SEE WHAT EARTH SCIENCE IS ALL ABOUT™

K-3

ASTRONOMY:

The Earth's Rotation

* **Use a model to explain the daily rotation of the earth:** [observational activity]

  Globe with paper "people" (earth)
  Styrofoam ball (moon)
  Light source (sun)
  Umbrella with paper "stars" (space)

* **Introduce directions (north, south, east, west) using compasses:** [observational activity]

* **Using model, determine which way the earth turns:** [observational experiment]

  1. What are the problems?

     "Where is light? Where is dark?"
     "Which way does the earth turn, clockwise or counterclockwise?"

  2. Make a guess (i.e. earth is turning counterclockwise)

  3. Make direct observations (using a compass)

     "Does the sun appear to rise in the east and set in the west?"

  4. Return to model to confirm.

  5. Form a conclusion ("Earth must turn counterclockwise")

Time and Time Zones (basic concepts)

* **Use model above to explain day and night:** [observational activity]

  Sunrise, noon, sunset, midnight

Moon - Characteristics and Motion

* **Discuss moon facts:** [lesson]

  Size - a tennis ball to a basketball is a good comparison
  Distance from earth - 400,000 km (250,000 miles) or 10 times around the earth at equator
  Time to go once around the earth - approximately 28 days

* **Using a flashlight, show how light is reflected sunlight** [observational activity]

* **Demonstrate movement of moon throughout the "moonth" with corresponding phases:** [observational activity, advanced topic]

  The moon is seen during the day at times and during the night at other times.
  The earth turns counterclockwise and everything **appears** to rise in the east and set in west (including the moon).

* **Students each keep a moon calendar** [observational experiment]

Stars and Constellations

* **Use same model to explain basic concepts about stars:** [observational activity]

Also appear to rise in east and set in west
Give off their own light (like flashlights)
Are grouped in constellations

* **Make direct observations using star maps:** [observational activity]

Big Dipper, Cassiopeia and Orion (see below)

* **Using model, demonstrate and discuss these topics:** [observational activity]

Shadow behind the earth (not cylindrical but cone-shaped as sun is very large compared to earth).
Directions from the north pole?
How people would move in one day (use a record as a model)
- Person on north pole makes one turn per day
- Person on equator travels very fast (1600 kph or 1000 mph)

Half the world is awake and working while we sleep

* **Use drawing and table top to show the circumpolar stars:** [observational activity]

Demonstrate daily motion of these stars.

* **Sun's shadow at 1-hour intervals with clay and straws** (extension - keep data throughout the year): [observational experiment]

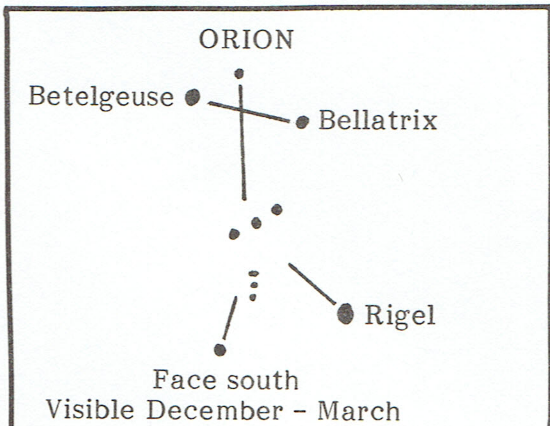
* **Students demonstrate relative brightness of stars using flashlights:** [observational activity] (Note: planets may look like stars but only reflect light)

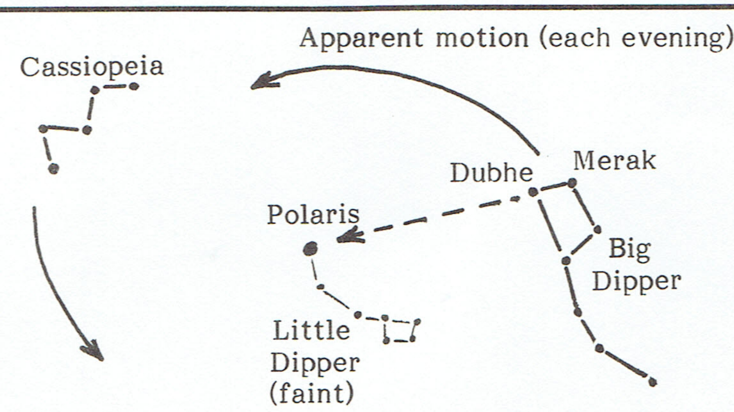
Two factors affect brightness: distance of star and amount of light given off from star

* **Demonstrate what galaxies look like using an old record and tiny clay balls:** [observational activity]

Look along the plane to simulate our "Milky Way"

* **Students find the milky way in the night sky** [observational activity]





Circumpolar Stars
January 8 pm

* - **Develop process skills by involving students as much as possible in these activities.**

GEOLOGY/OCEANOGRAPHY:

Properties of Rocks and Soils

* **Discuss general properties:** [lesson]

  Color, size, texture, weight, number of particles

* **Chocolate Chip geology - compare chocolate chip cookies to rocks:** [observational activity]

  Students each bring in a rock, are given a cookie and a magnifier

    Students observe their cookie
    Record the data (color, texture, number of particles)
    Evaluate the data - "Does everyone have the same kind of cookie?"

