materials can be recycled or conserved.*

*4.9.2 5.9.2*
*Know that the earth is composed of different layers.*

*4.14.1 5.14.1*
*Know that energy exists in many forms*

*5.10.3*
*Realize the difference between renewable and non-renewable resources.*

*8.10.4*
*Examine different types of energy resources and their importance to man.*

*8.10.5*
*Analyze approaches to conserving energy and natural resources.*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# GEOTHERMAL ORGANIZATIONS

**Geothermal Education Office**
664 Hilary Drive
Tiburon, CA 94920
Phone 1-800-866-4436
Fax: 415-435-7737
Email: geo@marin.org
Web: http://geothermal.marin.org

**Geothermal Heat Pump Consortium**
GHPC works to reduce barriers to geothermal heat pump technology
Web: http://www.geoexchange.org/public/segment/dir-school.htm

**Midwest Renewable Energy Association**
7558 Deer Road
Custer, WI 54423
715-592-6595
Fax: 715-592-6596
Email: info@the-mrea.org
Web: http://www.the-mrea.org

**Renewable Fuels Association**
One Massachusetts Avenue, N.W., Suite 820
Washington, DC 20001
Phone: 202-289-3835
Fax: 202-289-7519
Email: info@ethanolrfa.org
Web: http://www/ethanolRFA.org

**U.S. Department of Energy**
**National Alternative Fuels Hotline**
9300 Lee Highway
Fairfax, VA 22031
Phone: 1-800-423 IDOE
Phone: 703-934-3069
Fax: 703-934-3183
Email: hotline@afdc.nrel.gov
Web: http://www.afdc.doe.gov

# HYDROPOWER

*K.8.2 1.8.2 2.82. 3.8.2 4.8.1` 5.8.1*
*Realize that weather is associated with temperature, precipitation and wind conditions and can be measured using tools and instruments.*

*4.8.2 5.8.2*
*Recognize that landforms and bodies of water affect weather and climate*

*2.11.1` 3.11.1*
*Realize the basic concept that forces can move objects (push/pull)*

*2.14.1 3.14.1*
*Realize that the sun is the main source of earth's heat and light energy*

*5.8.3*
*Recognize the basic features of the water cycle.*

*5.10.3*
*Realize the difference between renewable and non-renewable resources.*

*5.14.1*
*Know that energy exists in many forms*

*6.14.4*
*Understand that one form of energy can be transformed into another form of energy*

*8.10.4*
*Examine different types of energy resources and their importance to man*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# HOW CAN WATER PRESSURE INFLUENCE WATER FLOW?

*Water pressure influences the rate of water flow. As pressure increases, so does the rate of flow. The pressure of water is greatest at the bottom of a collection of water, and least at the top. This principle will be illustrated as students conduct the activity in this lesson.*

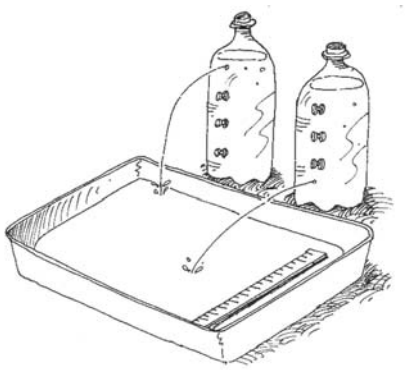
**Materials:**

For the entire class:

Duct tape (precaution in case of leaks)
An easy –to-reach water source, possibly buckets
(you will be refilling cartons 4 times)

***For each team**:*

2 liter pop bottle
4 push pins (round toothpicks optional)
meter stick



**Procedure:**

1. Ask: Will water which is twice as high fall out of a container twice as far? Discuss responses.

2. Have students predict what they think will happen.

3. Pass out materials and explain activity to test their predictions. Have the class set standards for measurement such as:
   Will we measure and place holes from the bottom or from the top of the bottle?
   Where is the water fill-up mark?
   How do we mark and measure the water stream?

4. Have teams prepare pop bottle by punching 4 holes with push pin at determined intervals in bottle and leaving the pin in each hole.

5. Fill carton to top with water. Place bottle on book or other object for elevation.

6. Start by removing the bottom pin. Mark where water touches paper with cube or coin. Refill and repeat 2 times.

7. Plug bottom hole, refill and go to next push pin. Repeat measurement 3 times. If leaks occur, use scotch tape to cover holes.

8. Continue repeating procedure until each hole has been tested.

9. Graph the average flow results. (A graph and chart is available at the end of http://www.fwee.org/TG/unit_2a.pdf, Lesson 2 B.)

*From FWEE at http://www.fwee.org/TG/unit_2a.pdf*

# HYDROPOWER
# RELATED WEB SITES

http://hydropower.id.doe.gov/more.htm
**HOW HYDROPOWER WORKS**
The Hydrologic Cycle: Water constantly moves through a vast global cycle. The energy of this water cycle, which is driven by the sun, is tapped most efficiently with hydropower.

http://newdeal.feri.org/library/q_o_ar.htm
**PICTURES OF NORRIS DAM CONSTRUCTION**

http://www.acme.com/jef/science_songs/
**SINGING SCIENCE RECORDS**
Listen to "The Grand Coulee Dam" song at this site.

http://www.bpa.gov/Corporate/KR/ed/hydromania/homepage.htm
**HYDROMANIA**
From Bonneville Power in Oregon. Hydromania is A Hands-on, ready-to-use science curriculum exploring nature and energy. Created by teachers for grades 4-6. Many of the lessons could also be used for middle school grades as well.

www.freefoto.com/pictures/industry/hydro_electric/index.asp
**FREE FOTO.COM**
Pictures of hydro electric facilities.

www.fwee.org/Tours.html
**HYDRO TOURS**
Students can take an online tour of a Hydro Plant, learn how a Hydropower Generator works and much more!

http://www.howstuffworks.com/hydropower-plant.htm
**HOW HYDROPOWER PLANTS WORK**
This simple 3-part lesson explains hydropower basics. Includes links.

http://www.hydro.org/waterworks
**NATIONAL HYDROPOWER ASSOCIATION**
Has a teacher's guide entitled *Water Works: A Question of Balance* which can be downloaded from the website. Designed for students in grades 3-8, this curriculum teaches about hydropower's role in providing electricity.

http://www.scienceonline.co.uk/energy/renewable-energy.html#solar
**PICTURE OF HYDRO DAM**

http://www.soton.ac.uk/~engenvir/environment/alternative/hydropower/hydrenvi.htm
**WOW! HYDROELECTRIC POWER SOUNDS BRILLIANT, OR DOES IT?**
Data use in schools. An examination of the negative ecological and environmental effects of building dams for producing hydroelectric power.

http://sourcesofelectricity.com/info.html
**SOURCES OF ELECTRICITY**

http://usgs.gov/education.html
**USGS LEARNING WEB**
Kid friendly format, click on the Learning Web which is a portion of the USGS web dedicated to K-12 education, exploration and life-long learning. Visit often and explore things on, in, around, and about the Earth such as plants and animals, land water, and maps. Learn how Biology, Geology, Hydrology, and Geography can help us understand our changing world.

