Riverside School

Friday, March 12, 1993

Everyone is welcome!

Riverside School Science Day '93
Friday, March 12

Welcome to Science Day!

On Science Day scientists, parents, and teachers bring to Riverside students the excitement of scientific exploration. In this booklet we have written descriptions of the short experiments in the gym and the long experiments in the classrooms. Please check the schedule and browse through the booklet before Science Day to familiarize yourself with the activities for your class. We have included some interesting explanations of the experiments and some activities for you to do at home. Please keep the booklet, read it, do the experiments described, and discover things for yourself.

Who worked on Science Day?

Many people have been busily preparing for Science Day over the past few months. We would like to especially recognize the more than twenty scientists, parents, and teachers who will present experiments in the classrooms. In addition, we would like to extend special thanks to Karen Fuchs for coordinating Science Day, to Michael Littman for designing and supplying the short experiments, to Maureen Quirk for editing and producing this booklet, to Monica Vildostegui for organizing the army of parent volunteers to run the short experiments,to Ann Marie Agnello for running the book sale, to Libby Ramage for the illustrations, to Ken Wilkie for the front cover, to Wendy Jolley for organizing lunch, and to Christine Finkelstein for doing the newspaper publicity.

Thank you,

Riverside Science Day Committee '93

Parents: Don't forget the Science Day Book Sale!

8:15 AM – 3:30 PM

Students: Don't forget to bring your dime on Friday!

Riverside School

Science Day Schedule - March 12, 1993

Class	R#	Grade	8:50-9:30 *40 min.*	9:40-10:20 *40 min.*	10:30-11:00 *30 min.*	11:00-11:20 *20 min.*	11:30-12:00 *30 min.*	12:00-12:20 *20 min.*	12:30-1:10 *40 min.*	1:15-1:55 *40 min.*	2:00-2:40 *40 min.*
Bruschi	1	K	SL	Wetherald	Fisch (until 11:10)		X	X	Lunch	Recess	X
DeVeaux	3	K	SL	Fisch	X	X	Wetherald (at 11:20)		Lunch	Recess	X
Lang	2	K	SL	X	Wetherald (until 11:10)		Fisch (at 11:20)		Lunch	Recess	X
Everitt	6	1	Messersmith	SL	X	Lunch	Recess	Wilkinson(until 12:40)		Goodman (at 12:50)	X
Kanter	11	1	Wilkinson	SL	X	Lunch	Recess	Goodman (until 12:40)		Messersmith (at 12:50)	X
Woods	8	1	Goodman	Wilkinson	X	Lunch	SL at 11:40	SL	Vanderbilt	Messersmith (at 1:40)	
Donlon	16	2	Wieschaus	Feigenson	SL	SL	Lunch	Recess	Hagadorn	Neumann	X
Hagadorn	10	2	Neumann	Wieschaus	SL	SL	Lunch	Recess	Feigenson	Wilkie	Hagadorn
Johnson	9	2	Feigenson	Neumann	Wieschaus (until 11:10)		Lunch	Recess	SL	Hagadorn	X
Bonette	12	3	Smyth	Wilkie	Dahlen(until 11:10)		Gurk (at 11:20)	Lunch	SL	X	X
Moore	14	3	Colihan	Smyth	Gurk (until 11:10)		Dahlen(at 11:20)	Lunch	Recess	SL	X
Paris	15	3	Dahlen	Gurk	Smyth (until 11:10)		Woods (at 11:20)	Lunch	Recess	SL	X
Findley	19	4	Zimmerman	Stearns	X	X	SL	SL	Lunch	Turner	Golding
Murray	21	4	Wilkie	Golding	X	X	Daglish (at 11:40)		Lunch	Vanderbilt	SL
Rosendorf	17	4	Golding	Bonette	X	Stearns (at 11:20)		X	Lunch	Daglish	SL

Wetherald-Weather
Fisch - Archimedes
Messersmith - Shadows
Wilkinson - Bubbles
Goodman - Sundials

Wieschaus - Biology
Newman - Math Games
Feigenson - Geology
Hagadorn - Plants
Wilkie - Size of Earth

Smyth - Density
Colihan - Structures
Woods - Structures
Zimmerman - Structures
Dahlen - Neptune, Jupiter

Golding - Optical Illusions
Stearns - Properties of Matter
Bonette - Magic Eggs
Daglish - Snakes
Vanderbilt - Oscillatory Motion

Turner - Planet Distances
Gurk - Satellites

SHORT EXPERIMENTS

There will be eight tables presenting activities in each of the following areas:

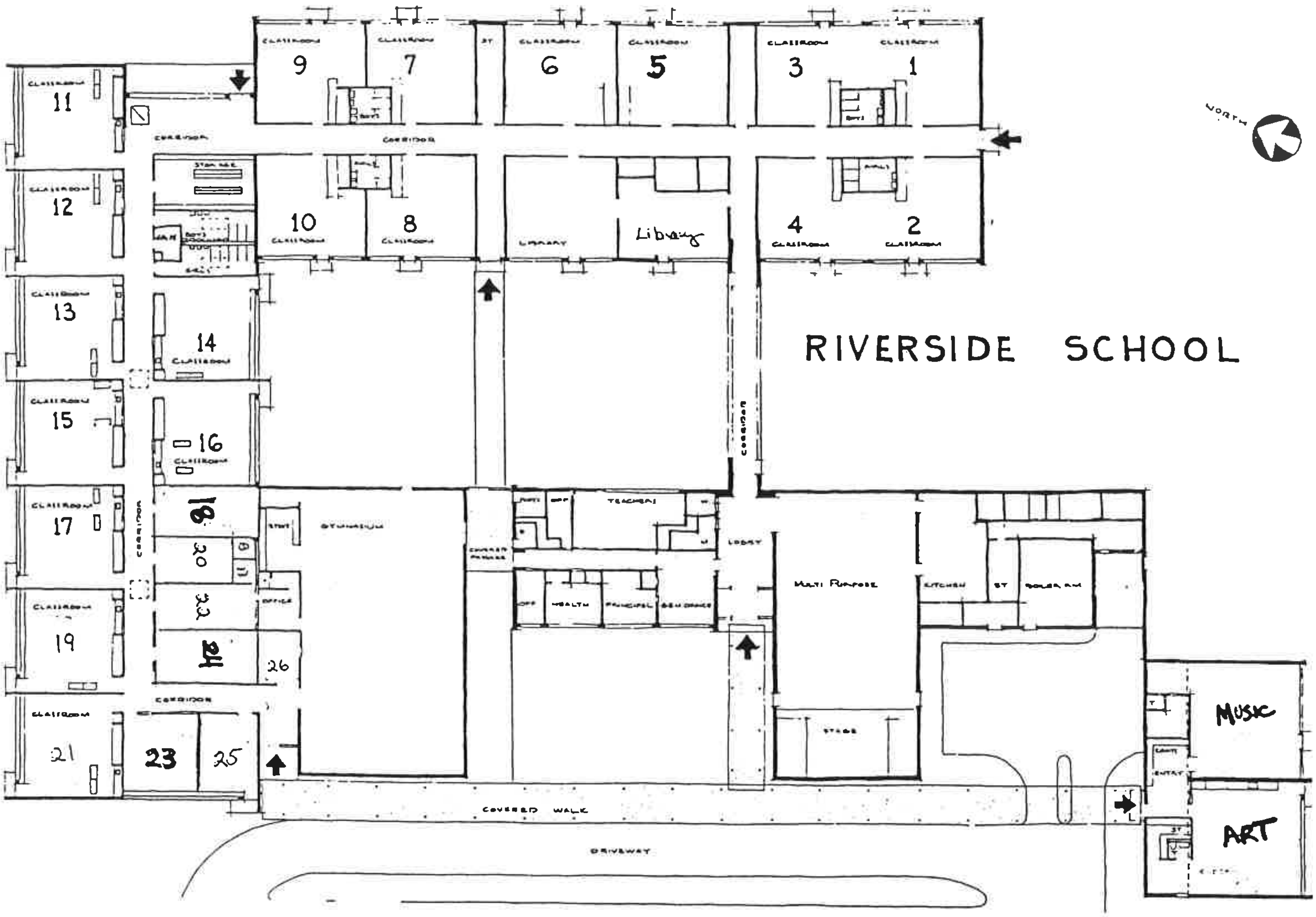
1.	COMPUTERS:	My Name in Binary Code. How Big Is a Bit?
2.	ENGINEERING:	Screw It Up! Stop That Ball!
3.	ELECTRICITY & MAGNETISM:	Rings of Magnetism. Vibrating Wires.
4.	CHEMISTRY:	Give a Dime a Penny Coat. Make Water Burn!
5.	GEOLOGY:	Do Rocks Glow in the Dark?
6.	OPTICS:	A Camera Without Lenses? Make a Blueprint.
7.	MATH:	Take a Chance!
8.	HUMAN BIOLOGY:	Mr. Kneejerk–What a Kick! Are The Colors Real?

The Geology display was set up by John and Nancy Jones. All of the other activities were designed by Michael Littman and set up with the help of Steve Carson and Luigi Martinelli.

LONG EXPERIMENTS

1.	Archimedes' Principle	Nat Fisch	K
2.	Clouds, Storms, and Rainbows	Dick Wetherald	K
3.	Shadows	Jim Messersmith	1
4.	Sundials: Shadows in Motion	Jeremy Goodman and Maureen Quirk	1
5.	Bubbles	David Wilkinson	1
6.	Oscillatory Motion	David Vanderbilt	1, 4
7.	The Life Cycle of Plants	Adele Hagadorn	2
8.	Volcanoes and Minerals	Mark Feigenson	2
9.	Square and Rectangular Numbers and the Sieve of Eratosthenes	Ann Neumann and Walter Neumann	2
10.	Development in Animals and Plants	Eric Wieschaus, Tom Vogt	2
11.	The World Through the Eyes of Eratosthenes	Ken Wilkie	2, 3, 4
12.	Jupiter, Saturn, Uranus, and Neptune	Tony Dahlen	3
13.	Space Programs and Their Applications	Herbert M. Gurk	3
14.	Density and Miscibility	Natalie Smyth	3
15.	How Big Is the Solar System?	Joyce Turner	4
16.	Silent Structures	Jan Woods, Karen Colihan, and Jen Zimmerman	3, 4
17.	Properties of Matter in Cold Liquid Nitrogen	Carole Stearns	4
18.	Magic With Eggs	Andrea Bonette	4
19.	Illusions: What you see is what you don't get.	Agnes Golding and Lois Gretzinger	4
20.	Snakes!	Jerry Daglish	4

The illustrations are by Elizabeth Ramage. The front cover is by Ken Wilkie. This booklet was printed courtesy of the Center For Communications Research, Princeton, New Jersey.



Long Experiment Room Assignments

Presenter	Room
David Wilkinson and Don Alvarez	Art
Eric Weischaus and Tom Vogt	Music
Agnes Golding and Lois Gretzinger	5
Ken Wilkie	13
Mark Feigenson	23

All other presenters will come to the individual classrooms. If room assignments change, you will be notified on Science Day.