  Students perform the same activity with their rocks.

* **Identify the rock:** [observational activity]

  Using these same rocks, mark each one to identify the "owner".
  Students write down different properties of 5 to 10 rocks:

    Color, texture, number of different particles, size (using sizing squares)

  Teacher describes the characteristics of one rock
  Students attempt to identify the rock using their data

* **Discuss minerals:** [lesson]

  Use samples of granite which contains several minerals: felspar, mica, quartz, hornblend

* **Demonstrate hefting - measuring the density or compactness of materials:** [observational activity]

  Rocks should be approximately the same size but of different densities (i.e. pumice and granite).
  Put one in each hand and feel the difference in weight.
  "Which rock is the most dense?"

Sink/float - Density of liquids

* **Soda straw hydrometer - relative density of different liquids:** [experiment]

  Students observe, collect values for each liquid and decide what the unknown is from their data.

    4 plastic cups marked "1", "2", "3", and "?"
    hydrometer (soda straw, clay, beebees, nail)
    salty water (4 parts water to 1 part salt)
    measuring card (1 cm divisions marked on posterboard strip)
    3 food colors
    isopropyl alcohol
    tap water

  "How high does the straw float in each liquid?"
  Make measurements and record data.
  Measure the mystery liquid and compare this value to those of other 3 liquids.
  "What color should the mystery liquid be?" (be sure to add the color)
  Note: Don't switch straw hydrometers between measurements or relative values may not be correct!

* **Egg sink or float:** [observational experiment]

2 plastic cups
tap water with blue food coloring
1 raw egg
salty water with red food coloring
basting utensil

"Does the egg float in salt water?" - solicit responses - float egg in salt water (should float)
"Does the egg float in fresh water?" - solicit responses - float egg in fresh water (will sink)
"Which water will float on top of the other one, red on blue or blue on red?"

Hint: If egg floats, the liquid is "thicker".
If egg sinks, the liquid is "thinner".
Will a thicker liquid float on a thinner liquid or will a thinner liquid float on a thicker liquid?

Make a two-layer solution using the basting utensil.
Guess where the egg will end up - top, bottom or on boundary - solicit responses (predictions)
Perform the experiment.

Earth's surface features

* **Build a relief map of the earth's surface features** (mountain, hill, valley, lake bed, etc.): [observational activity]

12 gal. fish tank
dirt or potting soil
water spray bottle
watering can
plastic wrap

Simulate conditions in this mini-environment:

rain storm
lake formation (use plastic wrap under dirt to hold water)
river flowing
erosion
flash flood

Soils - Water holding capacity

* **Classify soil particles** (color, size, etc., using magnifiers): [observational experiment]

Each student brings in a baggie of soil from their yard.
Observe and classify the different types - place similar samples next to each other.
Ask students with similar samples if they live near each other.
Leave sealed baggies out in the sun to see if water (fog) forms - compare several samples.
"Which sample had the most water in it?"

* **Which soil holds the most water?** [observational experiment]

3 plastic cups with nail holes in bottom
tap water
measuring container (i.e. graduated cylinder)
3 different soil samples
3 trays to collect run-off

Pour equal amounts of water in each. Measure the amount of water that comes through to each tray. Record results.

Observe data and formulate conclusion.

Sand

* **Investigate characteristics of sand using magnifiers and magnets:** [observational activity]

minerals (quartz, feldspar, mica, hornblend)
shell pieces
magnetic particles
living material

Saltwater

* **Introduce the concept of a solution:** [observational activity]

Make saltwater (2 T. salt + 1 qt. water).
"When salt dissolves in water, where does it go?" - solicit responses

The salt breaks down into tiny pieces (still solids) that we can't see and they are held evenly throughout by each tiny piece of water. If we add too much salt, the water cannot hold onto it and the salt sits on the bottom.

To show that the salt is still there, allow the water to evaporate.

Growing / Observing salt crystals

* **Make salt crystals:** [observational experiment]

1 c. very hot water
string
plastic cup or glass jar
$\frac{1}{4}$ c. salt
sharp object tied to end of string
magnifiers

Hang string and object in saltwater, wait a few days. Observe crystals with magnifiers.
To grow large crystals, use cool water, cover with a loose lid and wait about two months.