# HYDROPOWER
# FREE MATERIALS TO ORDER

**HINES POSTER SERIES**
This set of black and white pictures depict life in the Tennessee Valley in the early 1930's before the advent of electricity. Discussion questions and teaching suggestions are on the back of each photograph. Great for social studies class, too! (If you would like to make these photographs into a filmstrip so the entire class can view the pictures at once, request Energy Filmstrip Instruction Sheet when you call or write). One set per classroom. FREE to Tennessee teachers.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower,*
*312 8th Avenue North, 9th floor*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 inside Tennessee*
*or 615-674-2994 outside Tennessee,*
*Web: http://www.tnenergy.com*

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**WATER CYCLE HEXAFLEXAGON (4-8th grade)**
Manipulative device students construct which shows the parts of the water cycle. Developed for the 1995 Hydromania III science camp. Download from a link on http://www.bpa.gov/Corporate/KR/ed/6-activities.htm

**SAVING ENERGY WITH ZIPPIE, SPLASH, And SAM N. Coloring Book (2-4th grade)**
Splash, a drop of water, and Zippie, a watt of electricity, tell about how saving water and electricity can help Sam N. and his relatives who need water to survive. Straightforward line drawings invite the students to color, complete a maze and find hidden words, as they learn from simple captions Download from a link on http://www.bpa.gov/Corporate/KR/ed/6-activities.htm

**POWER BOARD GAME (4-8th grade)**
Simulation game where students form "utility companies" and try to balance environmental concerns and economic needs in the Northwest. Prepared in April 1995 to be used during Hydromania II science camp. Download from a link on http://www.bpa.gov/Corporate/KR/ed/6-activities.htm

**HYDROELECTRIC PROJECT PAPER MODEL**
This 3D replica of a dam with fish ladder, transformer and transmission tower can be assembled and taped to its base showing roads, grass and the river. The reverse side is printed with a diagram and explanation of how hydroelectricity is generated, as well as information on the phases of the water cycle and other hydro facts. Download from a link on http://www.bpa.gov/Corporate/KR/ed/6-activities.htm

*Bonneville Power*
*905 NE 11th Avenue*
*Portland, OR 97208*
*Phone: 1-800-622-4520*
*Web: http://www.bpa.gov/*

# SOLAR

*K.14.1*
*Realize that the sun is the main source of earth's heat and light energy.*

*1.14.1 a*
*Describe the effect of the sun's energy on different materials.*

*2.14.1*
*Realize that the sun is the main source of earth's heat and light energy.*

*3.14.1*
*Realize that the sun is the main source of earth's heat and light energy.*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# BUILD A PIZZA BOX COOKER

**Materials:**

A medium size pizza box (Pizza Hut boxes work great)
Black construction paper
Extra-wide aluminum foil
Plastic (Go to Kinko's and ask for their leftover laminating sheets after they have been run through the laminating machine. This heavy laminating film works great. Or perhaps you can get some plastic window covering from a hardware store.)
Glue, Tape
Scissors
Ruler
Magic Marker
String

**Procedure:**

1. Tape foil to the inside bottom of the box. Cover the foil with black paper. Tape in place.
2. Put the box on the plastic.
3. Draw the outline of the box on the plastic with the marker. Cut the plastic about 1/4 inch inside the marks.
4. On the top of the box, draw a line one inch from all sides. Cut along front and side lines **BUT NOT** along the back. This will be the hinge for the flap.
5. Carefully fold open the flap. Cut a piece of foil the size of the flap.
6. Glue it to the side of the flap that faces **INTO** the box. Flatten out all the winkles. Wipe glue smears off with a damp towel before they dry.
7. Tape the plastic to the inside of the box. Tape one side first, then the opposite side. Make it tight so it looks like glass. Tape the other edges. Seal tight so no air can get in.
8. Cut a piece of string as long as the box. Tape one end to the top of the flap.
9. Push a small nail into the back of the box so you have a place to tie the string.
10. Give it a try ... (English muffin pizzas, melting rate of chocolate smores, etc.

*From http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/other/solar.html*

**SOLAR S'MORES RECIPE I**

24 squares from chocolate bars
12 graham crackers, halved
6 large marshmallows

Place 4 squares of chocolate on each of 6 graham crackers, top with marshmallows. Cover with remaining graham cracker squares to form sandwiches. Press to seal. Wrap with foil. Place in oven. Bake until heated and chocolate begins to melt. Serve immediately. Makes 6 servings

**SOLAR S'MORES RECIPE II**

½ cup crunchy peanut butter
12 graham crackers, halve
6 large marshmallows

Spread peanut butter on 6 graham crackers, top with marshmallows and place in oven. Cover with remaining graham cracker squares to form sandwiches. Press to seal. Bake until heated. Serve immediately. Makes 6 servings.

*From Amazing Sun Fun Activities by Michael Dailey. Learning Triangle Press, 1998 . ISBN: 0-07-0151777-6 and Solar Matters at http://www.fsec.ucf.edu*

# UV BEADS
## The Invisible Energy In Light

**Materials:**

5 solar beads for each student*
2 clear Ziploc bags with five beads in each
1 piece of string for each student
1 large bowl or water
Clear spray sunscreen
Fabric
White and black paper
Umbrella

**Procedure:**

1. Have the students string the beads into bracelets in a room with no sunlight.

2. Have the students hold the bracelets close to an indoor light source and observe the beads.

3. Take the students outside into the sun and have them observe the beads.

4. Move into a shaded area and observe the color and intensity of the beads.

5. Have the students hold the bracelets under an umbrella, the white and black paper, and a piece of fabric. Observe any changes in the beads.

6. Place the Ziploc bags with the beads into the sun. Observe the beads.

7. Spray one bag with sunscreen. Observe the bags. Note any difference.

8. Place the bowl of water in the sun. Place the beads from one of the bags in the water. Observe the beads.

9. Ask the students:
   How can you tell there is energy in the light from the sun? Is all light the same? Where do you find ultraviolet light? What materials can stop ultraviolet light? What things can you do to keep from getting sunburned? If you put on sunscreen and stayed in the water all day at the pool, do you think you could still get a sunburn?

*Solar beads are white when there is no ultraviolet radiation. The beads contain special pigments that change color when they absorb ultraviolet (UV) radiation. They are not affected by visible light and do not react to indoor light or when shielded from UV radiation. The beads help demonstrate to children that ultraviolet light is invisible. It is the light that causes sunburns –it changes into heat when it touches someone. We can't see it, but we can use the solar beads to tell it's there.

**Purchasing information:**

A package of 250 UV detecting beads can be purchased from Educational Innovations $6.95.
http://www.teachersource.com/ or call 1-888-912-7474. item UV-AST.
*They can also be purchased from Museum Products. Item #154. 170 per package. $5.00/package.Phone: 1-800-395-5400,*
*FAX: 860-572-9589;*
Web: http://www.museumproducts.net/

*From Energy Exchange Magazine.Nov/Dec. 2002. (National Energy Education Development Project (NEED) Project.) The NEED Project Membership kit, valued at $35, filled with all kinds of energy-related materials, games, activities, competitions, and a quarterly magazine, Energy Exchange. You can request a kit for only $5.00 from The Tennessee Energy Education Network by calling 1-800-342-1340.*

# BOOKS ABOUT SOLAR ENERGY

***The Way To Start A Day*** by Byrd Baylor. Aladdin Library, NY 1978.
"The way to start the day is to go outside, face the east and greet the sun, as others in the past and present have celebrated the dawn." **ISBN:** 0689710542

***Sunlight*** by Sally Cartwright. Coward, McCann and Geoghegan, NY 1974.
**ASIN:** 0698202880

# SOLAR
# FREE MATERIALS TO ORDER

**EXPERIMENT HOUSE. (Grades 5-8)**
Students learn how to collect data for experiments by building a cardboard house for solar or insulation experiments. Suggestions for experiments included. Good for group work. Available in classroom sets, if desired. FREE in multiple copies to Tennessee teachers. Out-of-state teachers will be charged a nominal fee.

**NRG ART (Posters) Grades 3-10.**
Large 24x38 black and white posters that can be colored or painted. The following titles are available: Coal, Oil, Natural Gas, and Solar. One of each title per classroom available FREE to Tennessee teachers. Teachers in other states will be charged a nominal fee.

**SOLAR ENERGY Student Newspaper**
This newspaper, designed for grades K-1, is primarily pictures that can be colored along with very basic facts about solar energy. Classroom sets are available free from TEEN.