1. COMPUTERS

The COMPUTER activities show how letters (**A**, **a**, **B**, **b**, **C**, **c**, . . .) and symbols (**#**, **$**, **%**, . . .) are stored in a computer memory, and how much space is need to store information on a floppy disk.

KEY WORDS AND DEFINITIONS:

BIT – A short name for binary digit.

BINARY NUMBER – a number in base 2, it uses only 1 and 0.

BYTE – An 8-digit binary number, for example, 01101100.

CHIP – An integrated circuit that is the building block used to make computers.

YOUR NAME IN BINARY CODE – TO DO AND OBSERVE:

Write the letters of your name in the boxes provided. For example, if your name is JANE, then write:

[J] = 01001010
[A] = 01000001
[N] = 01001110
[E] = 01000101

Copy the binary code from the table. This is the code that the computer would use to store your name.

WHAT IS GOING ON HERE?

ASCII stands for American Standards Code for Information Interchange. It is the name of a code used by computers to represent letters and symbols like A, B, C, $, or %. Before there were computers, a popular code used in telegraphs and radios was Morse Code. In Morse Code a collection of short or long bursts known as "dits" or "dahs" were used to represent letters or symbols. For instance, the code [· · · — — — · · · (dit dit dit, dah dah dah, dit dit dit)] meant SOS which is short for SAVE OUR SHIP. This is an international distress call.

Computers work with binary numbers. Binary numbers are made up of binary digits known as "bits" for short and these have values 0 or 1. ASCII code uses 8 bits (known as a byte) to represent letters or symbols. Even the space between words has its own ASCII code. A table of ASCII code is given on the next page. By the way, SOS in ASCII code is 01010011, 01001111, 01010011.

BINARY ASCII CHARACTER CODES

<table>
<tr><td>space = 00100000</td><td>@ = 01000000</td><td>` = 01100000</td></tr>
<tr><td>! = 00100001</td><td>A = 01000001</td><td>a = 01100001</td></tr>
<tr><td>" = 00100010</td><td>B = 01000010</td><td>b = 01100010</td></tr>
<tr><td># = 00100011</td><td>C = 01000011</td><td>c = 01100011</td></tr>
<tr><td>$ = 00100100</td><td>D = 01000100</td><td>d = 01100100</td></tr>
<tr><td>% = 00100101</td><td>E = 01000101</td><td>e = 01100101</td></tr>
<tr><td>& = 00100110</td><td>F = 01000110</td><td>f = 01100110</td></tr>
<tr><td>' = 00100111</td><td>G = 01000111</td><td>g = 01100111</td></tr>
<tr><td>(= 00101000</td><td>H = 01001000</td><td>h = 01101000</td></tr>
<tr><td>) = 00101001</td><td>I = 01001001</td><td>i = 01101001</td></tr>
<tr><td>* = 00101010</td><td>J = 01001010</td><td>j = 01101010</td></tr>
<tr><td>+ = 00101011</td><td>K = 01001011</td><td>k = 01101011</td></tr>
<tr><td>, = 00101100</td><td>L = 01001100</td><td>l = 01101100</td></tr>
<tr><td>- = 00101101</td><td>M = 01001101</td><td>m = 01101101</td></tr>
<tr><td>. = 00101110</td><td>N = 01001110</td><td>n = 01101110</td></tr>
<tr><td>/ = 00101111</td><td>O = 01001111</td><td>o = 01101111</td></tr>
<tr><td>0 = 00110000</td><td>P = 01010000</td><td>p = 01110000</td></tr>
<tr><td>1 = 00110001</td><td>Q = 01010001</td><td>q = 01110001</td></tr>
<tr><td>2 = 00110010</td><td>R = 01010010</td><td>r = 01110010</td></tr>
<tr><td>3 = 00110011</td><td>S = 01010011</td><td>s = 01110011</td></tr>
<tr><td>4 = 00110100</td><td>T = 01010100</td><td>t = 01110100</td></tr>
<tr><td>5 = 00110101</td><td>U = 01010101</td><td>u = 01110101</td></tr>
<tr><td>6 = 00110110</td><td>V = 01010110</td><td>v = 01110110</td></tr>
<tr><td>7 = 00110111</td><td>W = 01010111</td><td>w = 01110111</td></tr>
<tr><td>8 = 00111000</td><td>X = 01011000</td><td>x = 01111000</td></tr>
<tr><td>9 = 00111001</td><td>Y = 01011001</td><td>y = 01111001</td></tr>
<tr><td>: = 00111010</td><td>Z = 01011010</td><td>z = 01111010</td></tr>
<tr><td>; = 00111011</td><td>[= 01011011</td><td>{ = 01111011</td></tr>
<tr><td>< = 00111100</td><td>\ = 01011100</td><td>| = 01111100</td></tr>
<tr><td>= = 00111101</td><td>] = 01011101</td><td>} = 01111101</td></tr>
<tr><td>> = 00111110</td><td>^ = 01011110</td><td>~ = 01111110</td></tr>
<tr><td>? = 00111111</td><td>_ = 01011111</td><td>DEL = 01111111</td></tr>
</table>

Write your name in binary ASCII code here:

HOW BIG IS A BIT? – TO DO AND OBSERVE:

Look at the disk and then look at it under the microscope. Do you see any patterns? You should see lots of circles, one inside the other. The circles are broken into 9 sections. These sections line up and make the disk look a bit like a slice of an orange.

WHAT IS GOING ON HERE?

A floppy disk stores bits (0's or 1's) by magnetizing little regions of iron-oxide that cover the surface of a flexible disk. We have sprinkled this disk with iron dust that sticks to the magnetized spots, just like iron filings stick to a bar magnet. You can see that the data on this disk is written in 39 circles. These circles are called cylinders. Each circle is divided in to 9 sections. These sections are called sectors. The sections line up so that the disk looks like a wheel with spokes. How big is a bit on a disk? Each section of each circle holds 4096 bits. A bit doesn't take up very much space! Did you know that 4096 bits is just about the right number of bits to store the first and last names of everyone in your class? How many bits are on this disk? There are 4096 in a sector, 9 sectors in a cylinder, and 39 cylinders. If we multiply all three numbers we get 1,437,696. How can we store almost 3 million bits on this disk? Use both sides! People who use computers like to measure things in bytes which are groups of 8 bits. They would say that about 360,000 bytes could be stored on this disk. How do they get this number? Try multiplying 1,437,696 by 2 for both sides then divide by 8 and round to the nearest thousand.

TO DO AND OBSERVE:

Look at the memory chip under the microscope. Push the button to see the data (numbers or letters) stored in the chip.

TO DO AND OBSERVE:

This chip, known as an EPROM, stores the entire Riverside Directory. Push the button and write down each of the binary numbers that appears between the byte 00100000 and when it appears again. 00100000 is the code for the space character which separates all of the names in the Directory. Whose name did you get?

WHAT IS GOING ON HERE?

The chip known as an EPROM can be used to store data, like the names in the Riverside Directory, or it can be used to store programs such as the game programs that are stored in the Nintendo cartridges. By pushing the button you are stepping through the entries in the EPROM.

2. ENGINEERING

The two activities in ENGINEERING demonstrate tools that are used in building things. You will use a tapered tap to cut a screw thread in bakelite, and you will use a water level to get a long board level.

KEY WORDS AND DEFINITIONS:

TAP – A sharp tool that cuts screw threads in materials.

PILOT OR TAP HOLE – The positioning hole that is drilled before the tap is used.

LEVEL – A tool that is used to see if a straight edge or a flat surface is level. A flat surface is either level or inclined (tipped). If it is level then all corners of the flat surface are at the same height above the center of the earth. A marble on a level surface will stay put if placed at rest anywhere on the surface. A marble on an inclined surface will roll towards the lowest point.

SCREW IT UP! – TO DO AND OBSERVE:

Drill a pilot hole in the bakelite. Tap a thread in the bakelite by twisting the tap (which is held in a wrench) clockwise. Unscrew the tap when you reach bottom.

WHAT IS GOING ON HERE?

A tap is a tool that machinists use to cut screw threads on the inside of a hole drilled in metals, plastics, or other machinable materials. The cutting edge of the tap is like a very sharp screw that scrapes away material as it threads itself deeper and deeper into a predrilled hole. The end of the tap is tapered so that, at first, only a small amount of material is removed. The tap itself is harder than the material it is cutting. The tap that you will use to cut a screw thread in bakelite is made of tempered steel, the same material used in the strongest locks. You will make a 1/4–20 screw thread. This size thread means that the screw is 1/4 inch in diameter and that there are 20 threads for every inch.

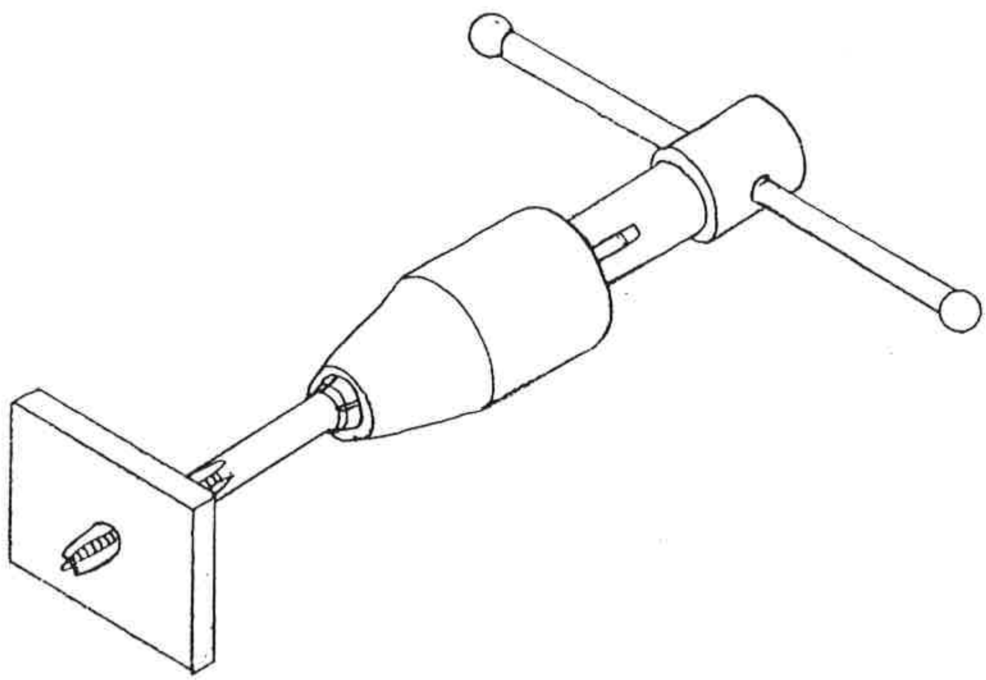
If you were cutting into steel you would have to alternate between clockwise twists and counter-clockwise twists to break-off little bits of metal as the tap works its way down to the bottom of the hole. Also for steel, you would have to use lots of oil on the tap to keep it cool and sharp as it cuts.

