Level K–1

PHYSICAL SCIENCE ACTIVITIES

for the Elementary Classroom (KSAM)

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Senior Editor

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INTRODUCTION

<u>Purpose</u>

The primary purpose of the series *Physical Science Activities for the Elementary Classroom: (Level K–1, Level 2–3,* and *Level 4–6)* is to provide elementary teachers with appropriate, quality materials for the enhancement of both science instruction and science learning in their classrooms; to aid them in their efforts to demonstrate to students not only the absolute necessity of a science competency in today's society, but also the simple fact that science can be fun and exciting. Because research has so clearly shown the strong relationship between the cognitive and affective domains—that students, at all levels, learn best those things that they enjoy or find interesting or feel are important—this guide stresses the incorporation of the science processes in hands-on activities that not only feature content integrity but also elicit positive affective responses from students.

Science is a required subject in the elementary curricula in most districts; yet, unfortunately, by the time students reach the middle school or junior high level, far too many have become disenchanted with science. In short, they just don't like it. It appears that much of the explanation for their "turnoff" can be attributed to two factors.

The first factor is the way in which science is presented or portrayed to the students. Science is as much a verb as a noun; one does science as well as learns about science. Science is an activity just as much as it is a body of knowledge. In fact, that body of knowledge—the content of science—developed (and continually expands) as a result of the doing of science. The science processes (see Appendix A) represent a framework of actions or operations that constitute the activity of science and the obtainment of content. Make no mistake, the content of science is vitally important. Content represents previous understandings that allow new scientific endeavors to begin at a point beyond the point at which previous endeavors ended. Content contains the terminology or language of science that allows more effective communication among scientists. And it is content that fuels applied science and technology—those efforts that provide society the myriad advancements that make life easier and better. Thus, science is a blend of both process and content. Historically, however, it has not been so portrayed and presented in many elementary, secondary, and college classrooms. Instead, it has been the content of science that has been stressed, sometimes to the complete disregard of the process of science. Consequently, students come away with a distorted perception of science. They see it only as facts, figures, terms, principles, and theories that must be memorized. No wonder many students find it boring! The content provided to students needs to be balanced with ample opportunities to engage also in the "doing of science"—to manipulate, to observe, to experiment, to discover. Students need to experience the whole of science to perceive it as the exciting adventure it really is.

The second factor contributing to student turnoff is that many concepts in science are inherently abstract; yet, most students at the K–6 level are in the concrete stage of mental development and thus experience difficulty thinking (learning) in abstractions. Along these same lines, it should be noted that the lecture, undoubtedly the most commonly used approach for the teaching of science, is an extremely abstract mode of instruction.

The activities in this guide are designed to provide students with concrete-level experiences to represent and/or supplement science concepts. In essence, they provide a “bridge” for the concrete thinker to better understand those concepts. In addition to promoting mastery of content material, the activities also promote the development of the science processes, including critical thinking and reasoning, and at the same time foster interest, creativity, and enthusiasm. In short, students will find these activities to be enjoyable and exciting avenues leading to a better understanding and appreciation of the world around them.

Physical Science Activities for the Elementary Classroom: Level K–1 is not intended as a K–1 science curriculum even though most physical science topics covered at this level are addressed by the activities. Rather, this activity guide is specifically designed to supplement and enrich any existing curriculum.

Activity Format

The activities in this guide were written for teachers. All activities follow a standard format developed by teachers to be of maximum utilitarian value. In fact, teachers will find the activities to be much like lesson plans. The format consists of ten components.

1. **Primary Content:** identifies the major content thrust(s) of the activity.
2. **Process Skills:** lists those science processes used by students in completing the activity. A complete listing of the processes, including definitions, is included in Appendix A. The processes listed under this heading will follow the same order as that presented in the appendix which, generally, runs from less complex to more complex.
3. **Prior Student Knowledge:** identifies any special knowledge, skills, or understandings needed by students to effectively complete the activity. When none are listed, normal skills and abilities for the general grade level of the activity are assumed.
4. **Group Size:** indicates the recommended size of student groups for effective learning. Entries under this heading typically fall into one of three categories: individual, groupings of various sizes, or whole class. Of course, availability of materials, class size, and teacher objectives may necessitate adjustments of the group size.
5. **Pre-Activity Preparation:** lists and describes any special materials and/or preparatory work that the teacher needs to do prior to doing the actual activity. The obtainment of typical or common materials is not included here; however, such materials are identified under the Materials Per Group heading.
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7. **Teacher Information:** content information that may be needed by the teacher to fully understand the activity concept(s) and/or to effectively direct the activity in the classroom. It should be noted that this information is intended for the teacher; there is no implication that this material be wholly transferred to students. How much, if any, of the information contained in this section is presented to students is solely a decision of the teacher based upon grade level, objectives, and student abilities.

8. **Procedure:** a detailed, easy-to-follow listing of the steps necessary to set up and complete the activity. Also included for most activities are a whole-class introduction and post-activity closure, both often in the form of suggested questioning sequences and/or discussion topics which the teacher can adapt to the appropriate student level.
9. **Extensions and Adaptations:** identifies appropriate activity extensions and adaptations to aid in the further development or reinforcement of the activity concepts.
10. **Reproducibles:** while not listed as an individual heading, all reproducibles that accompany the activity are identified in the Pre-Activity Preparation section and the Materials Per Group section, as well as in the Procedure. Reproducibles that have specific answers are included in the Answer Key.

Post-Activity Closure

Educational research has long supported the fact that post-activity closure is extremely important to concept attainment. Such closure may take many forms: an informal class discussion, a specific questioning sequence, review of the activity procedure and the results or answers obtained, etc. Most of the activities in this guide contain closure to one degree or another. Frequently, when time starts running short, the "closure section" is the easiest to omit. You are encouraged to retain closure to all activities, and when possible, to expand on the suggestions presented in this guide. When time does start running short, remember that closure can always be carried over to a subsequent day.

Activity Location

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The Table of Contents groups the activities by major topics. Abbreviated Activity Descriptions follow the Introduction. These descriptions stress the content nature of the activities—usually the first concern of a teacher. The activity numbers and page numbers are also included for quick reference.