*Tennessee Energy Education Network,*
*William R. Snodgrass Building/ TN Tower*
*312 8th Avenue North, 9th floor*
*Nashville, TN 37243-0405,*
*Phone: 1-800-342-1340 inside Tennessee or*
*615-674-2994 outside Tennessee,*
*Web site: http://www.tnenergy*

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**ALTERNATIVE FUEL MATTERS (Downloadable curriculum unit) Grades 6-9**
One of 3 free downloadable curriculum units available on the FSEC web site. The units include hands-on activities and PowerPoint presentations that align to science standards.

*Florida Solar Energy Center,*
*1679 Clearlake Road,*
*Cocoa, FL 32922,*
*Phone: 321-638-1000,*
*Fax: 321-638-1010*
*Email: info@fsec.ucf.edu,*
*Web site: http://www.fsec.ucf.edu/*

**RENEWABLE ENERGY FACT SHEETS**
Include information and classroom activities. FREE.

**ENERGY, TECHNOLOGY AND SOCIETY (Grades 9-12)**
Provides information on alternative energy technologies. FREE.

*Solar Energy Industries Association,*
*1616 H Street, N.W., 8th floor,*
*Washington, DC 20006*
*Phone: (202) 628-7979,*
*FAX: (202) 628-7779,*
*Web site: http://www.seia.org*

**********

**SOLAR ENERGY AND YOU (Grades 1-4)**
Fact Sheet. (FS118) FREE.

*Energy Efficiency and Renewable Energy Clearinghouse (EREC),*
*P.O. Box 3048,*
*Merrifield, Va. 22116-0121*
*Contact: Larry Goldberg, Project Manager,*
*Phone: 1-800-DOE-EREC (363-3732),*
*FAX: (703) 893-0400,*
*E-mail: doe.erec@nciinc.com,*
*Web: http:// www.eren.doe/gov/consumerinfo*

**********

**SOLAR COOKER KIT DIRECTIONS (Grades K-8)**
Directions for making a small solar device from common materials. May be duplicated. $1.00 per copy. Send self-addressed stamped envelope.

*Energy & Marine Center,*
*District School Board of Pasco County,*
*P.O. Box 190,*
*Port Richey, FL 34673*
*Phone: (727) 848-4870 or (727) 848-4881,*
*FAX: (727) 848-4881,*
*E-mail: gperkins@pasco.k12.fl.us*
*Web site: http://www.pasco.kiz.fl.us/EMC/emc-homepage.html*

**********

**SOLAR MATTERS (Downloadable curriculum unit)** Grades 4-8
One of 3 curriculum units available on the FSEC web site. The units include hands-on activities and PowerPoint presentations that align to science standards.

**SOLAR WONDERS (Curriculum Unit) Grades 9-12.**
One of 3 curriculum units available on the FSEC web site. The units include hands-on activities and PowerPoint presentations that align to science standards.

*Florida Solar Energy Center,*
*1679 Clearlake road,*
*Cocoa, FL 32922*
*Phone: 321-638-1000,*
*Fax: 321-638-1010,*
*Email: info@fsec.ucf.edu,*
*Web site: http://www.fsec.ucf.edu/*

# SOLAR

# INEXPENSIVE MATERIALS TO ORDER

**SOLAR COOKER KIT DIRECTIONS (Grades K-8)**
Directions for making a small solar device from common materials. May be duplicated. $1.00 per copy. Send self-addressed stamped envelope.

*Energy & Marine Center,*
*Phone: (727) 848-4870 or (727) 848-4881,*
*FAX: (727) 848-4881,*
*E-mail:gperkins@pasco.k12.fl.us.*
*Web site: http://www.pasco.kiz.fl.us/EMC/emc-homepage.html*

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**SOLARGRAPHICS KIT (same as SUN PRINT KIT below)**
Nature prints drawn by the sun. Arrange flowers, leaves, seashells or other nature objects on the 5 x 7 sun sensitive paper, expose in the sun for a few minutes then develop in tap water. 15 sheets and a transparent cover. #337. $6.95 each

**RADIOMETER**
This ever popular and intriguing instrument is used to demonstrate solar radiation. Black and white vanes will turn in a virtual vacuum inside the radiometer when placed in sunlight.#620.

**MAGIC BEADS**
Beads change color I sunlight instantly! Great for detecting ultraviolet light. Try experimenting with sun block lotion and sunglasses to test their effectiveness. Use a lanyard cord to make a Magic Beads necklace or bracelet. #154. 170 per package. $5.00 pkg.

*Museum Products,*
*84 Route 27,*
*Mystic, CT 06355*
*1-800-395-5400*
*FAX: 860-572-9589 ,*
*Web: www.museumproducts.net*

**********

**BE SUN-SIBLE**
Skin and sun facts, ready-to-reproduce teaching materials. , #PS10 - $4.00

*National Science Teachers Association (NSTA)*
*Marketing: Peggy Irwin,*
*1742 Connecticut Avenue, N.W.,*
*Washington, DC 20009*
*Phone: 703-243-7100,*
*FAX: (703) 243-7177,*
*Web: http://www.nsta.org*

**********

**RENEWABLE ENERGY ACTIVITIES. Grades 7-10**
Seven activities on solar, wind and biomass energy, as well as energy values and attitudes. may be reproduced . $4.00. Check or money order must be made out to the Research Foundation of SUNY

*New York Science, Technology and Society,*
*c/o W. Peruzzi,*
*89 Washington Avenue, Rm 674 EBA,*
*Albany, NY 12234*
*Phone: (518) 473-9471,*
*FAX: (518) 473-0858,*
*Website: http://www.nysed.gov*

**AMERICAN TOUR de SOL**

Innovative solar and electric cars –more than half of them built by high school and college students – compete in this annual road race every spring. The Northeast Sustainable Energy Association (NESEA), which organizes the race, has a teacher resource packet with background info plus instructions for building a miniature solar car and more – all for $2.00.

*Northeast Sustainable Energy Association (NESEA)*
*23 Ames Street*
*Greenfield, MA 01301*
*Phone: 413-774-6051*

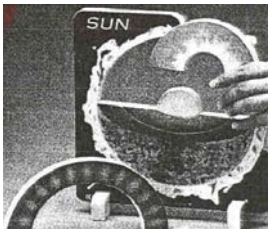
**********

**SUN PRINT KIT.**

All you need is water, a little sunshine and imagination for hours of fun making photographic type prints. Available in kits of 10 sheets (4"x 4" each). Included are sheets, acrylic plate and instructions in light proof envelope. $3.95

**SOLAR CELLS**

A photovoltaic cell in an encapsulated panel to allow handling without breakage normally associated with fragile solar cells. 1 " x ¾" .45 v, 100mA. Item #12052-2. $10.95




**BOOK PLUS: SUN**

The Sun consists of a colorful teaching model, reproducible activity cards and background information. Explore the layers of our nearest star – from corona to core. Each layers ha been recreated…the model is made of resilient, non-toxic, EVA foam. Teachers can cut out the task card and use it in a learning center or as a group activity. The models are 10" x 15" x .75" thick. Item #14994-2. $22.50

*Schoolmaster Science/School-Tech, Inc*
*745 State Circle Box 1941*
*Ann Arbor, MI 48106*
*Phone: (734)761-5072 or 1-800-521-2832*
*Fax: (734)761-8711 or 1-800-654-4321*
*Email: service@school-tech.com*
*Web: http://www.wolverinesports.com/*

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**SOLAR COOKER PLANS**

How to make, use and understand solar cookers. Instructions to build box and panel type solar cookers from cardboard and suggested alternate materials. Recipes and new section for teachers. Each one you buy makes one available to an educational institution overseas. $5.oo plus $1 postage.