STOP THAT BALL! – TO DO AND OBSERVE:

Turn the board on edge and rest one end on a table. Try to balance the ping-pong ball. It is not easy, is it? Now look at the water-filled tube. Adjust the end of the board so that the top of the water in the tubing matches the top of the board at each end. (You may have to add or remove water to do this.) Does the ping-pong ball stay in place? It should, because the water level helps you to match the height of each end of the board.

WHAT IS GOING ON HERE?

Water, or any liquid, likes to balance itself so that the surface everywhere is at the same height above the center of the earth. Think of this tube filled with water as a one pool with two surfaces. If one surface were above the other, then water would flow through the tube so that the heights were the same. In order for this to work, however, both ends of the tube must be open to the air. Levels of this type have been used by builders for thousands of years.



3. ELECTRICITY AND MAGNETISM

The activities in the area of ELECTRICITY AND MAGNETISM show that moving charges (currents) produce magnetism. You will see the effect of a current on a grid of pocket compasses and you will use a varying current to cause a wire to vibrate.

KEY WORDS AND DEFINITIONS:

ELECTRICITY AND MAGNETISM – Basic forces in nature associated with electric charges and magnets.

CHARGE – An electrical property of the building blocks of matter such as electrons and protons. Electrons have negative charge and protons have positive charge. The amount of charge represents the strength of the attraction between positive and negative charges, and the strength of the repulsion between unlike charges (negative—negative or positive—positive). Some building blocks, like neutrons, have zero charge.

MAGNETS – Magnetism is also a property of the building blocks of matter. The electrical strengths of protons and electrons are equal, but of opposite type. However, the magnetic strength of an electron is about 2000 times larger then the magnetic strength of a proton. The neutron also has a weak magnetic strength close to that of the proton. Because the magnetic strength of protons and neutrons are so small relative to that of electrons, it is the lining up of the electron magnets that causes materials like lodestone to be magnetic. All magnets, big or small, including the electron, proton, and neutron, have a North pole and a South pole.

NORTH AND SOUTH POLES – The North and South poles of magnets are so named because they are the ends of the magnet that are attracted the Earth's North and South magnetic poles.

RINGS OF MAGNETISM – TO DO AND OBSERVE:

Before you attach the wire to the battery look at the compasses. Where do they point? Attach the wire to the battery and look at the compasses again. Where do they point now? They should be pointing in a circle about the wire. Now reverse the leads on the battery. What happens? You should see the compass needles reverse direction.

WHAT IS GOING ON HERE?

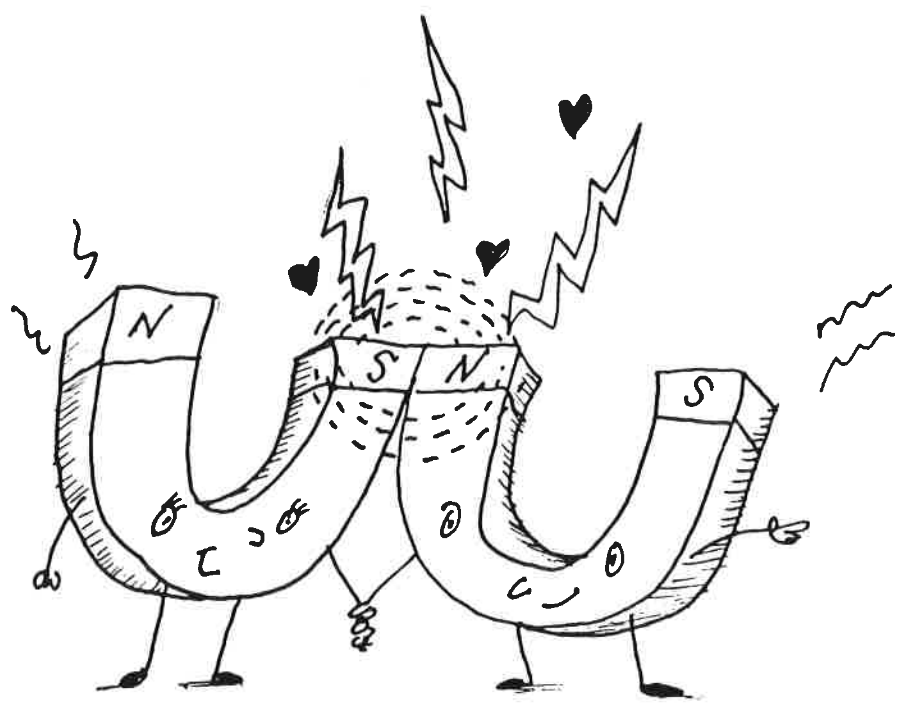
A current flowing in a wire turns it into a circular magnet. If the wire is coiled, the effect is to have the circular magnet for each coil add to the previous one, producing a stronger magnet.

VIBRATING WIRES – TO DO AND OBSERVE:

Apply a current to the wire. What happens? You should see the wire move. Try again with the signal generator. Can you get the wire to vibrate strongly?

WHAT IS GOING ON HERE?

The current in the wire produces a circular magnet which attracts or repels the permanent one. When we use a vibrating current, the wire vibrates. A speaker works the same way. A wire allows current to flow in a (voice) coil which is attracted or repelled by the permanent magnet which is part of the speaker.



4. CHEMISTRY

Both CHEMISTRY activities use electricity. In one activity you will cover a dime with a thin coating of copper extracted from a penny by a process known as electroplating. In another activity you will break down water into its elements (hydrogen and oxygen) by a process known as electrolysis.

KEY WORDS AND DEFINITIONS:

ELECTROLYSIS – Making chemical changes by passing electric current through an electrolyte.

ELECTROLYTE – Nonmetallic electric conductors in which ions carry the current.

CONDUCTOR – A material which carries electric current.

ION – A charged atom or molecule. Ions are atoms or molecules having either more or fewer electrons than protons. Atoms, molecules, and ions are made up of protons, electrons and neutrons.

ELECTROPLATING – Depositing a substance on an electrode by electrolysis.

ELECTRODE – A conductor, usually metal, used to connect to an electrolyte.

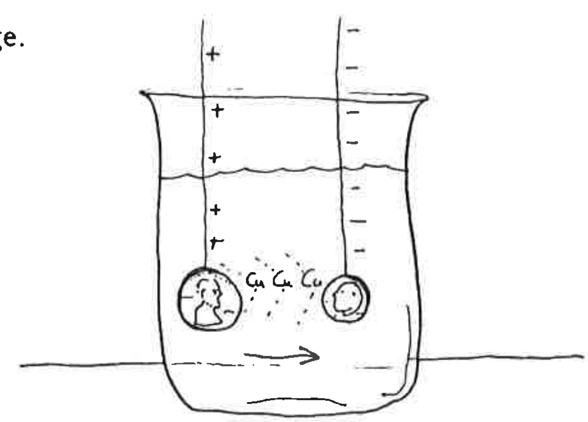
ELECTRIC CHARGE – A property of matter. Positive charges repel one another, so do negative charges. Positive charges are attracted to negative charges.

ELECTRIC CIRCUIT – The complete path of electric current including the source of electric energy.

ELECTRIC CURRENT – Flow of electric charge.

ELECTROPLATE – TO DO AND OBSERVE:

Attach the dime to the negative electrode and place it in the solution of $CuSO_4$. Attach the penny to the positive electrode. Watch as the dime changes its appearance as it is coated with a thin layer of copper.



WHAT IS GOING ON HERE?

In solution, $CuSO_4$ breaks apart into Cu^{++} and SO_4^{--} ions. If you put electrodes in the solution, Cu^{++} ions drift to the negative electrode (the dime), and combine with electrons from the battery to make copper atoms. Copper atoms like to stick to other metals, and so they stay attached to the dime. At the other electrode the SO_4^{--} ions drift and combine with copper from that electrode (the penny) making $CuSO_4$ molecules, and give up their extra negative charges (electrons) to this electrode. The electrons are then 'pumped' by the battery over to the other electrode. The $CuSO_4$ molecules like to dissolve, so the penny shrinks over time and needs to be replaced. Note that the penny loses the same number of copper atoms as the dime gains.

ELECTROLYSIS: TO DO AND OBSERVE:

Turn the crank on the ping-pong rocket and watch how bubbles form at each electrode. Is there the same amount of gas at both electrodes? There should be twice as much gas at one electrode than at the other. When there is enough gas, turn the control knob to the right and the ping-pong ball should go flying up in the air.

WHAT IS GOING ON HERE?

Each Water molecule is made up of 2 Hydrogen atoms and 1 Oxygen atom. Why do you think Scientists usually write H_2O for water? In liquid water, some of the H_2O naturally breaks apart into H^+ and OH^- molecules. The $+$ sign means that there is a positive charge and the $-$ sign means there is a negative charge. These charged particles, called ions, usually drift around, find each other and recombine to make water (H_2O). However, if there are positive and negative electrodes nearby, then the H^+ wanders to the negative electrode where it gets an electron, a $-$, to make an H atom. The $-$ from the electron cancels the $+$ from the H^+. Before traveling very far away from this negative electrode, the H atom will usually bump into another H atom and form H_2, or Hydrogen gas. H_2 is a stable gas that bubbles out of solution. At the positive electrode, OH^- combines with OH^- and forms $H_2O + O$. Only one Oxygen atom was needed for every two Hydrogen atoms, so there is some Oxygen left over. The two $-$'s (electrons) are also left over and these extra electrons are grabbed by the positive electrode and pumped by the battery over to the negative electrode. The O atoms which are left over here, bump into other O atoms and form O_2 which is a stable gas, and this, too, bubbles up out of solution. Did you know that we actually need 4 H_2O molecules to make one O_2 molecule? This switching of atoms and charges from one molecule to another is very confusing, so Chemists like to write little equations to keep track of things. They would write this whole explanation as:

$$4H_2O \rightarrow 4OH^- + 4H^+ \rightarrow 2H_2 + O_2 + 2H_2O$$

This means that first the 4 H_2O molecules form 4 OH^- and $4H^+$ ions, then these ions form 2 H_2 molecules and 2 H_2O molecules, but only 1 O_2 molecule. This is why there is twice as much Hydrogen gas as Oxygen gas. In the electrolysis experiment the products, O_2 and H_2, come out as gases which are the breaking down of the water electrolyte. In contrast, in electroplating the action was to move copper from one electrode to the other. When you turn the knob on the ping-pong rocket, you are combining 1 part O_2 with 2 parts H_2 and burning the mixture which forms H_2O plus energy (heat and noise). You have just made water burn!

5. GEOLOGY

The activity in the area of GEOLOGY is a display of different rocks and minerals, including igneous, sedimentary, and metamorphic rocks and a variety of minerals. Certain rocks, known as fluorescent rocks emit a red or green color only under ultraviolet light. There will also be petrified wood and fossils of leaves and fish.