National Science Content Standards

The National Research Council in cooperation with a number of other scientific and education associations, has established a set of national science content standards for all grade levels, K–12, in an effort to improve the quality of school science. The standards are divided into three categories based upon grade level: K–4, 5–8, and 9–12.

All the activities in *Physical Science for the Elementary Classroom: Level K–1* have been correlated to science content standards for grades K–4. That correlation, and a listing of the standards, can be found in Appendix B, page 128.

A Note on Safety

There is a need to be concerned about student safety in any hands-on activity in any subject. Of course, the degree of risk varies depending on the materials involved, the age and maturity level of the students, and the degree of adult supervision. Teachers sometimes think that they need be concerned only with those activities that involve heat, volatile chemicals or materials, or potentially toxic substances. However, even seemingly harmless items can become a safety threat in the more open and unstructured environment that typically accompanies hands-on learning.

In utilizing the activities in this guide, students should be closely supervised at all times. In addition, you are urged to exercise caution and good judgment in all matters that might affect the safety of students. It is also recommended that if a student feels uncomfortable or sensitive about participating in a given activity, an alternate experience should be provided for that student.

ABBREVIATED ACTIVITY DESCRIPTIONS

ACTIVITY NUMBER	TITLE	PAGE	ABBREVIATED ACTIVITY DESCRIPTION
1	Runrok	2	describing a substance by its physical properties
2	Balance Adventure	4	measuring mass with a simple balance
3	Metal Madness	8	classifying materials as metals and nonmetals
4	Is It the Same?	13	conservation of matter—shape versus volume of a liquid
5	Shape Shifter	16	conservation of matter—shape versus volume of a solid
6	Take It to the Limit	20	concept of solubility; solution capacity
7	I'm All Stirred Up	22	solubility and water movement
8	Resolve to Dissolve	26	relationship between temperature and solubility
9	Sink or Float	30	concept of floating and sinking; introduction to density
10	Are You Mixed Up?	34	concept of miscible or immiscible liquids
11	The Case of the Missing Water	38	concept of evaporation
12	Stay Cool	41	effect of wind on evaporation
13	The Great Salt Paint	44	relationship between air temperature and evaporation
14	The Race to Evaporate	47	evaporation rate as a function of liquid type
15	The Big Freeze	50	expansion of water during freezing
16	Hot or Cold	54	change in state and/or characteristics of substances with the addition or removal of heat
17	How Would You Like Your Change?	56	physical and chemical changes in matter
18	Invisible Ink	58	chemical change in matter as indicated by a change in color
19	Making Moo Glue	60	chemical reactions make new substances
20	Penny Drop	64	surface tension of water
21	Scientific Tug of War	67	friction and surface texture; the effect of lubricants on friction
22	Pushy-Pully	72	directional response of objects to forces
23	Toy Speedway	75	relationship between the duration of applied force and the distance of movement
24	The Domino Effect	80	force-induced motion that is not unidirectional
25	Potential to Be Kinetic	82	concept of potential and kinetic energy

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ACTIVITY 9

SINK OR FLOAT

PRIMARY CONTENT

- Concept of floating and sinking
- Introduction to density

PRIOR STUDENT KNOWLEDGE

Previous exposure to the concept of the molecular makeup of matter

PRE-ACTIVITY PREPARATION

1. Prepare one set of sink/float objects for each group. A set should contain one of each of the following eleven objects: a rock, a paper clip, a section of stick or twig, a penny, a piece of sponge, a piece of chalk, a cork, a tight ball of aluminum foil, a piece of plastic foam, a nail, and a wad of tissue.
2. Copy reproducible Student Data Sheet (page 33), one copy per student

PROCESS SKILLS

Observing, classifying, inferring, predicting, recording data, experimenting

GROUP SIZE

2–5 students, followed by whole class

MATERIALS PER GROUP

- 1 sink/float objects set
- 1 plastic shoe box, dishpan, or other suitable container $\frac{1}{2}$ filled with water
- 1 yellow crayon for each student
- 1 copy of reproducible Student Data Sheet for each student
- Modeling clay (for teacher demonstration)
- Playing marbles (for teacher demonstration)

TEACHER INFORMATION

Whether an object sinks or floats depends on two factors: the density of the material making up the object and the shape of the object. Density is the only factor considered in this activity. While shape is certainly important (steel is surely denser than water and will sink unless it is forged into the right shape—perhaps a battleship!), the buoyancy principles involved are considered too complex for understanding at this level. In terms of density alone, an object will sink if the material composing the object is denser than water; and an object will float if it is made up of a material that is less dense than water.

Density is not an easy concept in and of itself; plus it requires at least an acceptance of the molecular structure of matter. Still, it needs to be introduced at the K–1 level, then refined and reinforced at subsequent levels. The introduction to density is the main purpose of this activity.

Density is defined as mass per volume, its formula thus being $D = \frac{M}{V}$. Here on earth (under the same gravitational force), weight (in grams) can be used in place of mass. Volume is held constant at a cubic centimeter. As a consequence, density really tells us how much a cubic centimeter of a given material weighs. Note that density is not just weight (a log weighs more than a playing marble, but it is less dense that a marble); neither is density just size or volume (a log is also bigger than a marble, but still has a lower density). It is the ratio of weight to a given volume. In other words, one cubic centimeter of log weighs less than one cubic centimeter of playing marble.

The density of a material is determined by two factors:

1. The first factor is its molecular spacing (how closely packed or widely spaced the molecules are). The closer the molecular spacing, the more actual material there will be in that cubic centimeter of space, thus the greater the weight will be, and thus the higher the density.
2. The second factor is the actual mass of the molecules making up the material. This activity addresses only molecular spacing as a control of density.