Topography of the ocean floor

* **The ocean floor box:** [observational experiment]

Make various ocean floor boxes:

narrow boxes
glue
graph paper
pieces of wood
rulers

Students measure the depth at each slot in a box and record data.
Trick students by putting in a "fish" block somewhere above the bottom.
Use histogram or line graph to determine what they think the "ocean floor" looks like.
Open box later and check accuracy.

*** - Develop process skills by involving students as much as possible in these activities.**

METEOROLOGY:

Air - Characteristics and properties

* **Discuss general properties:** [lesson]

Air is matter (has weight and takes up space)

* **Use a model to show that air is matter and has weight:** [observational activity]

toy animal   jar   jelly beans (2 colors)

"What would it be like having all these jelly beans pushing down upon us?"
"What if the jar was twice this size?"
"What would it be like to be one of the jelly beans on the bottom or the top?"

Discuss the weight of air particles (refer to 4-6 Meteorology, Air pressure effects - demonstrate with can-crushing activity for impact).

* **Demonstrate that air takes up space:** [observational activities]

aquarium filled with water   drinking glass
crayon piece or cork   food coloring for water (optional)

Question students before performing demonstration: "Does air take up space?"

1. Invert glass and lower into tank.
2. Use a plastic cup and punch a hole in the top.
   Perform the same experiment - hold your finger over the hole, then release.
   Make observations and conclude that air takes up space.
3. Pouring air demonstration:

   aquarium filled with colored water   two drinking glasses
   crayon piece or cork

   "Pour" air from one glass into another.

* **Bag "experiments":** [observational activities]

baggie filled with air   trash bag filled with air

1. "Which bag has more air, the big one or the little one?"
2. Demonstrate air pressure:

   As air is compressed (force is put on it), it gives out force in return (bag could even burst).
3. Demonstrate how the force of air pressure does work for us.

   soda straw   baggie
   tape   book
4. Ask students why Rice Krispies go 'snap, crackle and pop'.

   The little bags of air are compressed by milk.

   Use a plastic bag filled with air as a model - pop it!

* **Demonstrate that air has weight:** [observational activity]

1. Yardstick with balloons on both sides
   Balance with a string in center, blow up one balloon (will be off-balance)

2. Using the balance (for "how to operate" see K-3 Physical Science, Part I)
   Ask students: "How much does the air in this balloon weigh?"

   Weigh balloon first.
   Weigh the same balloon after fully inflating (will weigh more).

   (The true weight of the air is actually greater because the balloon is surrounded by and displacing air in the room - **this is an advanced concept**).

Density - Gases vs. liquids

* **Which balloon weighs the most?** [observational activity]

Balloon inflated with air (larger size)
Balloon filled with water (smaller size)

Density vs. altitude

* **What are the particles in the air?** [observational activity]

Jar with toy animal and jelly beans - 80% of one color representing nitrogen
20% of another color representing oxygen

* **Model of air taken from three altitudes:** [observational activity]

3 balloons   popcorn   funnel

Using the funnel, put different amounts of popcorn in each balloon (blown up to same size) to demonstrate that air is more compressed (dense) at sea level than at higher altitudes.

Heat and air (useful for Physical Science, "Heat" unit, too)

* **Use model to demonstrate activity of particles when air is heated:** [observational activity]

balloon filled with $\frac{1}{4}$ c. popcorn
candle (do not light)

"What happens to the particles when they are heated?"
"What happens to the balloon as the particles move faster and faster?"

If the balloon gets bigger and still contains the same number of particles, what can we say about the space between each particle?

Important concept: When you heat things up, the space between the molecules gets greater. If you cool them down, the space will get smaller, the particles will get closer together and the speed of each particle will slow down.

Introduction to expansion of solids, liquids and gases

* **Demonstrate the behavior of air:** [observational activity]

small can
bowl with hot water
bubble soap
bowl with ice water

Always seek explanations before you perform the activities:
"What will happen to the film of bubble soap when the can is placed in hot water?"
"What would happen if we put it in cold water?"

* **Demonstrate the expansion of air #1:** [observational activity]

bowl of hot water
bowl of ice water
ice cold bottle with deflated balloon over neck

"What will happen as air inside this bottle heats up?" - solicit explanations

After air heats up, remove balloon, remove air from balloon.
Replace balloon onto warmed-up bottle.

"What will happen as this air cools?"

Place bottle in ice water.

* **Demonstrate the expansion of air #2:** [observational activity]

clear plastic bag of cold air (from refrigerator or outside)
clear plastic bag of warm air
2 thermometers

"Why is the liquid in the thermometer higher in the bag with warm air?"

Explanation: All the warm air particles are bouncing around hitting the thermometer glass. The particles in the glass start shaking harder and transfer energy into the liquid in the thermometer. As the thermometer liquid particles move faster, they expand.