KEY WORDS AND DEFINITIONS:

GEOLOGY – The study of the history of the earth and its life and the rocks which record this history. the earth's North and South poles.

FLUORESCENT ROCKS – Rocks which glow in the dark when ultraviolet light shines on them.

FOSSIL – Remains or traces of ancient animals or plants preserved in rocks.

IGNEOUS ROCKS – Rocks formed from molten rock (magma) like the lava that comes out of volcanoes.

METAMORPHIC ROCKS – Rocks whose mineral composition, structure, or texture have been changed by heat and pressure working beneath the Earth's surface.

MINERAL – The individual substances that make up rocks. Minerals have a unique chemical formula and can form crystals.

SEDIMENTARY ROCKS – Rocks formed by deposits of material laid down at the bottom of lakes or oceans and hardened into rock.

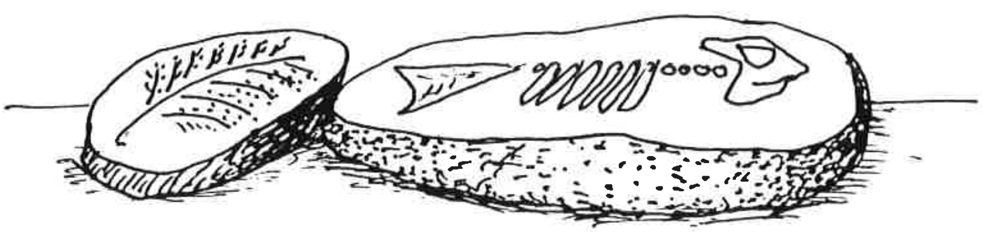
ULTRAVIOLET – Light whose color we can not see (it's beyond violet).

DO ROCKS GLOW IN THE DARK? – TO DO AND OBSERVE:

Look at the different colors, textures, and shapes of the rocks. Do you see any crystals? Do all the crystals have the same number of sides? What colors are the fluorescent rocks producing?

WHAT IS GOING ON HERE?

When the ultraviolet light shines on the fluorescent rocks they turn this invisible light into visible light with colors we can see. This is the same thing that happens in fluorescent light bulbs.



FOSSILS

6. OPTICS

Both OPTICS activities are related to photography. In one activity you will test a pinhole camera that uses a tiny hole instead of a lens to form a clear image on a screen made up of tissue paper. In another activity you will make a blueprint from an original drawing that you make on tracing paper.

KEY WORDS AND DEFINITIONS:

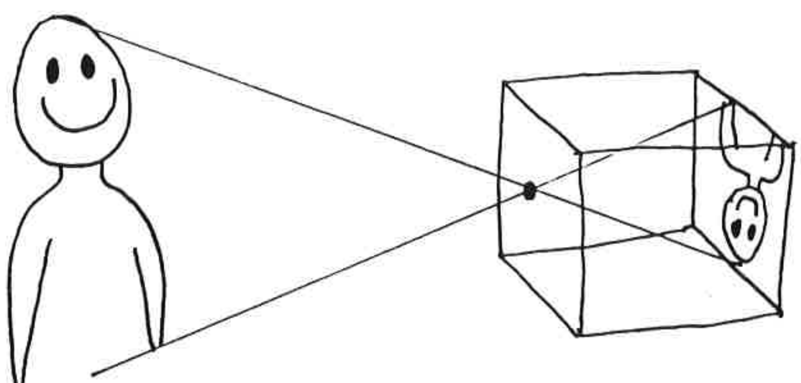
CAMERA – From the Latin word meaning room or chamber. A light-proof box fitted with a lens which forms an image on a light-sensitive film.

PINHOLE CAMERA – A camera that uses a small hole instead of a lens.

BLUEPRINT – A photographic print used especially for copying maps, drawings, and architects' plans.

A PINHOLE CAMERA – TO DO AND OBSERVE:

Place the arrow mask (which is taped to the face of a photoflash) a short distance in front of the pinhole camera and fire the photoflash. What did you see? Did you notice that the arrow appeared upside down on the screen? Try the flash again with the mask at twice the distance from the camera. Does the arrow change? You should see the arrow getting smaller.



PINHOLE CAMERA

WHAT IS GOING ON HERE?

Light travels in a straight line. In the pinhole camera, light from the arrow must pass through the hole to reach the screen so that each point on the screen can be reached from only one point on the arrow. The pinhole camera is always in focus and the size of the image is determined by the distances between the object that we are trying to image, the pinhole, and the screen. If the object is the same distance from the pinhole as the screen, then the image is the same size as the object, only it is upside down. Lenses are used in photographic cameras because they make brighter images by using larger holes. Unfortunately, the use of lenses requires certain distances between the object, the image, and the lens. If the distances are not exactly right, the image is out-of-focus.

MAKE A BLUEPRINT – TO DO AND OBSERVE:

Draw a picture on the piece of tracing paper. With the help of an adult, match it face-to-face with a piece of blueprint paper. Feed it into the machine and get your copy.

WHAT IS GOING ON HERE?

The blueprint paper is coated with a light-sensitive chemical compound known as a diazo. The diazo is slightly yellow in color. Light causes the diazo compound to break apart. Ammonia vapor (NH_3) reacts with the chemicals on the paper. (Ammonia is a common household cleaner – it is especially good for cleaning glass.) The ammonia causes the diazo to turn blue and the broken down diazo products to turn clear. After treatment with ammonia, the print is stable for several years. The diazo process was invented more than 100 years ago and it is still in use today because it is very inexpensive and simple.

7. MATHEMATICS

Both MATHEMATICS activities involve probability. In one experiment you will roll one die and figure out how frequently any given number comes up. In another experiment you will figure out how often the sum total of the face value of both dice comes up.

KEY WORDS AND DEFINITIONS:

MATHEMATICS – The science of numbers and their operations.

PROBABILITY – From the Latin word to prove or test–a branch of mathematics concerned with determining the likelihood of outcomes when results are not known with certainty.

STATISTICS – A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of numerical data.

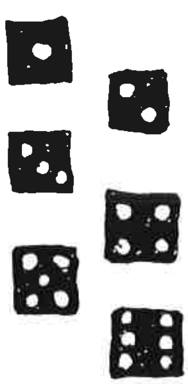
DATA – Factual information used as a basis for reasoning, discussing, or calculating.

TAKE A CHANCE! – TO DO AND OBSERVE:

Throw a die and record in the table with a check mark the number you obtain. Repeat this eleven more times. Add your results to the counters for each number. Which numbers did you get most often? Least often? Which numbers did your group get most often? Least often? Your group counts will be added to the big chart which keeps track of the totals for the whole school. How do your group's numbers agree or disagree with the big chart? Notice that the numbers on the big chart are all roughly same for each number. On average, you are equally likely to get any number when you throw the die.

WHAT IS GOING ON HERE?

How many sides are there on the die? Six, right! Since the die is a regular solid when you throw it, all sides have the same likelihood of coming up. So you would expect that the frequency of any one number (1, 2, 3, 4, 5, or 6) would be the same as the frequency of any other. This happens, however, only when you make many, many tests.



Number	Tally Marks	Your Total	School Total
1			
2			
3			
4			
5			
6			

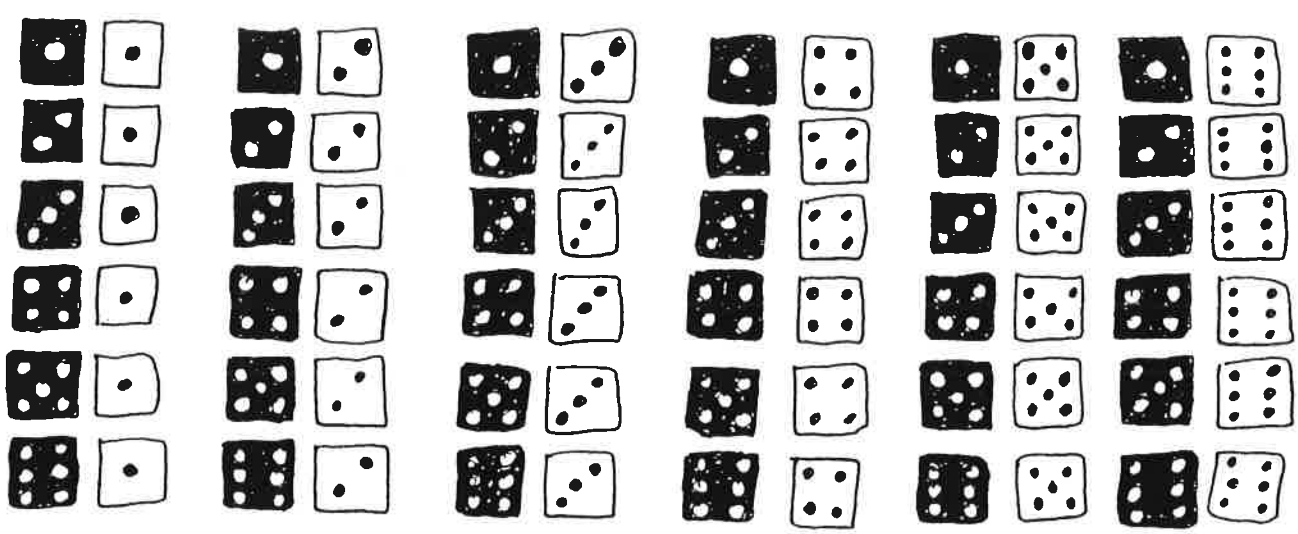
TO DO AND OBSERVE AT HOME:

Throw two dice and enter their sum total on the table. Repeat this 143 more times. Add your results for each sum. Notice that rolling a 7 is six times as likely as rolling a 2 or a 12.

WHAT IS GOING ON HERE?

We have just learned that all numbers are equally likely when we throw one die. This means that if we throw two dice, all pairs of values are equally likely. But what if we add the two values? Since there are six pairs which add up to 7, but only one pair which adds up to 2, getting a seven is 6 times more likely as getting a 2. The number of ways of getting each possible sum is shown in the chart below. The number of times each sum is actually obtained will be roughly proportional to the numbers in the chart after many trials.

Dice Sum	Total # of Ways to Obtain Sum	Possible Combinations	Your Tally Marks
2	1	(1+1)	
3	2	(1+2, 2+1)	
4	3	(1+3, 3+1, 2+2)	
5	4	(1+4, 2+3, 3+2, 4+1)	
6	5	(1+5, 2+4, 3+3, 4+2, 5+1)	
7	6	(1+6, 2+5, 3+4, 4+3, 5+2, 6+1)	
8	5	(2+6, 3+5, 4+4, 5+3, 6+2)	
9	4	(3+6, 4+5, 5+4, 6+3)	
10	3	(4+6, 5+5, 6+4)	
11	2	(5+6, 6+5)	
12	1	(6+6)	



8. HUMAN BIOLOGY

The activities in the area of HUMAN BIOLOGY involve reflexes and illusions. In one activity you will tap the knee of a skeleton with a doctor's hammer and watch the leg kick out, just as your own leg does when a doctor taps your knee. In another activity you will spin a black and white disk and see colors–are they real or imaginary? In a final activity you will stare at a spinning disk that will trick your eyes into thinking that you are moving–when you look at another object it will appear to move even though it is not.