PROCEDURE

PART A: Student Activity

1. If necessary, reacquaint students with the concept that materials are made up of extremely tiny units of matter called molecules.
2. Introduce the activity by asking the class why some things float and other things sink. Invariably, the explanation put forth by students will be that "heavy" things sink and "light" things float. Respond to this explanation with the question, "Which weighs more, a playing marble or a log from a tall tree?" Obviously a log weighs more than a marble, yet a log floats and a marble sinks. So weight alone cannot be the factor deciding which things float and which things sink. Indicate to students that today they will be taking a little closer look at floating and sinking.
3. Group students and distribute materials.
4. Instruct groups to observe the eleven objects provided. Have each student individually predict which objects will float, which will sink, and which will initially float and then sink within a minute or two. Have them make their predictions on their Student Data Sheet by using a pencil to mark the appropriate box beside each object with a large "X." (The Student Data Sheet is picture coded; names and descriptions are also included. If necessary, explain the Student Data Sheet to students prior to this step.)
5. Have students lay each object in the objects set onto the water, one object at a time, and observe the results. If the object floats, tell students to wait a minute or two before removing it to see if it is a floater that then sinks. Have each student record the results for each object prior to testing the next object. Tell each student to record his/her results on the Student Data Sheet by coloring the appropriate box yellow. Have students notice that if the box they colored yellow is the same one that they marked with an "X" in pencil, their prediction was correct.
6. When the groups have completed their testing, have students sort the objects into the three categories: sinks, floats, floats then sinks. Ask them to carefully observe the objects in each category. Are there any generalizations they can make about the sinkers versus the floaters versus the floaters/sinkers? Tell them to be especially concerned with the material the objects are made of.
7. Conduct a post-activity discussion and review of results. Include questions such as:
   - Which items sank? *(rock, paper clip, penny, chalk, aluminum foil, and nail)* List items on the chalkboard.
   - Which items floated? *(stick, cork, plastic foam, and, depending on the type used, possibly the sponge)* List items on the chalkboard.
   - Which items floated at first but than sank? *(tissue wad and, depending on the type used, possibly the sponge)* List items on the chalkboard.
   - Did you notice anything about the type of material the floaters, sinkers, and floaters/ sinkers were made of? *(Students will probably notice that the floaters/sinkers were made of material that absorbed water, thus gradually becoming waterlogged. They will probably also make the observation that most of the sinkers were made of metal or rock—although they probably won't know it, chalk is a type of rock; while the floaters were all made of nonmetal material.)*

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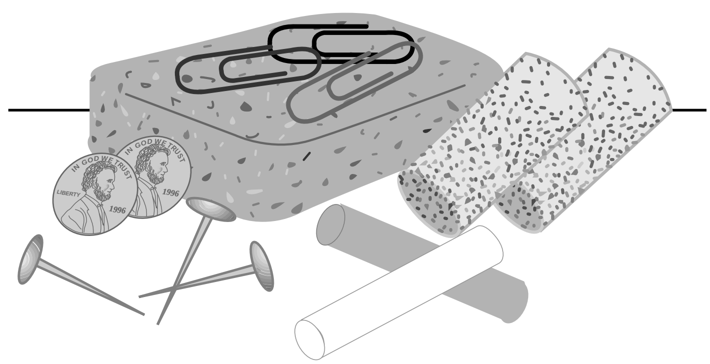
PART B: Teacher Demonstration

1. Introduce the concept of density through the following teacher demonstration.
   a. At this level, it is sufficient to explain the density of a material by describing how closely spaced or packed the molecules are that make up that material—that in some materials, like plastic foam, cork, or wood, the molecules are widely spaced, while in other materials, like metal and rock, the molecules are packed much closer together. The more closely packed the molecules are of a material, the greater will be its density.
   b. Illustrate by forming two spheres using modeling clay. The spheres should be made as large as possible (depending on how much clay is available), but of equal size. In one sphere embed marbles sparsely into its surface. In the other sphere, embed marbles densely into its surface.
   c. Tell students that the spheres represent two objects (rock and wood), and that the marbles represent the molecules that make up those objects. Have them observe how the marbles (molecules) of rock are spaced much closer together than the marbles (molecules) of wood. Thus, rock is denser than wood.
   d. Also have them notice that, even though they are the same size, the denser material (rock) is actually made up of more material or molecules (marbles) than is the wood.
   e. Indicate that all materials—solids, liquids, and gases—have density since they are made of molecules, but how high or low the density is depends upon the spacing of the molecules.
2. End by explaining that floating or sinking is determined by how the density of the object compares to the density of water. Objects made of material that has a density greater than the density of water will sink in water; or putting it another way, if the molecules of the material are spaced closer together than are the molecules of water, it will sink. On the other hand, objects made of material that has a density less than the density of water will float in water; or, if the molecules of the material are more widely spaced than are the molecules of water, the material will float. With a floater/sinker, the material at first is less dense than water, so it floats. However, because the material is such that it absorbs water, its density gradually increases until it no longer can float.

EXTENSIONS AND ADAPTATIONS

1. This activity is appropriate for use in a learning center.
2. Ask students to change the shape of a ball of aluminum foil to make an object that initially doesn't float into one that does.
3. Related activity Are You Mixed Up? on page 34.

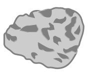
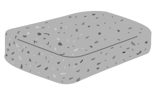
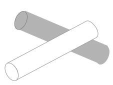
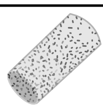
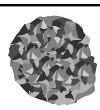
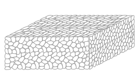


SINK OR FLOAT

ACTIVITY 9

STUDENT DATA SHEET

Name ______________________________

 rock	SINK	FLOAT	FLOAT SINK
 paper clip	SINK	FLOAT	FLOAT SINK
 stick or twig	SINK	FLOAT	FLOAT SINK
 penny	SINK	FLOAT	FLOAT SINK
 sponge	SINK	FLOAT	FLOAT SINK
 chalk	SINK	FLOAT	FLOAT SINK
 cork	SINK	FLOAT	FLOAT SINK
 ball of aluminum foil	SINK	FLOAT	FLOAT SINK
 plastic foam	SINK	FLOAT	FLOAT SINK
 nail	SINK	FLOAT	FLOAT SINK
 wad of tissue	SINK	FLOAT	FLOAT SINK

How many boxes are both marked with an X and colored yellow? __________

Level 2–3

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Life Science Activities for the Elementary Classroom: Level 2–3 is not intended as a 2–3 science curriculum even though most life science topics covered at this level are addressed by the activities. Rather, this guide is specifically designed to supplement and enrich any existing curriculum.