*Solar Cookers, International,*
*Kevin Porter, Office Manager,*
*1919 21st Street, Suite 101,*
*Sacramento, CA 95814*
*Phone: (916) 455-4499,*
*FAX: (916) 455-4498,*
*E-mail: info@solarcookers.org,*
*Web site: http://www.solarcooking.org*

**********

**THE MOUSE AND THE SUN SHORT STORY**

This Canadian folktale takes place in a time long ago, when the few people who lived were spread out over long distances. In the story, the animals rule the earth. When a young by becomes angry, he creates trouble for all creatures by catching the sun in a snare. A giant mouse, the biggest animal on earth at the time, saves the sun for everyone. Item #RL2-014. $3.00
*www.storycard.com/RLTwoScripts.html*

# SOLAR ENERGY
# RELATED WEB SITES

http://askeric.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Space_Sciences/SPA0020.html.
**SOLAR ENERGY EXPERIMENT**.
Simple experiment to demonstrate that energy from the sun can be collected and stored in many ways.

http://irecusa.org/schools/index.html
**SCHOOLS GOING SOLAR**
Did you know that many schools across the country are equipped with solar energy systems that not only provide solar electricity, hotwater, good quality lighting and other benefits to th school building, but also help students augment their math and science studies, and even help them stay healthier and earn better grades overall?

http://qihs.aps.org/science/teacher/solar.htm
**SOLAR ENERGY UNIT**
Background information as well as current solar energy options is presented in an active, hands-on format for students in grades 8 or 9. Learner outcomes will be measured utilizing alternative assessment. The culminating activity will involve groups creating a solar collecting device utilizing the following concepts; angle of the sun's rays, energy absorbing colors, insulation and reflection.

http://solar-center.stanford.edu/.
**STANFORD SOLAR CENTER.**
The solar investigations people at Stanford University are "providing Solar Online Activity Resources for the joy of solar science exploration."

http://solstice.crest.org/renewables/re-kiosk/solar/index.shtml
**ONLINE RENEWABLE ENERGY MODULE**

http://solstice.crest.org/renewables/sj/index.html
**THE SUN'S JOULES**

http://webpages.marshall.edu/~bady/RICK/ENERGY.HTML
**SOLAR COLLECTORS activities:** HOW THE SUN HEATS THE EARTH
Look under the "Light" heading for these activities

http://webphysics.ph.msstate.edu/ccp/27-5
**PHOTOELECTRIC EFFECT SIMULATOR**

http://wwwbhs1.bham.wednet.edu/squalweb/departments/Cap/ScienceProjects/projheat.htm
**SCIENCE ACTIVITIES FOR THERMAL ENERGY AND HEAT**
Links to this lesson available on this site:
Solar Cookout – Harness the energy from the sun to power a parabolic oven and cook a hotdog. (Issues in Science)

http://www.accessone.com/~sbcn/index.htm
**SOLAR ENERGY SUCCESS STORIES**

http://www.azsolarcenter.com/technology/cellwk.html.
**HOW A PHOTOVOLTAIC CELL WORKS DIAGRAM**

http://www.azsolarcenter.com/education/edtemplate1.html or http://www.azsolarcenter.com/education.html
**DOWNLOADABLE SOLAR UNITS**
This site offers a free solar energy curriculum for upper elementary/Intermediate grades. The curriculum , developed by Florida Solar Energy Center, has 25 exercises that rely on free or low-cost materials to provide students hands-on experience with the principles of solar water heating, photovoltaics, solar cooking and other subjects. The curriculum is available to teachers at no cost. It also includes a bibliography and list of related web sites, as well as more than 30 photos of solar applications around the world.

http://www.brainpop.com/science/seeall.weml
**MOVIE: SUN**
You can see a wide assortment of animated movie clips at this site.

http://www.eren.doe.gov/pv/howworks.html
**ABOUT PHOTOVOLTAICS: AN ANIMATED TOUR**
Has videos and a quiz.

http://www.fsec.ucf.edu/ed/sw/
**SOLAR WONDERS**
This online solar energy science unit, developed by the Florida Solar Energy Center, is intended to help high school teachers give their students an awareness of the power of solar energy and to show its impact on their lives. The programs presented in the unit provide an overview of the technologies, an understanding of their principles, and detailed case studies of their uses.

http://www.howstuffworks.com/solar-cell.htm
**HOW SOLAR CELLS WORK**
This simple three-part lesson explains solar cell basics. Includes links.

http://www.irecusa.org
**THE INTERSTATE RENEWABLE ENERGY COUNCIL**
This council has many educational resources for schools. Their www.SchoolsGoingSolar.org program highlights different ways schools are utilizing renewable resources in their construction and energy management.

http://www.solardome.com
**SOLAR DOME**

http://www.solarenergy.org/
**SOLAR ENERGY INTERNATIONAL**
This home page for Solar Energy International (SEI) lists workshops for learning about renewable energy sources and provides links to government agencies, nonprofit organizations and publications about energy.

http:/www.solarviews.com
**VIEWS OF THE SUN**
Energy generated in the Sun's core takes a million years to reach its surface. Every second 700 million tons of hydrogen are converted into helium ashes. In the process 5 million tons of pure energy is released; therefore, as time goes on the Sun is becoming lighter. To learn more about the sun and the awesome energy it releases, visit this site.

http://www.txses.org.
**SOLAR ENERGY COLORING BOOK**
A fun way to introduce kids to solar energy. Requires Acrobat Reader 4.0 or later – 365 k bytes.

# SOLAR ORGANIZATIONS

**Alliance To Save Energy**
1725 K Street NW, Suite 409
Washington DC 20006-1401
Phone: 202-847-0666

**American Solar Energy Society**
2400 Central Avenue, Suite G-1
Boulder, CO 80301
Phone: 303-443-3130
Fax: 303-443-3212
Email: ases#ases.org
Web: http://www.ases.org or www.solartoday.org

**California Energy Extension Service**
Governor's Office of Planning and Research,
1400 Tenth Street, Room 209
Sacramento, CA 94814
Phone: 916-323-4388

**Florida Solar Energy Center**
1679 Clearlake Road
Cocoa, FL 32922
Phone: 321-638-1000
Fax: 321-638-1010
Email: info@fsec.ucf.edu
Web: http://www.fsec.ucf.edu/ed/teachers

**Junior Solar Sprint.**
Sponsored by the U.S. Department of Energy with the Argonne National Laboratory, this annual competition challenges students in grades 7 and 8 to design, build and race small model cars powered entirely by solar energy. For solar car kits and information, contact: Argonne National Laboratory,Building 362-2B, 9700 South Cass Avenue, Argonne, IL 60439, Phone: 708-252-6489

**Midwest Renewable Energy Association**
7558 Deer Road
Custer, WI 54423
715-592-6595
Fax: 715-592-6596
Email: info@the-mrea.org
Web: http://www.the-mrea.org

**Northeast Sustainable Energy Association**
50 Miles Street, Suite 3
Greenfield, MA 01301
Phone: 413-774-6051
Fax: 413-774-6053
Email: edu@nesea.org
Web; http://www.nesea.org

**Renewable Fuels Association**
One Massachusetts Avenue, N.W., Suite 820
Washington, DC 20001
Phone: 202-289-3835
Fax: 202-289-7519
Email: info@ethanolrfa.org
Web: http://www/ethanolRFA.org

**Solar Cookers International**
1919 21st Street, Suite 101
Sacramento, CA 95814
Phone: 916-455-4499
Web: http://solarcooking.org/

**Solar Electric Power Association**
1800 M Street NW, Suite 300
Phone: 202-857-0898
Fax: 202-223-5537
Email; SolarElectriPower@ttcorp.com
Web: www.SolarElectriPower.org