KEY WORDS AND DEFINITIONS

REFLEX – An automatic reaction to something we sense.

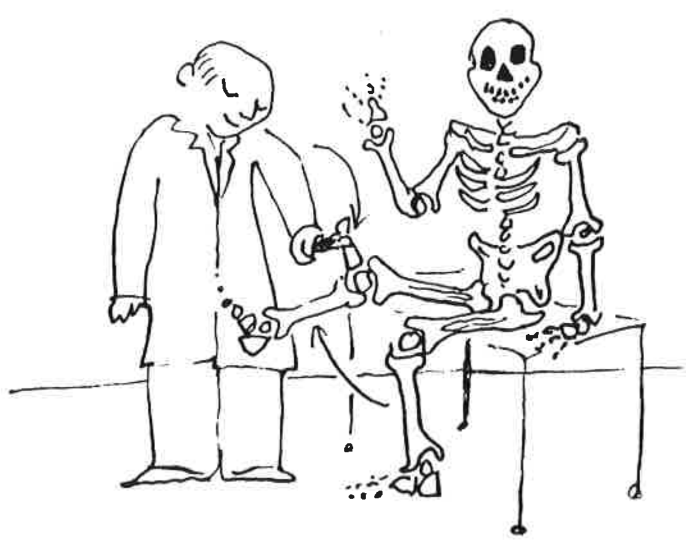
SPINAL CORD – An extension of your brain that turns into a bundle of nerves inside your spine (backbone).

STIMULUS – An action or event that causes one of your senses to be activated. For example, a tap on the knee is a stimulus which activates your sense of touch and location.

ILLUSION – When we think something exists or is happening but it turns out that we are mistaken, we refer to that as an illusion. Illusions are tricks played on the mind that teach us about the brain and how it collects and organizes information.

MR. KNEEJERK–WHAT A KICK! – TO DO AND OBSERVE:

Tap the knee of the skeleton. Watch the leg kick out.



WHAT IS GOING ON HERE?

When the knee is tapped, the muscle on top of the leg (the quadriceps) is stretched. Muscle sensors in the muscle are also stretched and these send electrical signals to the spinal cord. The spinal cord reflects these signals back to the muscle telling it to shorten. The shortening of the muscle causes the leg to kick out. Doctors use reflexes to test whether our spinal cords are okay. Do not be alarmed, however, if you do not have strong reflexes– some people's reflexes are hard to excite.

ARE THE COLORS REAL? – TO DO AND OBSERVE:

Spin the disk (known as Benham's disk) slowly. Watch the colors form. Are they real or imaginary?

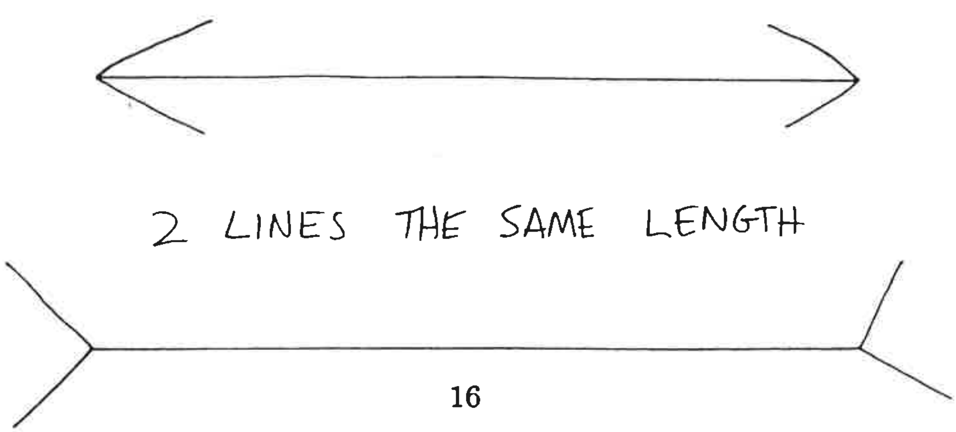
WHAT IS GOING ON HERE?

No one really knows for sure. We do know that the colors are only in our mind–they are not real. The color sensors in the retina (the inside of the back of your eye) are called cones and these are sensitive to red, green, and blue. Possibly, the imaginary colors are due to the fact that the cones respond at different speeds, but this is only a guess.

TO DO AND OBSERVE:

Stare at the spinning spiral disk for 30 seconds. Look straight in the middle and imagine that you are traveling down a subway tube painted with stripes on the side. When the disk stops, look at the picture of the train. Does it appear to move? Is it moving towards you or away?

WHAT IS GOING ON HERE? Your retina adapts to motion. When you have been moving, your eyes expect things to move. The disk tricks your eyes into thinking that you are moving even though you are not. When you then look at an object that is not moving your eyes become confused and force you to guess that the object is moving in the opposite direction than you thought you were moving. The movement you see is not real–it is an illusion.



1. ARCHIMEDES' PRINCIPLE

Nat Fisch

WEIGHT – What is **weight**? Some things are heavier than other things even if they are smaller. They feel heavier–so we say that they have more weight.

TO DO AND OBSERVE:

Feel a number of objects of different sizes and weights. Order the objects by weight. Check the ordering using balance scales.

VOLUME – What is **volume**? That is how big something is–some things are bigger than other things even if they do not weigh much. But how do we compare how big something is, if things have different shapes? One way to do that is to see how much water you have to push away to make room for it. Since water has no shape, we can put things of different shapes into water and find out how much water gets pushed away.

TO DO AND OBSERVE:

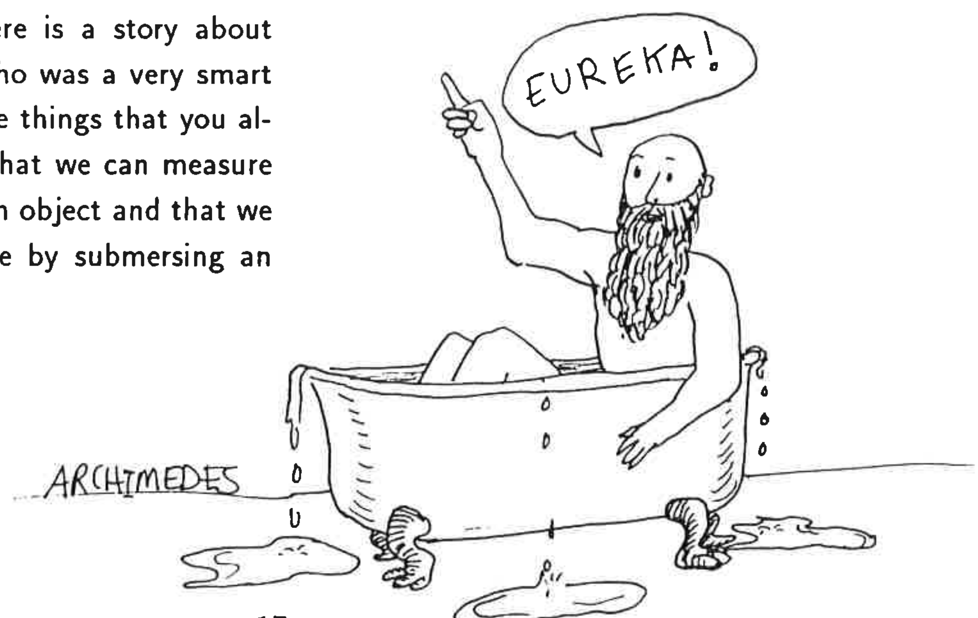
Look at a number of objects and order them by volume. Check the ordering by submersing the objects in water and measuring the water displaced.

Now here is something very interesting. All the objects that we checked for volume sunk in the water. So we say that a sinking object displaces water by volume. It does not matter how much it weighs. But a floating object displaces by weight.

TO DO AND OBSERVE:

Put the sinking objects in a little boat and show that now the displacement is by weight, retrieving the ordering by weight.

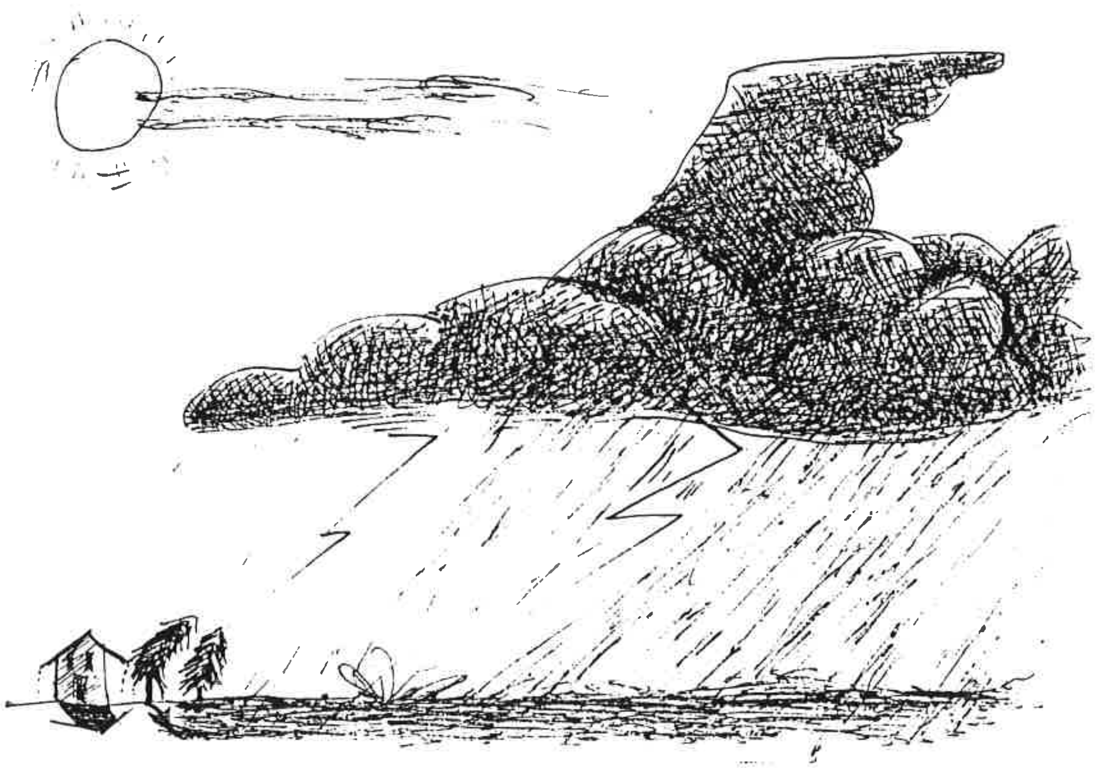
Archimedes – There is a story about how Archimedes, who was a very smart man, figured out the things that you already know now: That we can measure weight by floating an object and that we can measure volume by submersing an object.