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1	Look What I've Found!	2	Classifying things as living and nonliving
2	Secret Scavengers	5	Classifying items; interpreting classification criteria
3	One Size Fits All	10	Interpreting animal sizes from scale drawings
4	What Big Teeth You Have!	18	Understanding functions of different types of teeth; introducing herbivores, carnivores, and omnivores
5	Let's Eat	24	Classifying animals as carnivores, herbivores, or omnivores based on tooth characteristics
6	Don't Be an Egghead	26	Nutrition and the basic food groups
7	Rubber Chicken	30	Role of calcium in strong bone development
8	Watch Me Breathe	35	Relationship between breathing rate and level of physical activity
9	Take a Deep Breath	39	Functions of the lungs, diaphragm, and rib cage in respiration
10	Pop Your Bubble	44	Measuring and comparing lung capacity
11	My Heart Beats for You	47	Relationship between pulse rate and physical activity
12	Toad-Sicle	51	Correlating temperature and activity in cold-blooded vertebrates; warm- and cold-blooded animals
13	A Picnic for Ants	56	Investigating food preferences in ants
14	Does Your Worm Squirm?	59	Investigating earthworm response to stimuli
15	Waterlogged Seeds	64	Understanding seed parts and their functions; observing the life cycle of a flowering plant
16	How Does Your Garden Grow?	67	Relationship between type of planting media and plant growth
17	How Does It Measure Up?	70	Measuring growth rate of sunflower seedlings; communicating scientific information
18	Growing Up	76	Sequencing of plant growth and development
19	Celery Straws	81	Water movement through plants
20	Topsy-Turvy	87	Directions of root and stem growth in germinating seeds
21	Which Way Is Up?	92	Response of stem growth to gravity
22	A'mazed Plants	96	Plant-growth direction and available sunlight
23	Is There Air in There?	100	Oxygen production by green plants during photosynthesis
24	Too Much of a Good Thing	102	Effect of relocating a plant to a different habitat
25	My Tree and Me	105	Seasonal changes in, and characteristics of, a deciduous tree

ACTIVITY NUMBER	TITLE	PAGE	ABBREVIATED ACTIVITY DESCRIPTION
26	Hide and Seek	114	Camouflage as a survival adaptation in animals
27	In the Mood for Food	118	Classifying animal adaptations related to obtaining food
28	Critters from Zok	120	Animal adaptations to their environment
29	Catastrophe!	125	Effects of an unpredictable food supply on an animal population
30	The Nut Chase	129	Effects of overcrowding on an animal population
31	My Friendly Neighbors	134	Relating plants and animals to their habitats
32	What Do Little Fish Eat?	137	Importance of small pond and stream animals in the food chain
33	Don't Rattle My Chain	143	Food chains; effects on a food chain of human disruptions
34	World in a Jar	148	Roles of producers, consumers, and decomposers
35	The Acid Truth	150	Effect of acid rain on plants
36	A Disappearing Act	152	Role of decomposers; decomposition rates; landfills

ACTIVITY 19

CELERY STRAWS

PRIMARY CONTENT

The movement of water through plants

PRIOR STUDENT KNOWLEDGE

Ability to make measurements with a metric ruler

PRE-ACTIVITY PREPARATION

1. Obtain fresh celery with leaves, enough to provide each group with one complete stalk. For each stalk, cut off the whitish bottom part and then make a vertical cut 10 cm to 15 cm (4 in. to 6 in.) in length, beginning at the bottom of the stalk (see illustration at step 6 of the Procedure). Keep celery refrigerated until ready for use.
2. Copy reproducibles Student Data Sheet (page 84) and Line Graph (page 85), one copy of each per student

PROCESS SKILLS

Observing, comparing, inferring, measuring, recording data, communicating

GROUP SIZE

1–3 students, followed by individual

MATERIALS PER GROUP

- Masking tape
- 2 plastic cups 177 mL–355 mL (6 oz–12 oz)
- Available water
- Red and blue food coloring
- 1 prepared celery stalk (see Pre-Activity Preparation)
- 1 metric ruler
- 1 copy of reproducible Student Data Sheet for each student
- 1 copy of reproducible Line Graph for each student

TEACHER INFORMATION

This activity demonstrates how plants absorb and transport water. The efficient dispersal of water throughout a plant is vital since water is necessary for photosynthesis and food production as well as for carrying dissolved minerals throughout the plant. Most plants absorb water from the ground through their roots. The water travels up through tiny tubes to all parts of the plant, including the very top. This is true for even the tallest trees.

For best results, initiate this activity very early in the school day to allow time for six hourly observations and measurements.

PROCEDURE

1. Introduce the activity by reminding students that plants need water to survive since water is necessary for the food-making process of plants (photosynthesis) and for carrying dissolved minerals throughout the plant. Discuss this concept as necessary.

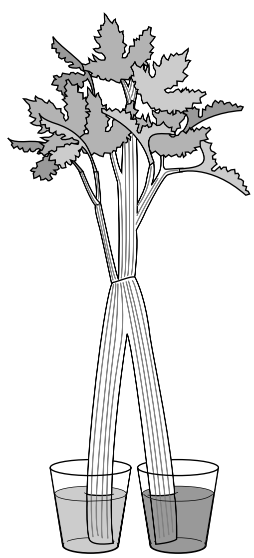
2. Ask students if they have any idea how water is transported within a plant—does it move up through all the plant tissues, or is it carried through small tubes or veins somewhat like blood is carried in our veins? Indicate that the purpose of today's activity is to answer that question.

3. Group students and distribute all the materials except the reproducible Line Graph. Guide students through steps 4–6.

4. Have students in each group write the names or initials of the group members on a strip of masking tape and then attach the strip to one of the cups.

5. Have each group fill their 2 cups about three-quarters full of water. Then have them add red food coloring to one cup and blue food coloring to the other, stirring to mix. Make sure they add enough food coloring to produce *deep* colors.

6. Point out to students that their celery stalks have been cut part way up the middle, dividing the main stalk into two halves. Ask students to set their two cups side-by-side. Have them place the stalk in the cups so that one half of the stalk is in the blue water and the other half of the stalk is in the red water (see illustration).



7. Instruct each group to carefully move their setup to a location in the room where they can make observations and measurements hourly throughout the day and once again tomorrow morning (after twenty-four hours).