Wind - what it is, causes, measuring

Properties:

"moving air"
"what makes the air move?"

* **Model of the wind #1:** [observational activity]

balloon

"How many breaths of air did it take to blow up this balloon?" (don't tie shut)

The surface of the balloon is pushing down on the particles of air inside the balloon, putting it under pressure.

"When the end of the balloon is opened up, which way will the air move?"
"Will the air go out or will the air outside go in?"

Let the air out so the students can observe that the air inside that's under pressure goes out toward the air that is not under pressure.

Pressure

Properties:

On our earth, we have "balloon" (high pressure) areas and "no balloon" (low pressure) areas. The wind always travels from the high pressure areas to the low pressure areas.

* **Model of the wind #2:** [observational activity]

2 clear plastic bags soda straw masking tape

Tape one bag to one end of the straw. Inflate that bag. Tape the other bag to the straw's other end.

"What happens if we put pressure (push down) on the inflated bag?" - solicit explanations

Demonstrate that heavier, more dense air pushes down increasing the pressure and causes a "wind" to flow (through the straw).

* **Measuring wind direction:** [observational experiment]

Make two types of wind vanes (refer to page ES(P)-15 "Weather Indicators"):

straw	block of wood	compass
paper	nail	electric fan
paper clip	straw	
straight pin	aluminium foil	
pencil		

To measure direction wind is coming from (wind is always measured this way), place compass so red needle points north. The direction the wind vane is pointing to will be the direction of the wind.

Have students measure wind direction inside the classroom using fan and compass.

Have students measure the real wind direction outside using compass.

Keep an on-going wind direction record.

* **Measuring wind speed:** [observational activity]

wind speed measuring device (refer to video) fan

Water - Solid, liquid and gas

* **Demonstrate water as a solid:** [observational activity]

All molecules (particles) are connected together. They can only vibrate in place.

Model #1: popsicle stick and 2 balls of clay

Model #2: Ask students to hold hands and shake in place to represent a solid.

* **Discuss water as a liquid:** [lesson]

"What happens when solid particles heat up?"

The particles shake harder and harder and eventually break apart (turn to a liquid).

Analogy: Bees in a hive.

* **Explain evaporation:** [lesson]

Some particles move faster than others. If they go fast enough, they fly out of the liquid and off into the air. The more heat, the faster the particles go. This means that water will evaporate faster as it is heated.

* **Demonstrate water as a gas:** [observational activity]

Model of air: jelly beans in jar (add 3rd color to represent water as a gas)

Water molecules (in gas form) fit in between the "jelly bean" particles (O_2+N_2). The warmer the air and the further apart the air molecules, the more room for water molecules to fit in between. When air is cold, there is less room.

Concept: Warm air holds more water than cold air.

Collecting water from the air

* **Demonstrate condensation and show that air holds water (in gas form):** [observational activity]

large juice can   ice water

Students observe water droplets forming on outside of can. This water is coming from air nearest the can (not seeping through the can).

Clouds

* **Discuss formation of clouds:** [lesson]

Air cools as it rises (water particles get "squeezed out" as air particles get closer together). Gaseous water particles turn into liquid and float around together (too small to fall to earth).

* **Making a cloud in a bottle:** [observational activity]

large bottle with small mouth (preheated with hot water)
boiling water
hot pad
ice cube

When an ice cube is placed on top of the bottle, hot air rises and cools forming small water particles swirling around inside the jar (students must be close to observe).

* **Identifying and classifying clouds:** [observational activity]

Clouds are classified according to shape and altitude at which they are found.

Types: Cirrus - wispy, feathery edges. Found at 20-40,000 feet. Made up of tiny particles of ice.

Stratus - thin, layered clouds stretching out for miles. "Fog" at ground level.

Cumulus - flat bottom, round, fluffy top, vertical (look like cauliflower). Turn into thunderheads.

Make cloud models with construction paper and cotton.

Weather chart

* **Use symbols and pictures to characterize the daily weather.** [observational activity]

* **Advanced weather chart:** [observational activity]

Measure and record air temperature (and time of day) with thermometer in the shade.
Measure wind direction with wind vane and compass.
Measure wind speed with wind speed indicator.
Observe clouds, if any, and record types.

* **Measure humidity factor (dew point):** [observational experiment]

large juice can filled with tap water
thermometer
ice cube

One student stirs water containing ice cube, another student watches for moisture to appear outside can. As soon as moisture appears, record temperature of water. If "dew point" is low (cold) there is little water in the air. If high, air contains a lot of water.

* **Which will dry out first?** [observational experiment]

2 paper towels
clear plastic bag
water

Wet both paper towels. Leave one out and place other inside sealed bag. Observe after 1 to 2 hours.

Extension: Test effects of wind (fan) or direct sunlight on evaporation time.