2. CLOUDS STORMS, AND RAINBOWS

Dick Wetherald

This experiment will start with examples of the three basic cloud types, **cirrus**, **altocumulus**, and **cumulus** (i.e. high, medium, and low). We will look at a sequence of slides which show the various stages of thunderstorm formation. After this we will look at some pictures of lightning and tornadoes. We will end up by investigating some interesting optical phenomenon such as rainbows and halos. We will demonstrate how the colors of a rainbow can be reproduced by passing a strong beam of light through a prism and projecting the color sequence on a white screen.



3. SHADOWS

Jim Messersmith

Where is the shadow? How can I lose my shadow? We will experiment with shadows and find out.

4. BUBBLES

David Wilkinson and Don Alvarez

Bubbles are extraordinary. No scientist could have predicted that they would exist–they're too complicated. Yet we make them easily, and they look so beautiful and so simple. Even today scientists disagree about the details of how bubbles work. it seems that the bubble is like a very thin sandwich with soap on both sides of a film of water. In the experiment, we'll divide up into small groups to do several things with soap bubbles and films. Here's a list of projects:

- ○ Look at how soap spreads out on water.
- ○ Measure how long bubbles last.
- ○ Look at and draw the shapes of soap films inside wire frames. (You would never have guessed the answer.)
- ○ We'll put on our coats and go outside to make some BIG BUBBLES, just for fun.

5. SUNDIALS: SHADOWS IN MOTION

Jeremy Goodman and Maureen Quirk

Shadows show where the sun is in the sky. We can tell time by how long the shadows are and where they point. We will use a globe and a bright light to show how the shadows change as the Earth turns. The students will experiment with their own sundials and flashlight to see how the shadows move.

TO DO AND OBSERVE:

Look at the shadow on the globe. When is it longest? When is it shortest? Where does the shadow point when it is shortest? Do the shadows depend on where you live?

SUNDIALS

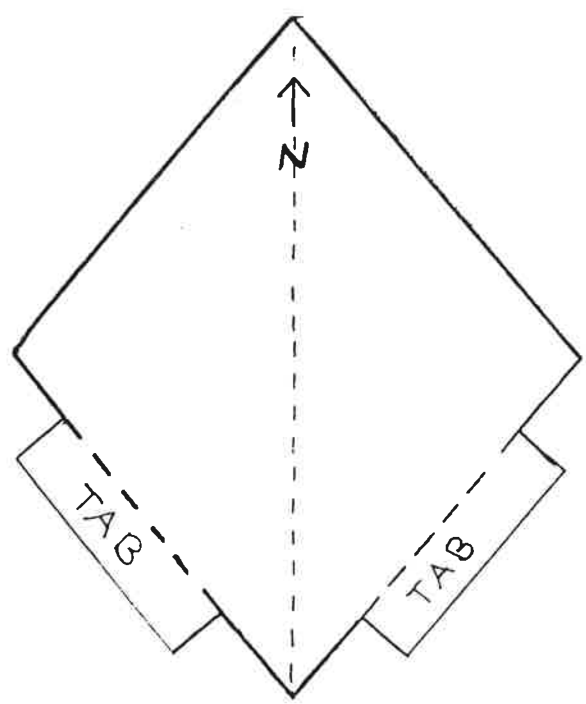
A long time ago people may have told time by watching their own shadows or the shadows of trees. Later, people used a stick or pillar, a **gnomon**, to cast shadows. The oldest known sundial was made about 3500 years ago. More than 2000 years ago, the Babylonians made sundials that divided the daylight into twelve hours. These hours were longer in the summer than in the winter.

TO DO AND OBSERVE:

Shine the flashlight on the sundial to cast a shadow. Where do you hold the flashlight to make the shadows longer? Can you make the shadow move from hour to hour?

MAKE YOUR OWN SUNDIAL:

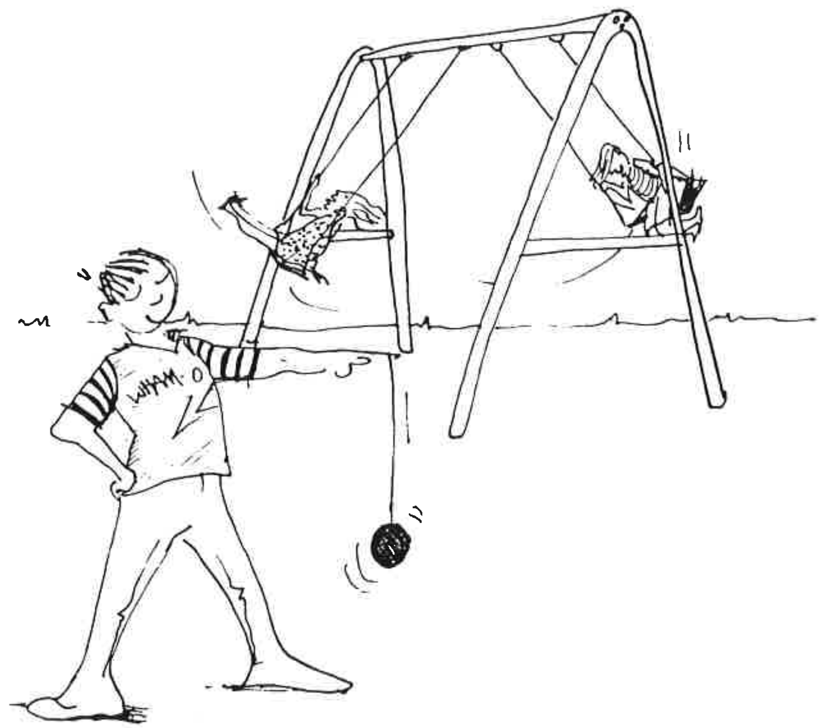
Trace the gnomon pattern and cut it out. Fold along the dotted line. Use the tabs to glue it to the center of a piece of cardboard or a large paper plate. Take the sundial outside at noon on a sunny day and put it on a table or on level ground. Turn the sundial until the shadow of the gnomon is as thin as you can make it. Mark where the shadow points on the edge of the plate. If it is noon, this direction is almost due north. Put a few pebbles in the plate to hold it down and leave it outside, or take the sundial back inside after marking the ground or the table so that you can point the sundial in the same direction when you bring it back outside. If you can, come back every hour and mark where the shadow points at one o'clock, two o'clock, and so on. Come back in the morning and mark the morning hours.



6. OSCILLATORY MOTION

David Vanderbilt

Oscillatory motion is a scientific name for a back-and-forth or up-and-down kind of motion, like the movement of a rocking chair or playground swing. We will observe a demonstration of two examples of oscillatory motion: a weight swinging from a string (or **pendulum**), and a weight bouncing up and down as it hangs from a spring. We will illustrate the meaning of **frequency** by counting the number of swings or bounces per minute. Then we will explore how this frequency changes if we use a longer or shorter string, or a heavier or lighter weight, or a stiffer or softer spring. Perhaps we can uncover some surprises.



7. THE LIFE CYCLE OF PLANTS

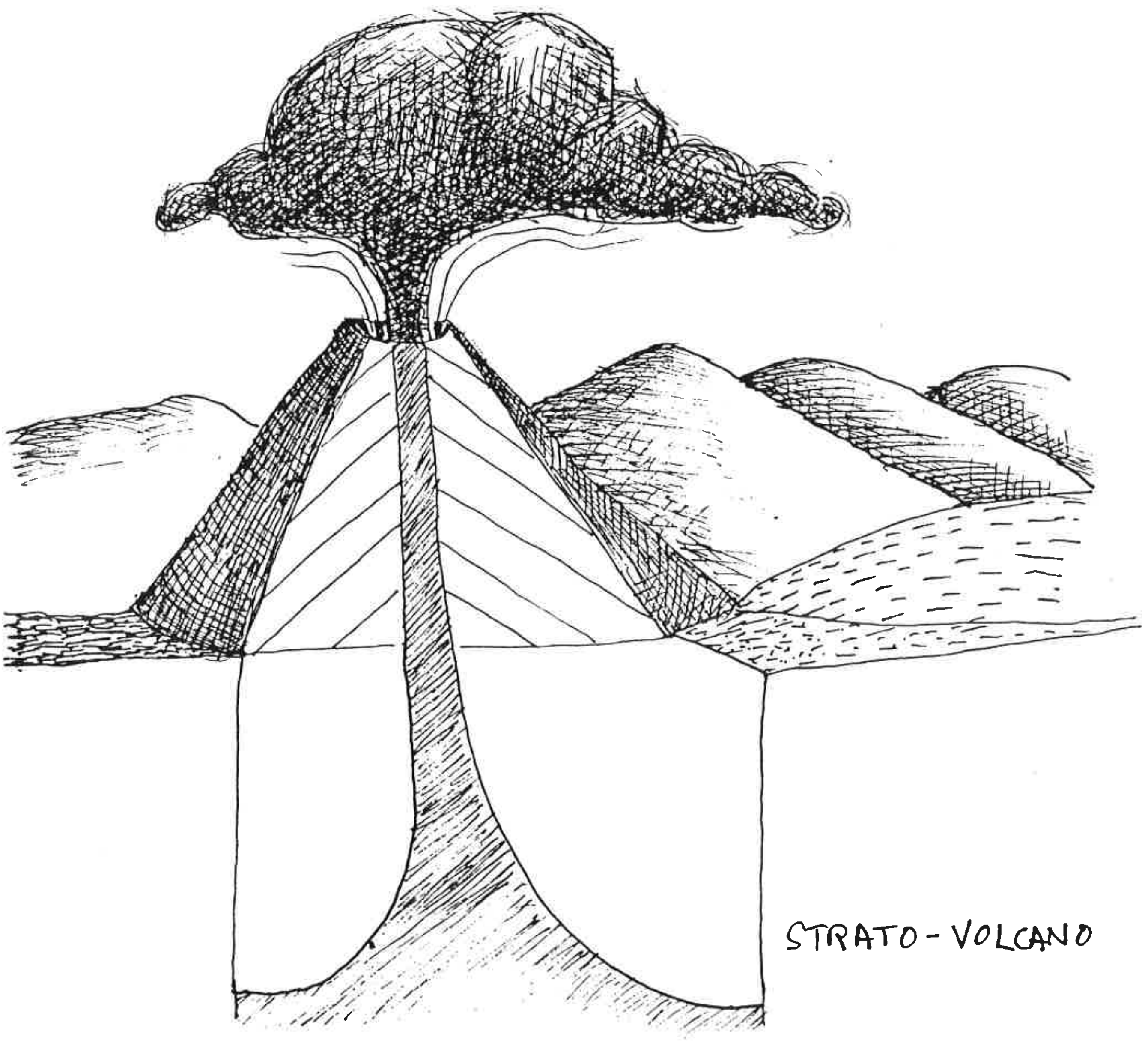
Adele Hagadorn

Growing plants through successive generations is one of the best ways to begin to understand that life is a continuous process. Children will discover how an edible vegetable is related to the rest of the plant it comes from. A cauliflower is a flower; a tomato is a fruit; celery is a stem, etc. Each part of a flowering plant performs necessary functions which allows the plants to continue from one generation to the next. In this workshop, second graders will investigate the life cycle of the bean and pea plants. Groups of students will plant seeds, set up recording and observation logs and prepare and discuss preparations for the second generation of seeds that should be ready by late spring. Activities will be provided to assist and enrich the study of the life cycle through the rest of the school year.