8. Each hour, ask groups to measure (in centimeters) the height of the red water and of the blue water in the celery-stalk halves. Students should record this information in the appropriate columns of their Student Data Sheets. Assist students in finding the average length of the two lengths (red length plus blue length divided by 2). Have them record this average length in the last column on their sheets.

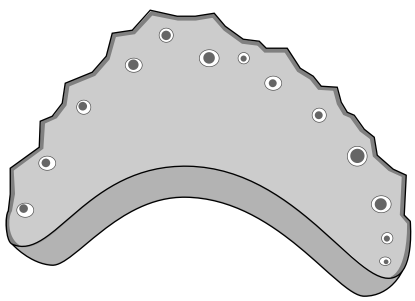
9. The next morning (twenty-four hours later), students in each group should make one final observation and measurement.

10. Distribute the reproducible Line Graph to each student and have each plot the celery data as a line graph.

11. Conduct a session to review and discuss results. (See Teacher Information.) Include questions such as:
    - Did the water move up through all the plant tissue? *(No, it rose through small, separated tubes in the stalk.)*
    - Did the water rise at the same rate in both halves of the stalk? *(Yes, in most cases.)*
    - Did the water rise the same amount each hour? *(Often yes, at about 5 cm per hour; however, exceptions will occur, related to factors such as total length of the stalk, initial dryness or freshness of the stalk, environmental variations affecting the stalk throughout the day [for example: located in an area that has bright sun for part of the day and shadow for the rest of the day, temperature consistency within the room, wind or draft consistency within the room].)*
    - What was the average rise of water per hour? *(Answers will vary.)*
    - Can you think of any reasons (variables) to explain why there was variation in the data among the groups (if such occurred)? *(See the variables previously identified.)*
    - Do you think that most plants have special veins or channels to carry water to the rest of the plant? *(yes)*

EXTENSIONS AND ADAPTATIONS

1. After the twenty-four hour period, use a single-edged razor blade to cut one or more thin cross sections from one of the celery stalks. Allow students to examine the cross sections by eye and with a hand magnifier. They will clearly see colored spots (celery "strings") where water transport occurs (see illustration below).



2. Do the same activity with each group using 2 stalks of celery. Treat one stalk as in the original activity. Put the split ends of the second stalk in 2 empty cups. At the end of twenty-four hours (and after you have finished the measuring procedure with the first stalk), pour colored water into the 2 cups with the second stalk and repeat the measuring procedure. Plot the water rise of the second stalk on the same graph as the first stalk, but use a different color pencil. Discuss the differences between the water rise of the first stalk and that of the second stalk. *(The second stalk will have become dry by the time the water has been added. The water will typically rise much faster in the second [dry] stalk than in the first [fresh] stalk—much as a dry sponge will take in more water more quickly than a wet sponge.)*

3. Discuss how the veins stick out on a celery stalk. Compare them to the veins in students' hands.

4. Try the same activity using other plants. Bok choy, because of its white color, works extremely well—although it is more expensive than celery. White carnations show colored streaks in their petals when placed in colored water.

CELERY STRAWS

STUDENT DATA SHEET

Name____

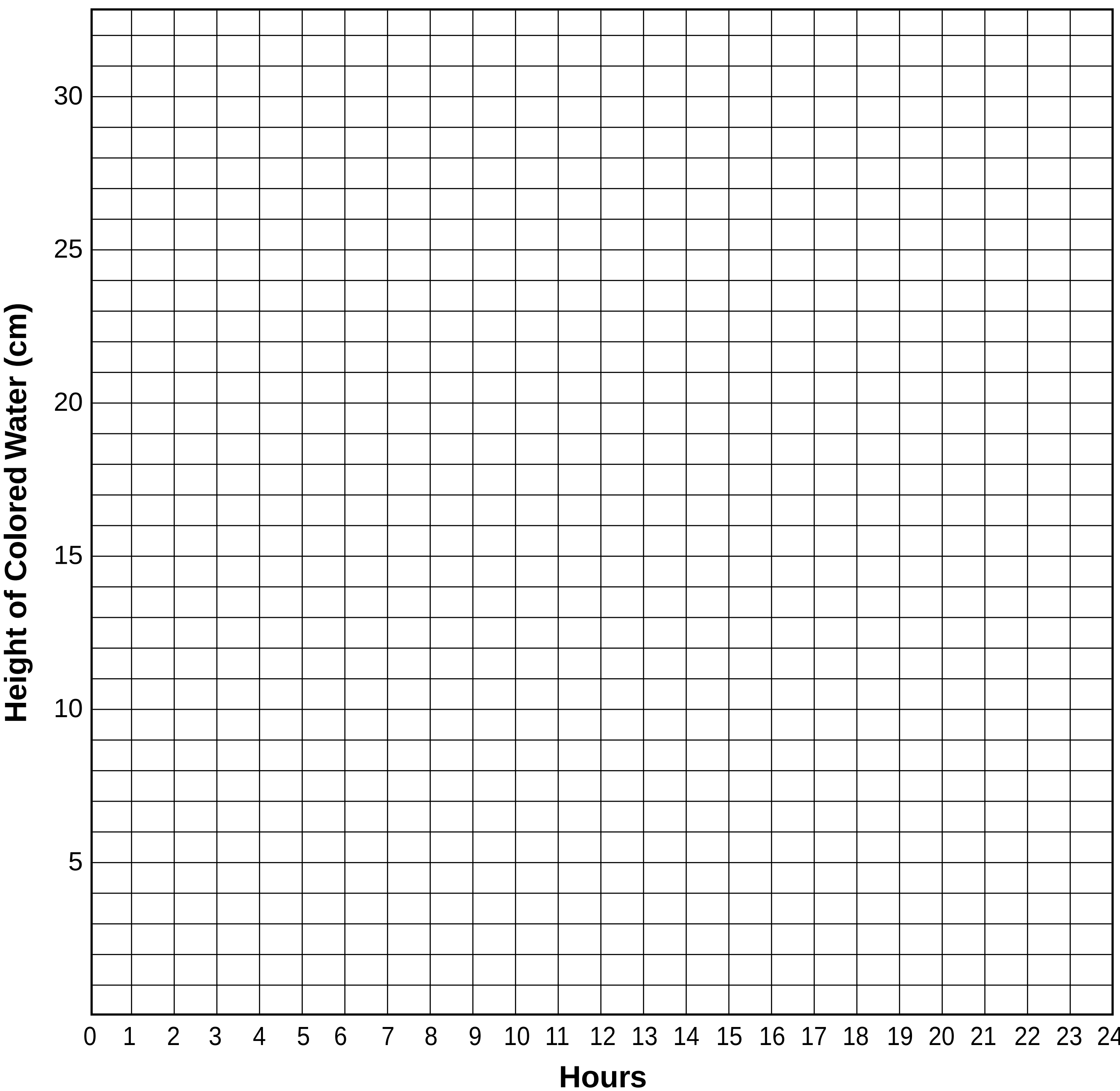
DATA TABLE

Time in hours	Length of Red Color in centimeters	Length of Blue Color in centimeters	Average Length (of red and blue)
0			
1			
2			
3			
4			
5			
6			
24			