**Solar Energy Industries Association**
1616 H. Street, NW 8th floor
Washington DC 20006
Phone: 202-628-7979
Fax: 202-628-7779
Email: info@seia.org
Web: http://www.seia.org

**Solar Now, Inc.**
The Sunroom
100 Sohier Road
Beverly, MA 01915
Phone: 978-927-9SUN
Fax: 978-927-9191
Email: solarnow@attbi.com
Web: http://www.Solarnow.org

**U.S. Department of Energy**
**Conservation and Renewable Energy Inquiry and Referral Service**
PO Box 8900
Silver Spring, MD 20907
Phone: 800-523-2929

**U.S. Department of Energy**
National Alternative Fuels Hotline
9300 Lee Highway
Fairfax, VA 22031
Phone: 1-800-423 IDOE
Phone: 703-934-3069
Fax: 703-934-3183
Email: hotline@afdc.nrel.gov
Web: http://www.afdc.doe.gov

# WIND ENERGY

*K.8.2 1.8.2 2.82. 3.8.2 4.8.1` 5.8.1*
*Realize that weather is associated with temperature, precipitation and wind conditions and can be measured using tools and instruments.*

*4.8.2 5.8.2*
*Recognize that landforms and bodies of water affect weather and climate*

*1.9.1 2.9.1. 3.9.1 4.9.1 5.9.1*
*Identify the earth's major geological features*

*2.11.1` 3.11.1*
*Realize the basic concept that forces can move objects (push/pull)*

*2.14.1 3.14.1*
*Realize that the sun is the main source of earth's heat and light energy*

*5.10.3*
*Realize the difference between renewable and non-renewable resources.*

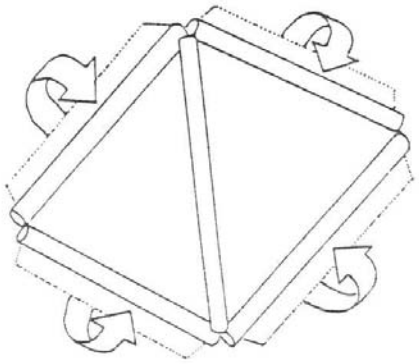
*5.14.1*
*Know that energy exists in many forms*

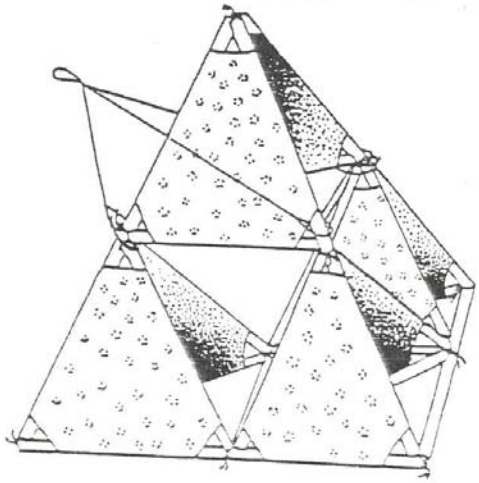
*6.14.4*
*Understand that one form of energy can be transformed into another form of energy*

*8.10.4*
*Examine different types of energy resources and their importance to man*

*For more background information about this topic, see*
**http://www.need.org/infobooks.htm**

# MAKING A TETRAHEDRAL KITE





The instructions below are to help anyone with the construction of a four-celled tetrahedral kite. The final product, however, may contain as many cells as desired. But, remember, the final product must always maintain the overall tetrahedral shape!

**Materials Needed:**

24 drinking straws (24.5 cm long)
1 roll fishing line (will be more than enough for one kite)
Wrapping paper or tissue paper (1 package will make one cell and half of another)
Adhesive
Scissors
Pencil
Ruler

**Procedure:**

1. Cut off approximately 2 cm of fishing line and thread it through three straws to secure them firmly. Tie the lines securely to form a triangle. Do not cut off excess line.
2. Add two more straws to the triangular figure and thread more string through and tie to form a diamond-shaped figure (as seen in the illustration)

3. Cut out paper approximately 2 cm larger than the diamond-shaped frame. Fold the edges of the paper over the frame and secure with adhesive or tape. The dotted line (left) makes the paper and the arrows mark the fold directions. Secure with tape.

4. Thread a piece of fishing line through the straws from one pointed end of the diamond to the other. Continue threading line through a sixth straw and tie together both ends of the line. This will produce one tetrahedral kite cell.

5. Complete four such cells and tie them together in a tetrahedral shape. Make sure that all the surfaces covered with paper are facing in the same direction. Then run like the wind!

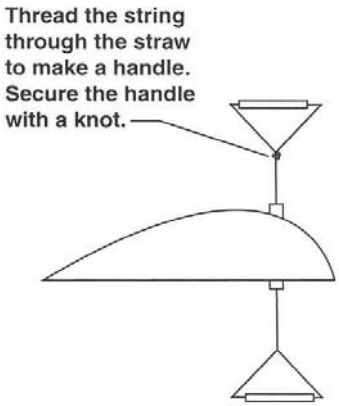
# WING ON A STRING

## (PATHFINDER ON A STRING)

In this activity you will construct a model of the Pathfinder aircraft that really flies. It is also a good demonstration of wind energy.

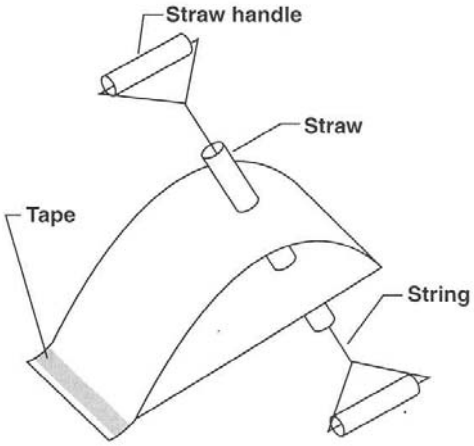
### Materials needed per student

One meter of string or fishing line
One drinking straw
Transparent tape
One sheet of letter-size paper, with template copy
Scissors




### Procedure:

1. Distribute the materials.
2. Students will follow the four steps marked on the template:
   Step One. Make a pencil-size hole in copy of template marked Step 1.
   Step Two. Make a pencil-size hole in copy of template marked Step 2.
   Step Three. Fold along the line marked Step 3, and keep folded.
   Step Four. Align the 8.5" edges and tape them together.
3. Cut straw into three equal pieces, approximately 5 cm long.
4. Insert one of the straw pieces through both holes (see picture).
5. Thread the string through the straw to create the Pathfinder on a String.
6. Use the other two pieces of the straw for handles (see picture).




### Flying your Pathfinder on a String

Hold the straw handles, with your arms straight out, so the string through the wing is parallel perpendicular to the ground. This forward motion will cause air to flow over and under the Pathfinder creating *lift* and a flying model. Flying Pathfinder on a String can be done indoors or outdoors.

### Explanation

The Pathfinder is a giant *airfoil.* What you have done is built an airfoil model on a string. When you fly your Pathfinder model, the shape of the airfoil creates lift. Lift is created when slow moving air molecules under the wing create high pressure, and fast moving air molecules above the wing create low pressure. There are many other factors that affect the flight of your airfoil. As you walk forward, your motion is creating the *thrust* that moves the airfoil forward. The forces of *drag* and *gravity* are other forces that act upon the flight of your Pathfinder on a String.

*http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Pathfinder/Pathfinder.Aircraft.pdf*

Step 4. Tape along this line

Step 1. Punch hole with pencil

Step 3. Fold along this line

Step 2. Punch hole with pencil

# WIND TUBES

A Windtube is an 8-foot long, 10-inch wide plastic bag that can be inflated like a balloon. Unlike Latex balloons, Windtubes do not have to stretch to inflate, so they are very easy to fill with air. Doron Gazit first invented Windtubes in 1979 while a college student in Israel. He originally called them “Wind Bags”, but quickly changed to the more descriptive “Windtube” name.