8. VOLCANOES AND MINERALS

Mark Feigenson

In this presentation we will view a videotape of recent volcanic eruptions, and discuss why volcanoes around the world have different shapes, and what makes some volcanoes more dangerous than others. We will also look at hand specimens of some lavas and see fragments from the deeper parts of the Earth that are brought to the surface in a few eruptions. Although the minerals that make up the lavas are too small to be seen with the unaided eye, we will investigate a few samples with a petrographic microscope to magnify the lavas. We may be able to compare the minerals we see in the microscope with some larger varieties of crystals than we can hold in our hands.



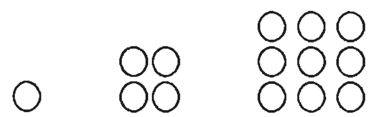
9. SQUARE AND RECTANGULAR NUMBERS AND THE SIEVE OF ERATOSTHENES

Ann and Walter Neumann

Experimenting with square and rectangular numbers is a fun way to explore number patterns, multiplication, division, and prime numbers. Each student needs 25 pennies, a pencil, and some crayons. We will work individually and in groups of four.

SQUARES – TO DO AND OBSERVE:

Form a 2-by-2 square of pennies. How many pennies are in the square? Do the same thing with 3-by-3, 4-by-4, and 5-by-5. Can you go any higher? Get together in a group of four and make larger and larger squares until you run out of pennies. Record your results for each square. What was the largest square you could make?



1 4 9

DIFFERENCES – TO DO AND OBSERVE:

What is the difference between the numbers of pennies in the 2-by-2 square and the 3-by-3 square? The 3-by-3 square and the 4-by-4 square? Keep figuring out the differences between each square and the next largest square. Do you see a pattern?

PATTERNS – TO DO AND OBSERVE:

Can you explain the pattern? Which pennies do you need to add to get from the 2-by-2 square to the 3-by-3 square? The 3-by-3 square to the 4-by-4 square? What shape do these added on pennies form?

RECTANGLES – TO DO AND OBSERVE:

Let's call the numbers like 1, 4, 9, ..., which are equal to the number of pennies in some square, the **square** numbers. Notice that some numbers are square numbers, but most numbers are not. Which numbers can you make by forming rectangles instead of just squares? What kind of a rectangle is 9? Experiment with 12, can you make more than one rectangular shape with 12 pennies? Is 11 a rectangular number? (Of course you can make a long skinny rectangle with all the pennies in one line, but you can not use 11 pennies to make a rectangle with more than one line.) We will call these one-line numbers **skinny** numbers, and say that they are not rectangular. What numbers can you find that are not rectangular? Are all even numbers rectangular? What about odd numbers?

THE SIEVE OF ERATOSTHENES – TO DO AND OBSERVE:

The ancient Greek mathematician Eratosthenes found a way to predict which numbers are rectangular and which are not. You can use a number line and the **sieve of Eratosthenes** to repeat his experiment. Join with a partner and place a penny on every whole number from 1 to 50. Starting at 2, skip count by 2's and push the penny off every number you land on (but not 2). Use a crayon to mark the numbers you pushed pennies off. Next start with 3 and skip count by 3's, pushing the penny off every number you land on that still has a penny. Use a different colored crayon to mark the numbers you land on. What happens when you start with 4 and skip by 4's? Start with 5 and skip count by 5's. Use a new color to mark the numbers. Why can you ignore the 6 step and go on to the 7 step?

PRIME NUMBERS – TO DO AND OBSERVE:

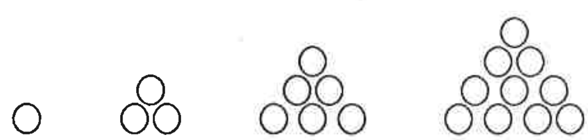
Look at the numbers that are not marked on the number line. Do you see a pattern? Which numbers are rectangular numbers? Mathematicians call the non-rectangular numbers **prime** numbers. We called them **skinny** numbers since we could not make any **fat** rectangles out of them. Why does the sieve of Eratosthenes catch only the prime (skinny) numbers? Why is every number with at least one mark (or no penny) rectangular? When you skip count by 2's, every number you land on can be made from a rectangle with one side equal to two. When you skip count by 3's, every number has a rectangle with 3 on one side. The amount you skip by is one side of the rectangle.

PRIME NUMBERS – SOME INTERESTING QUESTIONS:

1. Why does skip counting by 2, 3, 5, and 7 find all the prime numbers up to 50?
2. Which skip-counting steps must you do to find all the prime numbers less than 100?
3. Is there a largest prime number somewhere up the number line?

TRIANGULAR NUMBERS – TO DO AND OBSERVE AT HOME:

Triangular numbers can be formed by triangles of pennies:



1 3 6 10

Form triangular numbers using up to 50 pennies. By counting or adding find the sum of neighboring pairs of triangular numbers. What pattern do you see? Can you use pennies to explain this pattern? Hint: form the two triangles from pennies then turn one triangle upside down. Can every square number be divided into two neighboring triangular numbers?

10. DEVELOPMENT OF PLANTS AND ANIMALS

Eric Wieschaus and Tom Vogt

Although animals and plants come in all different shapes and sizes, all of them begin their life as seeds or eggs. These seeds or eggs are often so small that they can only be seen with a microscope. During the first days of their development, they increase in size and gradually take on the shape of mature plants or animals. In this experiment, we will use a microscope to learn how some plants and animals develop.

PLANT DEVELOPMENT

The plant embryo is kept in a resting state inside the seed. Many plant seeds begin to develop further when they are soaked in water and potting soil. The first sign of development are little sprouts that come out of seeds.

TO DO AND OBSERVE:

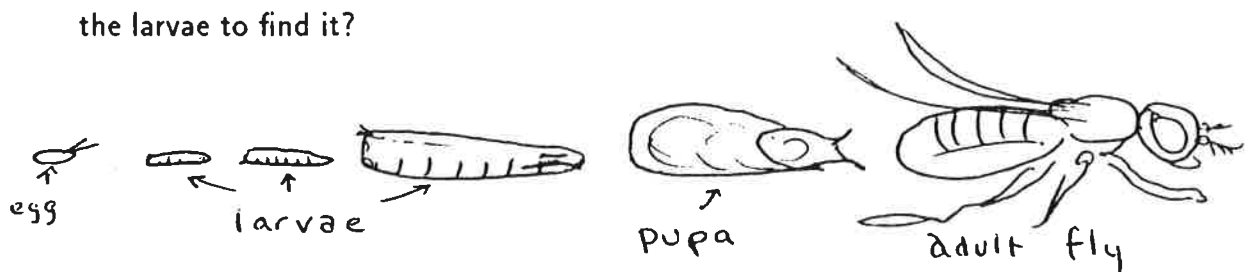
We have soaked small batches of Mung Bean and alfalfa seeds in water, some for 6 days, some for 4 days, and some for 2 days. Take some of the seeds and look at them under the microscope. How many days does it take for the sprouts to form? Draw a picture of the seeds that show the biggest sprouts. Do you think the first sprouts will form at the top of the plant (the stem and leaves) or the bottom (the roots)?

FRUIT FLY DEVELOPMENT

Many insects lay eggs that develop into worm-like animals called **larvae** or caterpillars. When they hatch, these larvae are about the size of the eggs. They crawl around and spend most of their time eating. They get bigger and bigger until they are about the size of the adult flies, even though they still look like a larva. Then they find a dry place to form a **pupa** or cocoon. Inside the pupa, most of the cells and organs that functioned in the larva die and are destroyed. Other little groups of cells grow and form wings and legs and other adult structures.

TO DO AND OBSERVE:

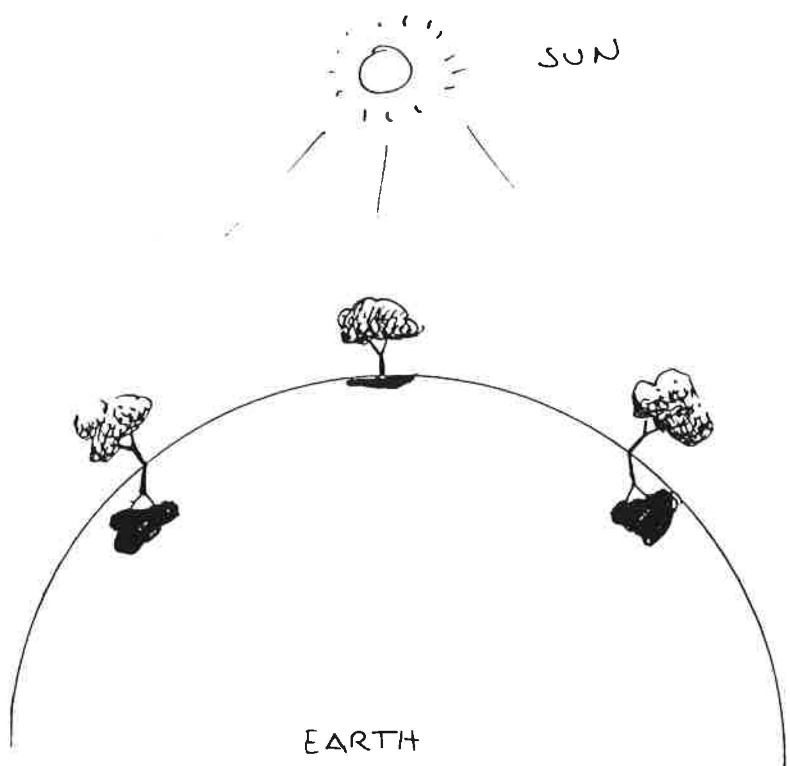
Look at the dishes containing eggs, larvae, pupae, and adults. Which move? What color are the eggs and larvae? Can you see the adult flies inside the old pupae? What color are the eyes of the flies? Put a drop of yeast on the plate. How long does it take the larvae to find it?



11. THE WORLD THROUGH THE EYES OF ERATOSTHENES

Ken Wilkie

Around 200 B.C., Eratosthenes took what he knew about eclipses, circles, the sun, and mathematics and figured out that he was living on a spherical object (Earth) and, without traveling very far, how big the Earth was. His estimate was very close to what would not be accurately measured for centuries to come. In his experiment, the students will estimate the Earth's size and go through the steps that Eratosthenes took to get his amazingly accurate figure.