CELERY STRAWS

LINE GRAPH

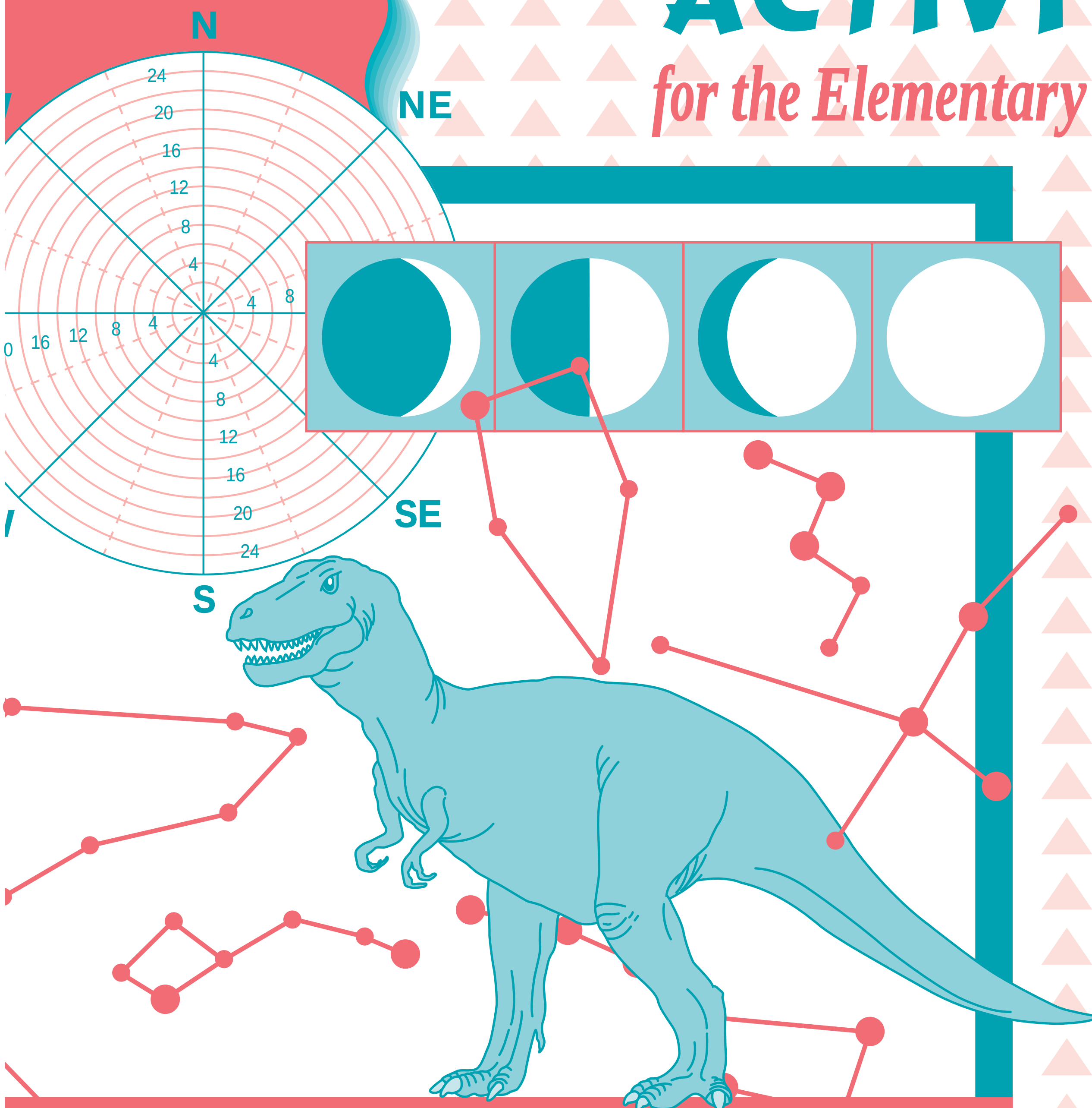
Name____



Level 4–6

EARTH SCIENCE ACTIVITIES

for the Elementary Classroom (KSAM)



Ernest L. Kern,
Senior Editor

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INTRODUCTION

Purpose

The primary purpose of the series *Earth Science Activities for the Elementary Classroom: (Level K–1, Level 2–3,* and *Level 4–6)* is to provide elementary teachers with appropriate, quality materials for the enhancement of both science instruction and science learning in their classrooms; to aid them in their efforts to demonstrate to students not only the absolute necessity of a science competency in today's society, but also the simple fact that science can be fun and exciting. Because research has so clearly shown the strong relationship between the cognitive and affective domains—that students, at all levels, learn best those things that they enjoy or find interesting or feel are important—this guide stresses the incorporation of the science processes in hands-on activities that not only feature content integrity but also elicit positive affective responses from students.

Science is a required subject in the elementary curricula in most districts; yet, unfortunately, by the time students reach the middle school or junior high level, far too many have become disenchanted with science. In short, they just don't like it. It appears that much of the explanation for their "turnoff" can be attributed to two factors.