**Procedure:**

1. Tie off one end of your Windtube.
2. Ask students to estimate how many breaths it takes to blow up the 8-foot tube…15?….20?…40?
3. Ask a student to inflate the tube. Count the number of breaths required.
4. Next, show your students that, using Bernoulli’s Principle, you can inflate the tube with only a single breath!

## Here’s How!

Have an assistant hold the closed end of your Windtube so it extends out horizontally. Hold the other end wide open. Keeping your mouth about 10” away from the opening, blow a fast stream of air into the center of the tube for a few second. As soon as your tube is full, close it tightly with your hand and twist it tight. With a little practice, you’ll be an expert!

## Here’s Why!

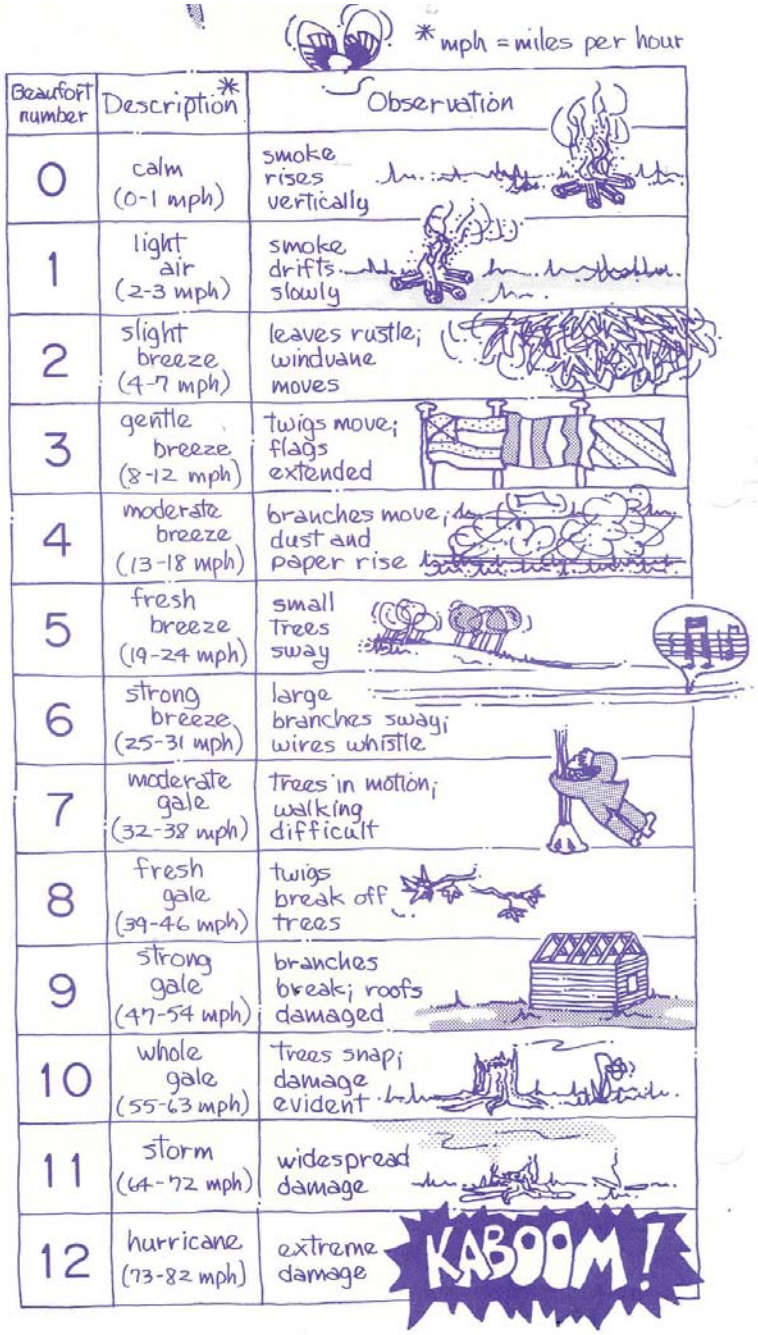
In 1738, Swiss physicist and mathematician, Daniel Bernoulli stated that as the velocity of a fluid (any gas or liquid that flows) increases, the pressure it exerts decreases. Fast moving air has a lower pressure than air that is not moving. The faster the air moves, the lower the pressure. Likewise, the fast stream of air moving from your mouth flowing into the Windtube has a lower pressure than the air outside the tube. Air from the room rushes into this low-pressure area within the windtube and helps to fill the Windtube.

**Real Life Applications:**
Firefighters use Bernoulli’s Principle to clear smoke by placing exhaust fans back from doorways, leaving a space. This draws more air (and smoke) from the room. Hot air balloons are filled more quickly using the same technique.

**Ordering Information:**

Wind Tubes are available from Educational Innovations, 362 Main Avenue, Norwalk, CT 06851, Phone: 1-888-912-7474Fax: 203-229-0740, Email: *info@teachersource.com*, Web: www.teachersource.com. Item #WIN-600. 1 package of 4 tubes. $4.75.

# BEAUFORT WIND SCALE

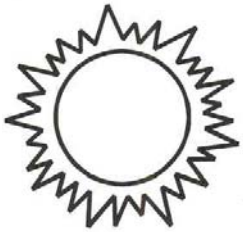


*mph = miles per hour

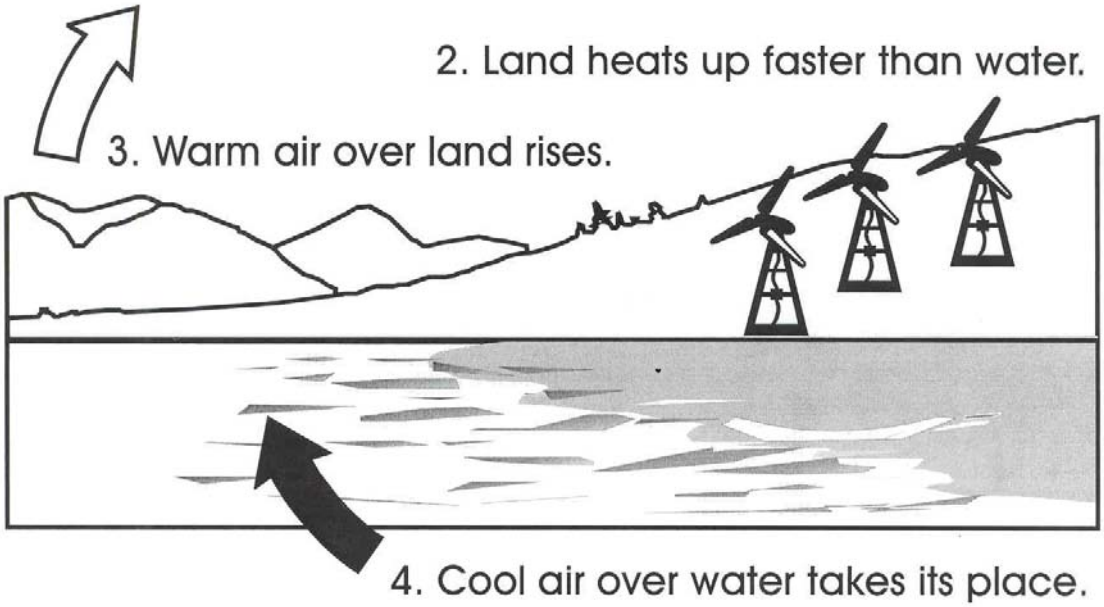
| Beaufort number | Description* | Observation |
|---|---|---|
| 0 | calm (0-1 mph) | smoke rises vertically |
| 1 | light air (2-3 mph) | smoke drifts slowly |
| 2 | slight breeze (4-7 mph) | leaves rustle; windvane moves |
| 3 | gentle breeze (8-12 mph) | twigs move; flags extended |
| 4 | moderate breeze (13-18 mph) | branches move; dust and paper rise |
| 5 | fresh breeze (19-24 mph) | small trees sway |
| 6 | strong breeze (25-31 mph) | large branches sway; wires whistle |
| 7 | moderate gale (32-38 mph) | trees in motion; walking difficult |
| 8 | fresh gale (39-46 mph) | twigs break off trees |
| 9 | strong gale (47-54 mph) | branches break; roofs damaged |
| 10 | whole gale (55-63 mph) | trees snap; damage evident |
| 11 | storm (64-72 mph) | widespread damage |
| 12 | hurricane (73-82 mph) | extreme damage KABOOM! |