* **Demonstrate that hot air rises using "spiral":** [observational activity] (refer to page ES(P)-16)

cut-out paper spiral
tape
thread
light source

Hold spiral over light source **after** soliciting explanations of what will happen.

Working with air - Experiment using scientific methods

* **Bugscopters:** [observational experiment]

paper cut-outs
crayons or felt pens
paper clips

Students cut out several different shaped bugscopters and drop them to the ground from chair height.

"Which twirls fastest?"
"Which falls fastest?"
Introduce variables: "How are they different?"

(continue with ball bouncing activity next page)

* **Which ball bounces higher?** [observational activity]

tennis ball
towel
racquetball

Demonstrate effects of variables on making "fair" comparisons (height of drop, initial force on ball, surface they hit). Since you are comparing two different balls, all other variables **must** be the same or you can't make a fair comparison.

* **Bugscopters continued:** [observational experiment]

"What things can we change to affect the rate at which it falls?"

ear width
body length
ear length
number of paper clips

Introduce the control (super bugs). All experimental designs will be tested with respect to this standard (see next page):

ears - 1 1/2" across (4 cm.)
4" down (10 cm.)

body - 3" down (8 cm.)
3/4" chin area (2 cm.)

Do experiments:

1. Make test bugscopter with **only one change** from super bugs (width of ears, for example).
   Different groups try different **ear widths.**
   Drop test bugs at same time as super bugs.

   "Does it hit the ground sooner? later? or at the same time?"

   Each group records their results.
   Discuss as a class: "What did groups with narrow ears find out? wide ears?"
   Formulate a conclusion concerning falling rate vs. **ear width.**

2. Test another variable: ear length, for example. This time, keep ear width and all other dimensions the same as super bugs except **ear length.**

   "How does the length of the ear affect the rate it falls?"

   Do the experiment. Record the data.
   Discuss results as before. Determine how **ear length** affects fall rate.