The first factor is the way in which science is presented or portrayed to the students. Science is as much a verb as a noun; one does science as well as learns about science. Science is an activity just as much as it is a body of knowledge. In fact, that body of knowledge—the content of science—developed (and continually expands) as a result of the doing of science. The science processes (see Appendix) represent a framework of actions or operations that constitute the activity of science and the obtainment of content. Make no mistake, the content of science is vitally important. Content represents previous understandings that allow new scientific endeavors to begin at a point beyond the point at which previous endeavors ended. Content contains the terminology or language of science that allows more effective communication among scientists. And it is content that fuels applied science and technology—those efforts that provide society the myriad advancements that make life easier and better. Thus, science is a blend of both process and content. Historically, however, it has not been so portrayed and presented in many elementary, secondary, and college classrooms. Instead, it has been the content of science that has been stressed, sometimes to the complete disregard of the process of science. Consequently, students come away with a distorted perception of science. They see it only as facts, figures, terms, principles, and theories that must be memorized. No wonder many students find it boring! The content provided to students needs to be balanced with ample opportunities to engage also in the "doing of science"—to manipulate, to observe, to experiment, to discover. Students need to experience the whole of science to perceive it as the exciting adventure it really is.

The second factor contributing to student turnoff is that many concepts in science are inherently abstract; yet, most students at the K–6 level are in the concrete stage of mental development and thus experience difficulty thinking (learning) in abstractions. Along these same lines, it should be noted that the lecture, undoubtedly the most commonly used approach for the teaching of science, is an extremely abstract mode of instruction.

The activities in this guide are designed to provide students with concrete-level experiences to represent and/or supplement science concepts. In essence, they provide a “bridge” for the concrete thinker to better understand those concepts. In addition to promoting mastery of content material, the activities also promote the development of the science processes, including critical thinking and reasoning, and at the same time foster interest, creativity, and enthusiasm.
In short, students will find these activities to be enjoyable and exciting avenues leading to a better understanding and appreciation of the world around them.

Earth Science Activities for the Elementary Classroom: Level 4–6 is not intended as a 4–6 science curriculum even though most Earth Science topics covered at this level are addressed by the activities. Rather, this guide is specifically designed to supplement and enrich any existing curriculum.

Activity Format

The activities in this guide were written for teachers. All activities follow a standard format developed by teachers to be of maximum utilitarian value. In fact, teachers will find the activities to be much like lesson plans. The format consists of ten components.

1. **Primary Content:** identifies the major content thrust(s) of the activity.
2. **Process Skills:** lists those science processes used by students in completing the activity. A complete listing of the processes, including definitions, is included in the Appendix. The processes listed under this heading will follow the same order as that presented in the appendix which, generally, runs from less complex to more complex.
3. **Prior Student Knowledge:** identifies any special knowledge, skills, or understandings needed by students to effectively complete the activity. When none are listed, normal skills and abilities for the general grade level of the activity are assumed.
4. **Group Size:** indicates the recommended size of student groups for effective learning. Entries under this heading typically fall into one of three categories: individual, groupings of various sizes, or whole class. Of course, availability of materials, class size, and teacher objectives may necessitate adjustments of the group size.
5. **Pre-Activity Preparation:** lists and describes any special materials and/or preparatory work that the teacher needs to do prior to doing the actual activity. The obtainment of typical or common materials is not included here; however, such materials are identified under the Materials Per Group heading.
6. **Materials Per Group:** a detailed listing of all materials, supplies, and equipment needed by each student group (as indicated under Group Size) for the activity. This approach makes calculating materials needed for a given activity much simpler. Whenever a listed item is intended for other than the group size previously identified in the activity, such will be indicated with that item listing. With very few exceptions, only easy-to-obtain materials are called for, usually items found in most classrooms or homes. It is assumed that every student will have pencils and paper available, therefore, those items are usually not included in the materials listing.
7. **Teacher Information:** content information that may be needed by the teacher to fully understand the activity concept(s) and/or to effectively direct the activity in the classroom. It should be noted that this information is intended for the teacher; there is no implication that this material be wholly transferred to students. How much, if any, of the information contained in this section is presented to students is solely a decision of the teacher based upon grade level, objectives, and student abilities.
8. **Procedure:** a detailed, easy-to-follow listing of the steps necessary to set up and complete the activity. Also included for most activities are a whole-class introduction and a post-activity closure, both often in the form of suggested questioning sequences and/or discussion topics which the teacher can adapt to the appropriate student level.

9. **Extensions and Adaptations:** identifies appropriate activity extensions and adaptations to aid in the further development or reinforcement of the activity concepts.
10. **Reproducibles and Supplements:** while not listed as an individual heading, all reproducibles that accompany the activity are identified in the Pre-Activity Preparation section and the Materials Per Group section, as well as in the Procedure. Reproducibles that have specific answers are included in the Answer Key. Supplements include pages with instructions for the teacher to make items required for certain activities. Usually these pages do not need to be reproduced.

Post-Activity Closure

Educational research has long supported the fact that post-activity closure is extremely important to concept attainment. Such closure may take many forms: an informal class discussion, a specific questioning sequence, review of the activity procedure and the results or answers obtained, etc. Most of the activities in this guide contain closure to one degree or another. Frequently, when time starts running short, the "closure section" is the easiest to omit. You are encouraged to retain closure to all activities, and when possible, to expand on the suggestions presented in this guide. When time does start running short, remember that closure can always be carried over to a subsequent day.

Activity Location

In some guides, finding the right activity to supplement a given topic is quite a chore and often necessitates reviewing a number of different activities before the right one is located. *Earth Science Activities for the Elementary Classroom* incorporates several aids to help facilitate this task.

The Table of Contents groups the activities by major topics. Abbreviated Activity Descriptions follow the Introduction. These descriptions stress the content nature of the activities—usually the first concern of a teacher. The activity numbers and page numbers are also included for quick reference.

National Science Content Standards

The National Research Council in cooperation with a number of other scientific and education associations, has established a set of national science content standards for all grade levels, K–12, in an effort to improve the quality of school science. The standards are divided into three categories based upon grade level: K–4, 5–8, and 9–12.

All the activities in *Earth Science for the Elementary Classroom: Level 4–6* have been correlated to science content standards for grades K–4 and grades 5–8. These correlations, and a listing of the standards, can be found in Appendix B, pages 204–211.