*From Wind: Science Activities in Energy, DOE*

# HOW WIND IS MADE



1. The sun shines on the Earth.



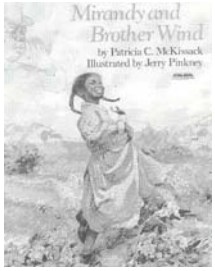
# WIND TRIVIA

1. Europe leads the world in the use of wind power. Ireland is on the verge of building a giant 200-turbine wind farm that will generate about 10 percent of the country's energy needs. In contrast, wind supplies less than one percent of the United States' energy needs.
   *NSTA newsletter, April 3, 2002*

2. Wind power has major potential; one scientist says windmills spread across the Great Plains could furnish half the electrical power for the whole nation.
   *Energy Options for Man quoted in The Best Present of All, National Wildlife Federation.*

# BOOKS ON WIND

***Mirandy and Brother Wind*** by Patricia C. McKissack.
Tomorrow night is Mirandy's first cakewalk, and somehow, some way, she's going to be kicking up her heels with Brother Wind. But how do you catch the Wind? With neighbors up and down Ridgetop suggesting all manner of strategies, and friend Ezel laughing at each foiled one, Mirandy grows ever more determined; she'll get hold of that Brother Wind yet! (Alfred A. Knopf, Inc.) ISBN: 0-394-88765-4




***Gilberto and the Wind*** by Maria Hall Ets
Fanastic introduction to a unit or discussion on wind. Gilberto is a little boy experiencing and playing with the wind (Viking Press, 1963 ) ISBN: 0670340251

# WIND ORGANIZATIONS

**American Wind Energy Association**
122 C. Street, NW, Suite 360
Washington, DC 20001
Phone: 202-383-2500
Fax: 202-383-2505
Email: windmail@awea.org
Web: http://www.awea.org

**Midwest Renewable Energy Association**
7558 Deer Road
Custer, WI 54423
715-592-6595
Fax: 715-592-6596
Email: info@the-mrea.org
Web: http://www.the-mrea.org

**Northeast Sustainable Energy Association**
50 Miles Street, Suite 3
Greenfield, MA 01301
Phone: 413-774-6051
Fax: 413-774-6053
Email: edu@nesea.org
Web; http://www.nesea.org

**Renewable Fuels Association**
One Massachusetts Avenue, N.W., Suite 820
Washington, DC 20001
Phone: 202-289-3835
Fax: 202-289-7519
Email: info@ethanolrfa.org
Web: http://www/ethanolRFA.org

**U.S. Department of Energy**
**National Alternative Fuels Hotline**
9300 Lee Highway
Fairfax, VA 22031
Phone: 1-800-423 IDOE
Phone: 703-934-3069
Fax: 703-934-3183
Email: hotline@afdc.nrel.gov
Web: http://www.afdc.doe.gov

# WIND

## INEXPENSIVE MATERIALS TO ORDER

**WIND TUBE**
Fantastic for teaching the properties of air, Bernoulli's Principle. Windtubes are 8 feet long and 10 inches in diameter. It takes as many as 70 breaths of air to fill a Windtube or as few as one breath if you use Bernoulli's Principle. They can be connected together with simple rubber bands to create space frames. Item #WIN-600. 1 package of 4 tubes. $4.75.

*Educational Innovations*
*362 Main Avenue*
*Norwalk, CT 06851*
*Phone: 1-888-912-7474*
*Fax: 203-229-0740*
*Email: info@teachersource.com*
*Web: www.teachersource.com*

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**RADIOMETER**
This ever popular and intriguing instrument is used to demonstrate solar radiation and the formation of wind. Black and white vanes will turn in a virtual vacuum inside the radiometer when placed in sunlight.#620. $8.95

*Museum Products,*
*84 Route 27,*
*Mystic, CT 06355*
*1-800-395-5400*
*FAX: 860-572-9589 ,*
*Web: www.museumproducts.net*

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**RADIOMETER**

This ever popular and intriguing instrument is used to demonstrate solar radiation and the formation of wind. Black and white vanes will turn in a virtual vacuum inside the radiometer when placed in sunlight. Item #07323W2. $9.95

*School-Tech, Inc.*
*1-800-521-2832,*
*www.schoolmasters.com*

# WIND – RELATED WEB SITES

http://pbskids.org/zoom/sci/windmills.html
**WINDMILLS**
Build a windmill. Use the windmill to lift as many quarters as possible from the floor to the top of a table using a hair dryer.

http://pbskids.org/zoom/sci/puffmobile.html
**PUFF-MOBILE**
Make a car out of 3 straws, 4 Lifesavers, 1 piece of paper, 2 paper clips and 50 centimeters of tape. Race it. Here's the catch: you can only blow on it to make it move!

http://pittsford.Monroe.edu/Jefferson/calfieri/weather/Wind.html
**WIND ENERGY**
When you finish reading this page, you can take a Wind Quiz.

http://www.awea.org/pubs/documents/swslides/toc.htm
**WIND SLIDE SHOW**
AWEA's new small wind slide show can be viewed from your browser in PowerPoint, Acrobat PDF or HTML format (*Webshow*) or downloaded for later use in promotional educational presentations

http://www.brainpop.com/science/seeall.weml
**BRAIN POP MOVIES**
A myriad of online movies at this site, including Energy Sources and Wind,

http://www.freefoto.com/pictures/industry/wind_farm/index.asp
**FREE FOTO.COM**
Pictures of wind farms

http://www.nbt.nl/NBT-amst-get-mills.html
**PICTURES OF WINDMILLS IN HOLLAND**

http://www.ncrtec.org/tl/picture/content.htm
**THE AMAZING PICTURE MACHINE**
Has pictures of all types, including ones on weather and meteorological phenomenon, that can be downloaded.

http://www.nrel.gov/
**NATIONAL RENEWABLE ENERGY LAB HOME PAGE**
This is the National Renewable Energy Laboratory. Want to know how much electricity is provided by wind energy in the U.S.? This is the place to find out. Menus are all graphic-based so be warned.

http://www.nrel.gov/data/pix/
**NATIONAL RENEWABLE ENERGY PHOTOGRAPHIC INFORMATION EXCHANGE**
Search for energy-related pictures such as wind mills and wind farms at this site.

http://www.pbs.org/saf/1109/teaching/teaching2.htm
**FLYING FREE: MAKING A WIND TUNNEL**
Students construct a model of an open jet wind tunnel that uses a household desk fan to produce a flow of air. Using this airflow generator they can test small wings and see the effect of control surfaces.

http://www.presscom.com/windfarms.shtml
**PICTURE OF WIND FARM IN TEHACHAPI, CA**

http://www.scienceonline.co.uk/energy/renewable-energy.html#solar
**PICTURE OF A WIND FARM**

# HYDROPOWER ORGANIZATIONS

**Midwest Renewable Energy Association**
7558 Deer Road
Custer, WI 54423
715-592-6595
Fax: 715-592-6596
Email: info@the-mrea.org
Web: http://www.the-mrea.org