3. Test **body length**

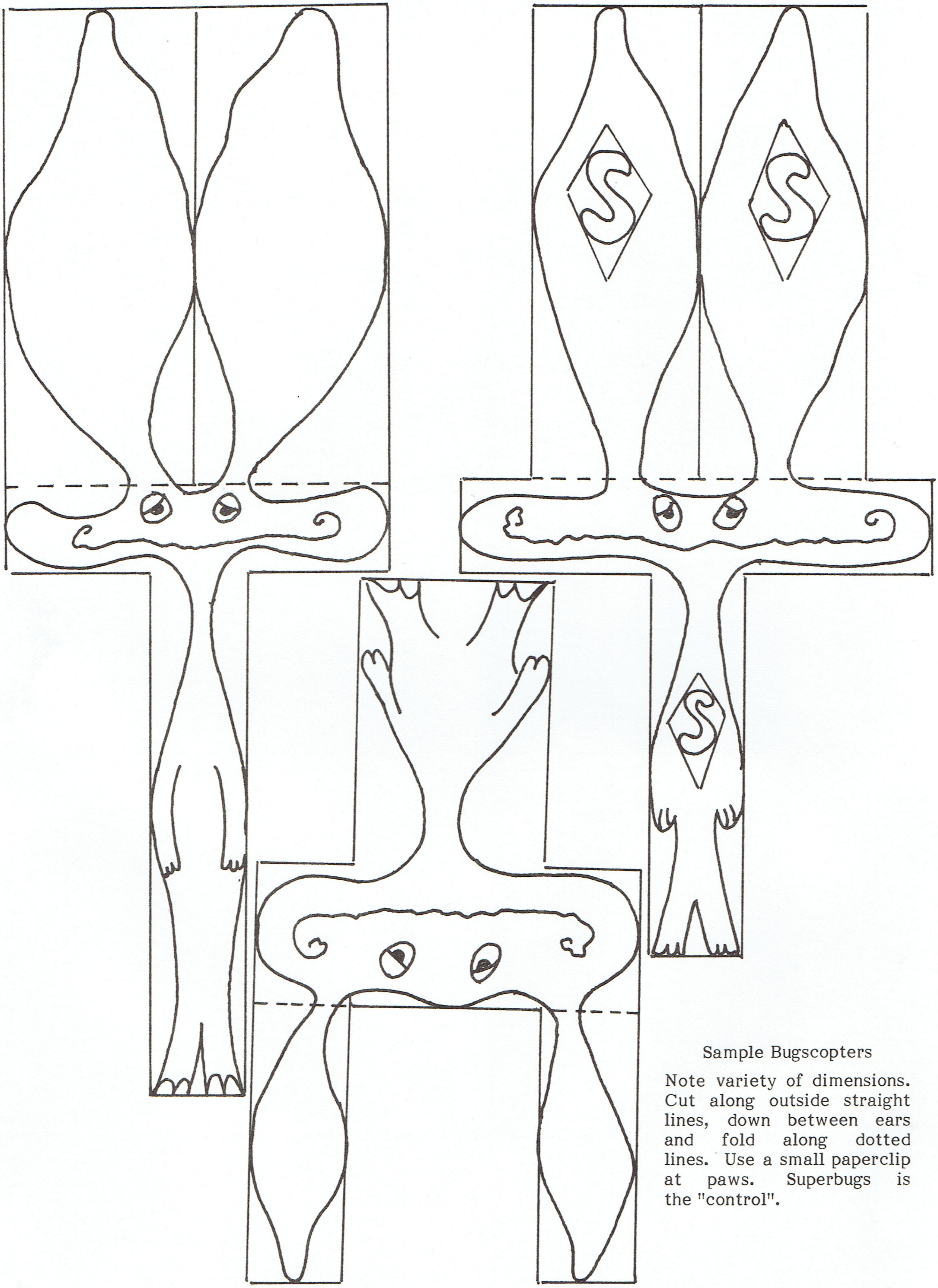
4. Test **number of paper clips.**

* **Bugscopter contest:** [observational experiment]

Give students the dimensions of paper they can use. Have them design their own bugscopter that will stay in the air the longest.

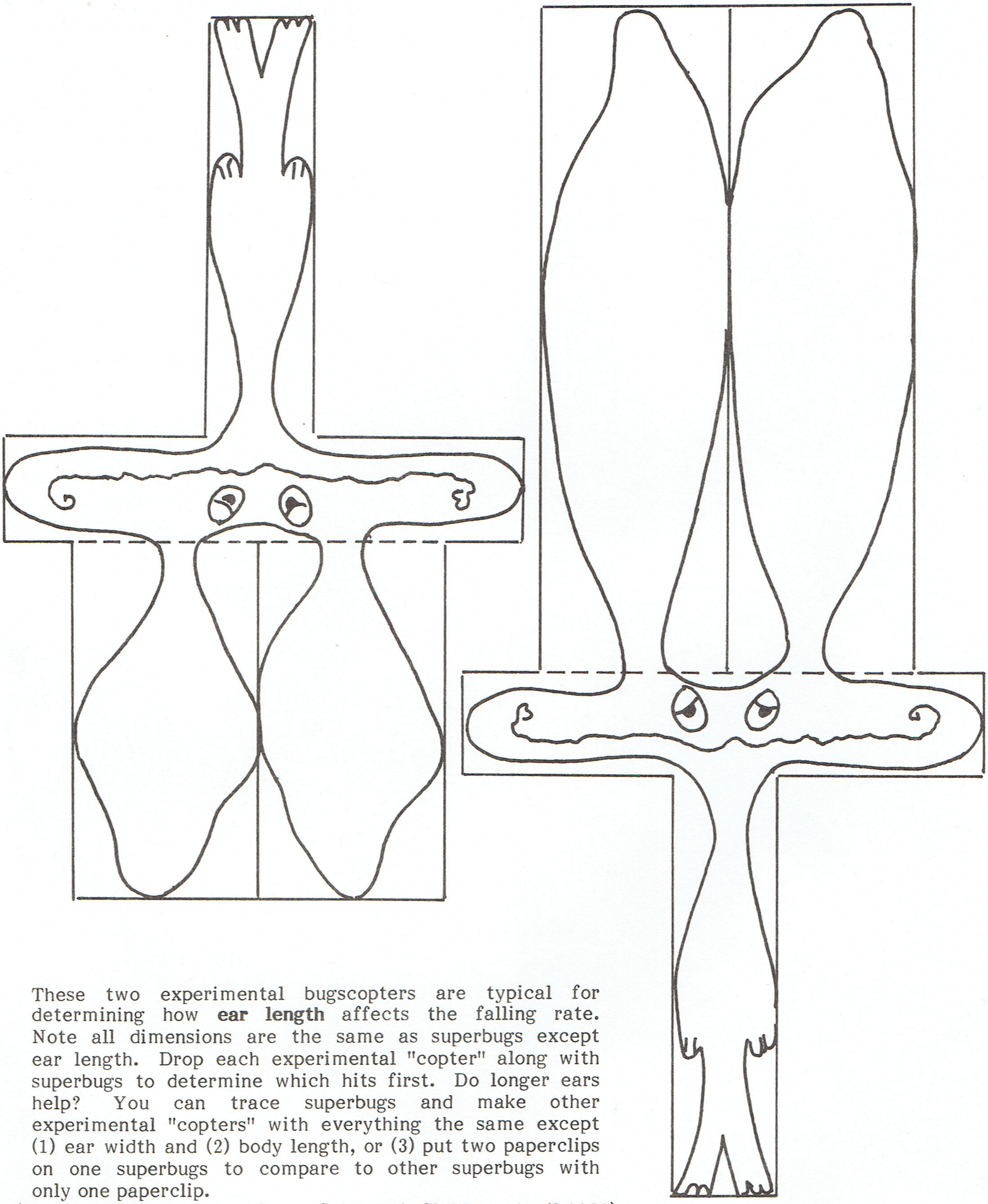
Ideally, all students will learn from the previous four experiments and end up with similar designs (i.e., wide, long ears and short body with one paper clip).