12. JUPITER, SATURN, URANUS AND NEPTUNE

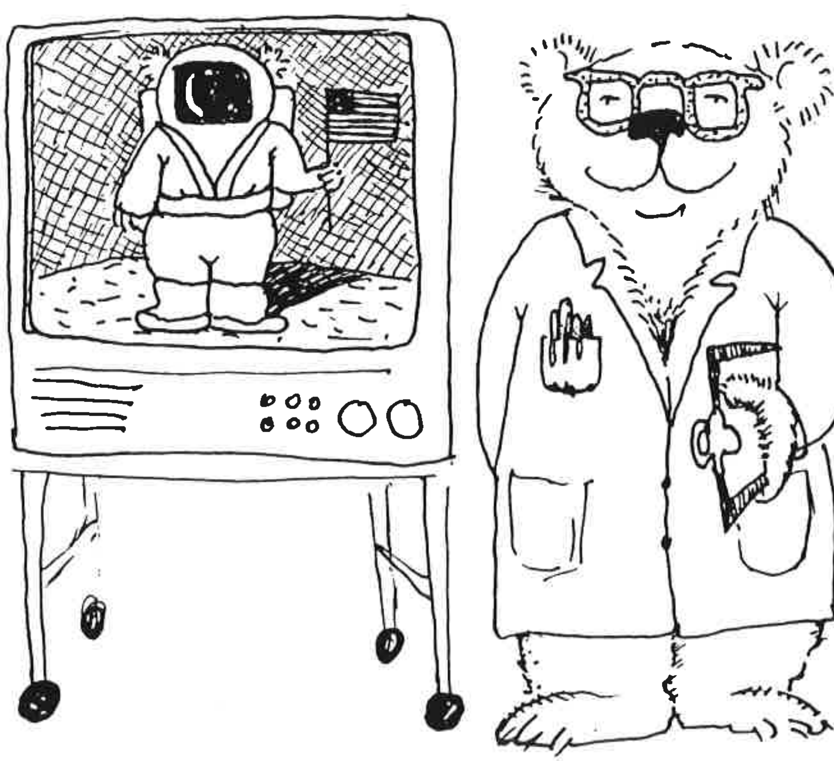
Tony Dahlen

In this session we will study the four large outer planets of the solar system: Jupiter, Saturn, Uranus and Neptune. We will look at the magnificent images of these planets and their moons sent back to the Earth by the two Voyager spacecraft. We will discuss how very different these distant worlds are from the Earth. We will see moving pictures of the Great Red spot on Jupiter and the Great Blue Spot on Neptune; both are violent, long-lived cyclones larger in size than the whole Earth. We will see erupting sulfurous volcanoes on Io, the nearest moon of Jupiter, and the many airless, icy moons of Saturn and Uranus. We will also see close-up images of the intricate rings of Saturn; all four of the large, gaseous planets have rings, composed of millions of dirty snowballs.

13. A SUMMARY OF SPACE PROGRAMS AND THEIR APPLICATIONS

Dr. Herbert M. Gurk

In this presentation Dr. Gurk will summarize past, present, and future space programs using videos provided by NASA, and other material from his years at the GE Astro Space Division in West Windsor. The United States' civilian and military space program has developed and successfully flown many different kinds of satellites, space probes, and manned explorations since the late 1950's. Such programs will continue during the 21st century with even more ambitious ventures. Dr. Gurk will provide highlights on systems which he has helped develop and on others which he feels are especially exciting. Weather and Earth observation satellites and their applications, the Space Station Freedom, manned life in space, and planetary programs will be reviewed. There also will be time to ask questions and find out how challenging and how much fun a career in developing space systems can be.



RIVERSIDE BEAR - IN SCIENCE
AND IN SPACE

14. DENSITY AND MISCIBILITY

Natalie Smyth

In this experiment we will explore the properties of density and miscibility.

DENSITY

What weighs more: a feather or a rock? Check the answer by weighing a big feather and a small rock on a balance scale. Scientists need something more complete than weight (or mass) to describe the properties of the feather and the rock–they use mass/volume. Take two clear containers the same size and fill one with feathers and the other with rocks. Which do you think weighs more? Check your answer using the balance.

MISCIBILITY

Mix some magnetized marbles and some plastic beads the same size in a container. What happens? Do the marbles clump together? The same thing happens in liquids. Fill a graduated cylinder with equal amounts of chloroform, methylene chloride, and baby oil. Do you see the different layers. Pour some colored water into the cylinder. What happens now? Try adding some small objects to the cylinder. Some good choices are a rock, a slice of carrot, a chunk of wood, a piece of styrofoam, etc. What happens? Do all the objects sink to the bottom or float on the top? Can you explain what you see?

15. HOW BIG IS THE SOLAR SYSTEM?

Joyce Turner

In this activity we will explore the distances in the solar system using scale models of the planets. The students will get to keep a set of solar system models. The nine planets in our solar system are:

Earth	Mercury	Saturn
Jupiter	Neptune	Uranus
Mars	Pluto	Venus

TO DO AND OBSERVE:

Which planet is closest to the sun? Which one is the Earth? How far is the Earth from the sun? How far away is Pluto? Where would you place the sun and the first seven planets on the scale below?

16. SILENT STRUCTURES

Jan Woods, Jen Zimmerman, Karen Colihan

This activity focusses on structures and the way each culture builds structures to fit their own needs and environment. Silent Structures also focusses on the necessity for cooperation and effective communication while working together to build a structure.

TO DO AND OBSERVE:

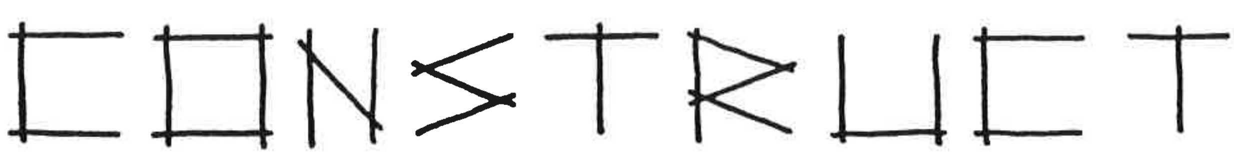
Each group of students will work together to design and build a structure with dowels and rubberbands. Each group will have about 30 dowels, 40 rubberbands, pencils, and paper.

SOME RULES TO FOLLOW:

1. No talking! Write, draw, use hand signals, or use facial expressions.
2. The structure should be about 4 feet high.
3. A child should be able to stand up inside the structure.
4. Do not break the dowels or rubberbands.
5. Use only the materials given to you.

TO DO AND OBSERVE AT HOME:

1. Build a bridge out of drinking straws and paper clips.
2. Build a geodesic dome out of toothpicks and gumdrops.
3. Make origami (paper folding) structures.
4. Make cubes or triangular prisms out of straws and paper clips.
5. Design and construct a house out of gumdrops, toothpicks, marshmallows, or other readily available materials.



17. STUDIES WITH LIQUID NITROGEN

Carole Stearns

Many things change properties as they become colder. Water is one familiar example. Can you think of another? We are going to become **Cold Chemists**. These chemists use a special material called liquid nitrogen. It is so cold that **Cold Chemists** must wear special gloves and carry liquid nitrogen in special conatiners. As you prepare to be a **Cold Chemist** you will want to think about the following questions:

- ◇ What changes take place in water when it becomes very cold?
- ◇ How cold is the coldest place in your house?
- ◇ What happens to air when it becomes very, very, very cold?

18. MAGIC WITH EGGS

Andrea Bonette

THE SILVER EGG: How to turn an ordinary egg into something shiny and beautiful.

EGGS CAN READ: They can read these signs: "SINK", "FLOAT ON TOP", "SWIM", and "FLOAT IN THE MIDDLE".

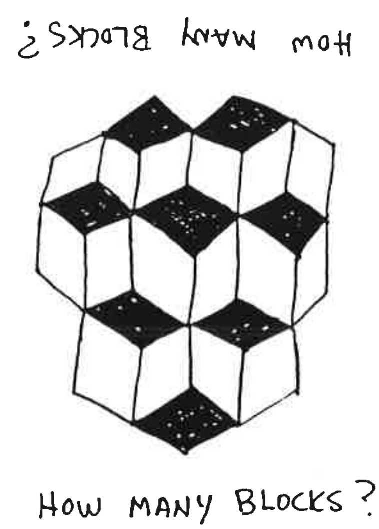
THE OBEDIENT EGG: Eggs can be trained to take certain positions.

THE X-RAY EGG: How can you "see" inside an egg to tell whether it's cooked or raw?

19. ILLUSIONS: WHAT YOU SEE IS WHAT YOU DON'T GET

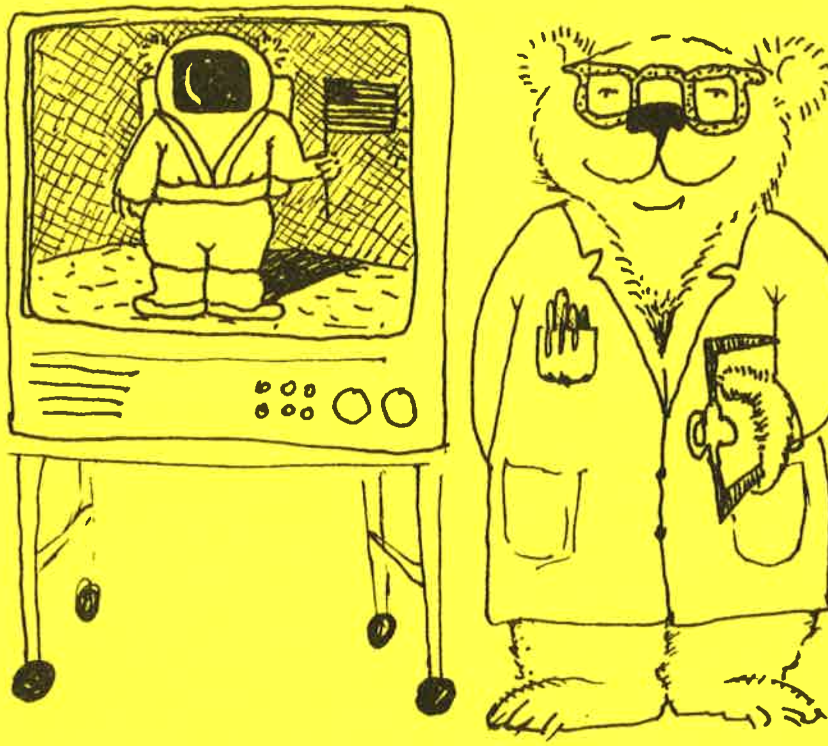
Agnes Golding and Lois Gretzinger

Our ability to judge shapes, size, and even color can be distorted by the context in which an object is seen, and by our own expectations of what should be. The students will have the opportunity to observe several optical illusions containing contradictory visual cues. They will be asked to describe what they see and then explore further to check the accuracy of their initial perceptions.



20. SNAKES!

Jerry Daglish



RIVERSIDE BEAR - IN SCIENCE
AND IN SPACE