**National Hydropower Association**
One Massachusetts Avenue, NW, Suite 850
Washington, DC 20001
Phone: 202-682-1700
Fax: 202-682-9478
Email; info@hydro.org
Web: http://www.hydro.org

**Renewable Fuels Association**
One Massachusetts Avenue, N.W., Suite 820
Washington, DC 20001
Phone: 202-289-3835
Fax: 202-289-7519
Email: info@ethanolrfa.org
Web: http://www/ethanolRFA.org

**U.S. Department of Energy**
**National Alternative Fuels Hotline**
9300 Lee Highway
Fairfax, VA 22031
Phone: 1-800-423 IDOE
Phone: 703-934-3069
Fax: 703-934-3183
Email: hotline@afdc.nrel.gov
Web: http;//www.afdc.doe.gov

# NATURAL GAS ORGANIZATIONS

**American Gas Association**
400 N. Capitol Street, N.W.
Washington, DC 20001
Phone: (202) 824-7000
Fax: (202) 824-7115
Home Page: http://www.aga.org

**American Petroleum Institute**
1220 L Street, N.W.
Washington, DC 20005
Phone: 202-682-8118
Fax: 202-682-8115
Web: www.api.org
www.classroom-energy.org
http://www.recycleoil.org

**BP**
535 Madison Avenue
New York, NY 10022
212-451-5010
Fax: 212-451-8088
Web: http://www.bp.com

**National Energy Foundation**
Resources for Education
National Office
3676 California Avenue, Suite A117
Salt Lake City, UT 84104
Phone: 801-908-5800
Fax: 801-908-5400
Email: info@nefl.org
Web: http://www.nefl.org

**National Propane Gas Association**
1150 17th Street, N.W., Suite 310
Washington, D.C. 20036
Phone: 202-466-7200
Fax: 202-466-7205
Email: info@npga.org
Web: http://www.npga.org

**Natural Gas Supply Association**
805 15th Street, N.W., Suite 510
Washington, DC 20005
Phone: 202-326-9300
Fax: 202-326-9330
Email: mail@ngsa.org
Web: http://www.ngsa.org

**The Natural Gas Vehicle Coalition**
400 North Capitol Street, N.W.

Washington, DC 20001
Email: kbatte@NGVC.org
Web: http://www.NGVC.org

**Propane Education and Research Council**
1776 K Street, N.W., Suite 204
Washington, DC 20006
Phone: 202-452-8975
Fax: 202-452-9054
Email: info@propanecouncil.org
Web: http://www.propanecouncil.org

**Shell Oil Company**
Corporate Communications
PO Box 2463
Houston, TX 77252
Phone: 713-241-6161
Fax: 713-241-6988
Web: http://www.shellus.com

# BOOKS ABOUT COAL

***A Coal Miner's Bride: The Diary of Anetka Kaminska, Lattimer, Pennsylvania, 1896*** by Susan Campbell Bartoletti

Ages 9 to 12. In 1896 Anetka Kaminska, 13, must leave her Polish village for an arranged marriage with a coal miner in Lattimer, Pennsylvania. Her husband, who was married once before, doesn't love her, and when he's killed in a mining accident a few months after the wedding, she's left to care for his three small daughters and take in boarders to survive. The appalling working conditions in the mines are an integral part of the story and so is the labor struggle for change. (2000) ISBN 0-439-05386-2. A summary of this book and 3 excerpt page can be found at http://www.amazon.com/exec/obidos/tg/detail/-/0439053862/104-3049873-4830353?vi=glance

***A Diamond in the Dust*** by Carla Joinson

Ages 12 and up. Joinson evokes the hardships of life in a turn-of-the-century southern Illinois mining town in this affecting novel. Her 16-year-old heroine, Katy Sollis, knows there must be something better than the grit and terrible dangers of the mines, and she's determined to find it. (2001)

***A Place Called Freedom*** by Ken Follett

Hidden by a Scottish river bank in the winter of 1767, Lizzie Hallim watches a naked figure emerging from the icy water. Mack McAsh is a slave and Lizzie is helping him escape. Mack challenges the mighty Jamisson family, which enslaves whole families to work their mine. Mack soon finds himself wrongly sentenced to death. Rescued from hanging, he is transported to America, where he continues to struggle for freedom... (Crown Publishers, New York 1995) Also published as an audio book by Random House Audio and Chivers Press. ISBN: 0449225151

***Growing Up In Coal Country*** *by Susan Campbell Bartoletti*

Ages 9 and up. Based on personal interviews, newspaper accounts, mining inspection records, and other original sources, a pictorial portrait of life in the Pennsylvania coal mines and ""patch villages"" tells the heartbreaking but life-affirming story of children and adults for whom this region represented a way of life. (1996) A summary of this book can be found at http://www.amazon.com/exec/obidos/tg/detail/-/0395979145/104-3049873-4830353?vi=glance

***How Green Was My Valley*** *by Richard Llewellyn*

This is a classic story, first published in 1940, that chronicles life in a Welsh mining town. The characters deal with life's difficulties with a courage and strength that makes them, and their story, unforgettable.(Simon and Schuster) **ISBN:** 0684825554

***Kit's Wilderness*** *by David Almond*

When thirteen-year-old Kit and his parents go to an old coal mining town in England for his grandfather's funeral, Kit gets involved with a dark boy, named John Askew, who recreates an ancient tragedy in the local coal mines. (Delacorte, 2000) ISBN 0-385-32665-3. Printz Award Winner

***Theodore Roosevelt: Letters from a Young Coal Miner*** *by Jennifer Armstrong*

Part of the Dear Mr. President series. (Winslow Press)

***The Magic Schoolbus Inside the Earth*** **(**drilling for coal and oil) by Joanna Cole.

Ages 4-8. Scholastic Paperbacks, 1989. ISBN: 0-59040-7600

*Together in Pinecone Patch* *by Thomas F. Yezerski*

Keara Buckley's family loves Ireland just as much as Stefan Pazik's family loves Poland, but when terrible hardships force them to leave their respective countries in search of a better life, they wind up in the same place--the dreary coal-mining town of Pinecone Patch, Pennsylvania. The Irish and Polish communities in the small town have a mutual disdain for each other, but when Keara and Stefan fall in love, everyone must learn to live together. Full color. (1998)

***Trapped in the Old Mine*** *by Alvena Seckar*

*A science fiction story for young children. More than 50 years ago, author Alvena Seckar wrote three children's books dealing with the lives of miners and their families; it is striking how many of the same concerns expressed in her books are still relevant today. This book deals with ventilation and respiration problems, dramatized by an actual incident in an abandoned mine shaft (1953). Visit Bolchazy-Carducci Publishers at www.bolchazy.com for more information on this book. For more information or to request review copies contact Marie Bolchazy at latin@bolchazy.com, by phone at(847)526-4344 (x22) or by fax at(847)526-2867*

***Trouble at the Mines*** *by Doreen Rappaport*

*1898 is the year when there was a violent clash between coal mine owners and union workers in Illinois. (Harper, 1987) ISBN 0-690-04445-3*

***Zuska of the Burning Hills*** *by Alvena Seckar*

*Seckar, whose parents were immigrants from Slovakia, and whose father and stepfather were both miners, was born and raised in the coal fields of West Virginia and Pennsylvania. By the time she was 12 years old, Seckar had lived in 22 different mining communities. Seckar says that this book, which describes a Slovak immigrant family living in the soft coal region, is more or less autobiographical. (1952) On New York Times' list of the hundred best books published for children in 1952. Visit Bolchazy-Carducci Publishers at www.bolchazy.com for more information on this book. For more information or to request review copies contact Marie Bolchazy at latin@bolchazy.com, by phone at (847)526-4344 (x22) or by fax at(847)526-2867*

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