*** - Develop process skills by involving students as much as possible in these activities.**



Sample Bugscopters

Note variety of dimensions. Cut along outside straight lines, down between ears and fold along dotted lines. Use a small paperclip at paws. Superbugs is the "control".

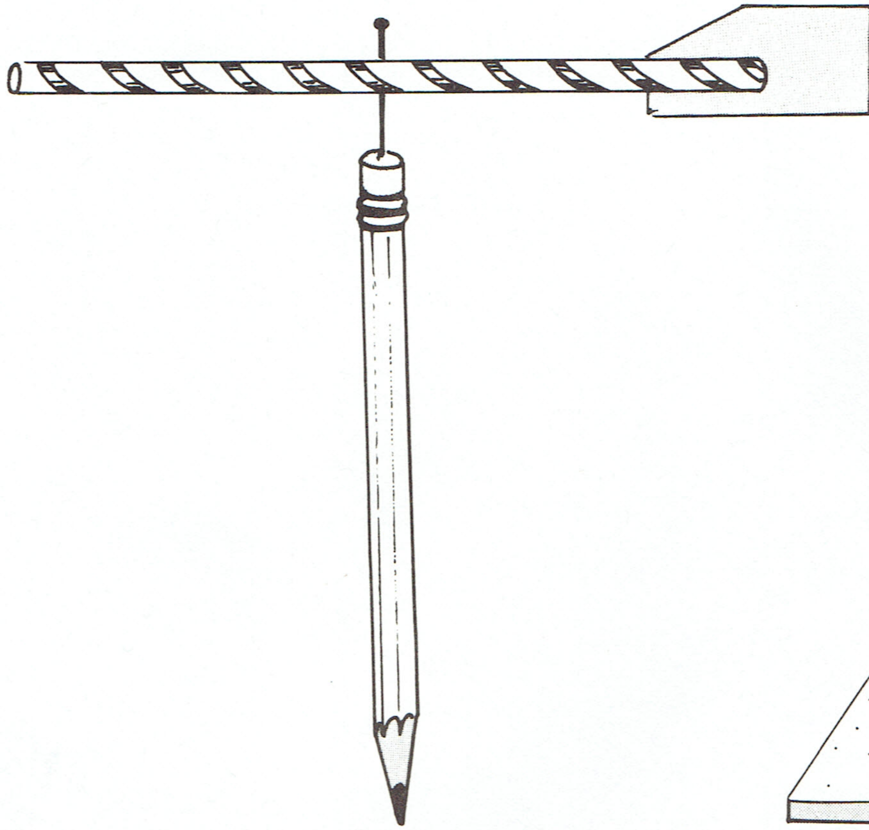


These two experimental bugscopters are typical for determining how **ear length** affects the falling rate. Note all dimensions are the same as superbugs except ear length. Drop each experimental "copter" along with superbugs to determine which hits first. Do longer ears help? You can trace superbugs and make other experimental "copters" with everything the same except (1) ear width and (2) body length, or (3) put two paperclips on one superbugs to compare to other superbugs with only one paperclip.

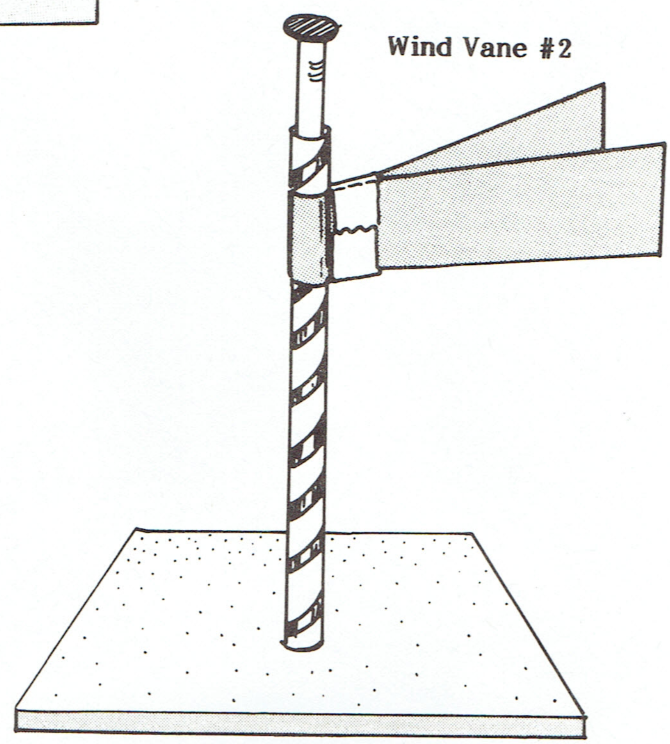
(for more information, refer to *Science & Children*, April 1982)

WEATHER INDICATORS

Wind Vane #1



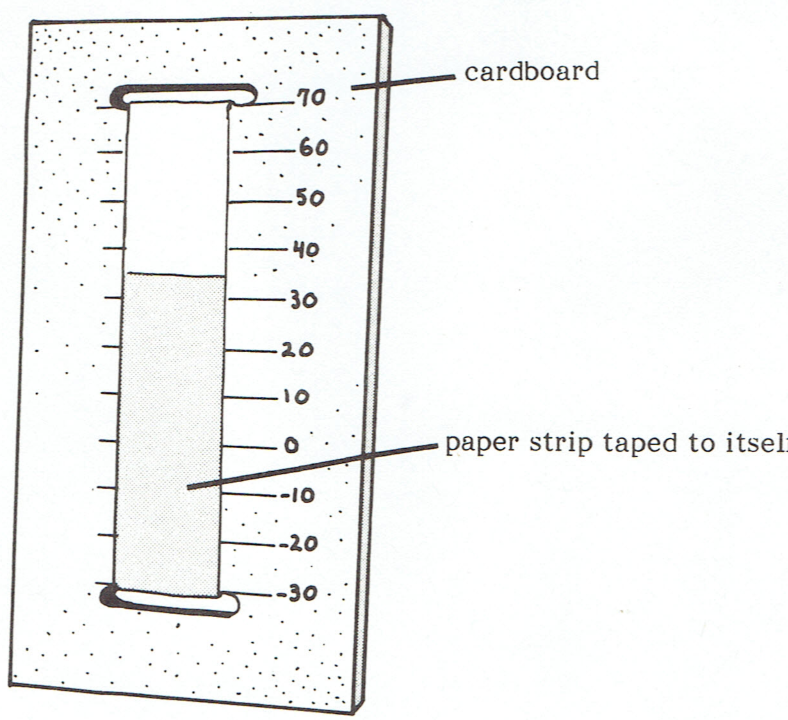
Wind Vane #2



(from page ES(P)-9

Bulletin Board Temperature Indicator

(extra classroom idea)

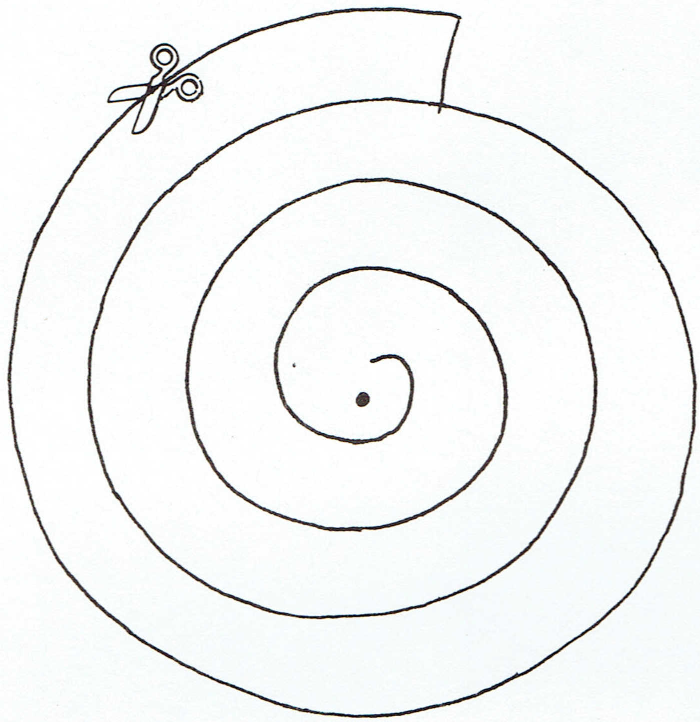


HOT AIR SPIRAL

(Use to demonstrate that hot air rises)

Materials:

1 piece of paper
30 cm (12") sewing thread
sewing needle
scissors
cellophane tape
light source



Directions:

1. Trace the spiral shown above onto a separate piece of paper or photocopy this page.

2. Cut along the line with scissors to form a 1 cm (3/8") wide spiral of paper.

3. Thread needle and make a knot at one end. Insert needle at center dot of spiral from underneath. Pull thread through to knot. Fasten knot to spiral with tape.

4. Holding the loose end of the thread, hold spiral over the light source and observe its movement. DO NOT HOLD OVER OPEN FLAMES!