A Note on Safety

There is a need to be concerned about student safety in any hands-on activity in any subject. Of course, the degree of risk varies depending on the materials involved, the age and maturity level of the students, and the degree of adult supervision. Teachers sometimes think that they need be concerned only with those activities that involve heat, volatile chemicals or materials, or potentially toxic substances. However, even seemingly harmless items can become a safety threat in the more open and unstructured environment that typically accompanies hands-on learning.

In utilizing the activities in this guide, students should be closely supervised at all times. In addition, you are urged to exercise caution and good judgment in all matters that might affect the safety of students. It is also recommended that if a student feels uncomfortable or sensitive about participating in a given activity, an alternate experience should be provided for that student.

ABBREVIATED ACTIVITY DESCRIPTIONS

ACTIVITY NUMBER	TITLE	PAGE	ABBREVIATED ACTIVITY DESCRIPTION
1	Hey Punk!	3	Air temperature and air density; warm air rises and cold air sinks (convection)
2	The Crusher	6	Air pressure; air moves from high to low pressure
3	Impossible	9	Air occupies space; air pressure environments and air flow
4	Which Way Will It Go?	12	Predicting direction of air flow; a “brain-teaser” activity that shows things aren’t always as they seem
5	Highs and Lows	14	Aneroid barometers; constructing a barometer
6	Pressured by the Weather	17	Measuring and recording air pressure; influence of air pressure on weather
7	Add Ice to Make It Boil	22	Relationship between air pressure and boiling temperature
8	Temperamental Temperatures	25	Measuring, recording, and graphing air temperature; variables influencing air temperature
9	What’s It Like in There?	31	Greenhouse effect
10	’Tis the Season	35	Seasonal differences in temperature
11	Windy Way	39	Winds; measurement; naming; making a wind vane
12	Tharr She Blows!	43	Measuring, recording, and plotting wind directions; prevailing winds
13	Is It Full?	49	Relative humidity; evaporation rate; moisture capacity
14	Hot and Dry	52	Air temperature; evaporation rate, moisture capacity; experimental design
15	Windy and Dry	56	Wind movement; rate of evaporation; experimental design
16	Water in the Air	61	Relative humidity and variability; making a psychrometer
17	Create a Cloud	68	Condensation; cloud formation; adiabatic temperature changes (due to changes in air volume)
18	Misty	71	Fog formation; conductional cooling
19	Raindrops Keep Falling on My Head	75	Raindrop formation; measuring raindrop sizes; variation in raindrop sizes
20	Pick-a-Precipitation	80	Precipitation, cloud type, surface temperature, aloft temperature

ACTIVITY NUMBER	TITLE	PAGE	ABBREVIATED ACTIVITY DESCRIPTION
21	Breaking Up Is Hard to Do	88	Rock weathering; physical and chemical weathering agents
22	Paint Tray Erosion	95	Erosion; running water as an erosional agent
23	Down the Drain	98	Permeability, water retention, soil-grain size
24	Crystal Palace	102	Crystal forms and sizes; igneous rocks
25	Mineral Detectives	106	Physical properties of minerals; identifying minerals
26	Geologic Lineup	110	Identifying basic rocks and minerals
27	Fossil Forms	120	Fossils, indicators of the geologic past
28	Dinosaur Word Puzzle	124	Dinosaurs; dinosaur names; starter activity
29	Another Paper Caper	129	Geologic time; constructing a scale model of geologic time
30	Voyage to the Center of the Earth	134	Interior structure of the earth
31	Rock-Layer Sandwich	138	Rock layering; relative-age dating; basic rock structures; faulting; igneous activity
32	Just Drifting Around	142	Introduction to plate tectonics (continental drift)
33	Clean It Up	154	Natural cleaning and filtration of water in the subsurface
34	A Bucketful of Water	159	Distribution of the world's total water supply
35	Moon on a Stick	163	Phases of moon; predicting next lunar phase in sequence
36	Space Shadows	168	Lunar and solar eclipses
37	How Far Is Far?	173	Astronomical distance; modeling planetary distances
38	How Big Is Big?	178	Planetary sizes; modeling planetary sizes
39	Star Light, Star Bright	182	Stars; constellations; locating and identifying selected constellation

ACTIVITY 8

TEMPERAMENTAL TEMPERATURES

PRIMARY CONTENT

- Measuring, recording, and graphing air temperature
- Understanding the variables influencing air temperature

PRIOR STUDENT KNOWLEDGE

Ability to compute averages and to read a thermometer

PRE-ACTIVITY PREPARATION

1. Copy reproducibles Student Data Sheet (page 28) and Bar Graph (page 29), one copy of each per student.
2. Do this activity on a sunny day, starting it as soon as school commences.

PROCESS SKILLS

Observing, comparing, inferring, measuring, predicting, recording data, communicating, identifying variables

GROUP SIZE

2–4 students

MATERIALS PER GROUP

- 1 thermometer
- 1 copy of reproducible Student Data Sheet for each student
- 1 copy of reproducible Bar Graph for each student

TEACHER INFORMATION

A bulb thermometer is an instrument used to measure air temperature. Inside the thermometer bulb is a liquid (mercury or alcohol). When the liquid is heated by warmer air through conduction, the liquid will expand and rise in the tube. When the liquid is cooled by conductive lose of heat to cooler surrounding air, the liquid will contract and fall.

The primary control of air temperature is the amount of solar energy received at a location. Variation in this amount of solar energy is the basic reason that temperatures change throughout the day at a given site—as the sun changes position in the sky, the angle at which the sun's rays strike the earth also changes. The steeper the angle, the more concentrated the energy and the greater the heating; the lower the angle, the more dispersed the energy and the less the heating. Other factors such as changing cloud cover, changing winds, precipitation events, and the influence of fronts and air masses may also contribute to hourly temperature changes.

Even within small areas, spacial variations can characterize temperatures. A number of factors, either singularly or in combination, account for one location having a different temperature than another nearby location. Factors include: the type of surface material, surface colors, moisture availability and resultant evaporation rates, vegetation cover, the type of vegetation, sun exposure versus shade, proximity to buildings, height of the thermometer above the surface, proximity to bodies of water, and wind exposure. It is for such reasons that official temperatures are measured under these strict requirements: in the shade, four feet above a grass surface, and away from buildings.

PROCEDURE

1. Introduce the activity by displaying a thermometer and asking if anyone can explain its operating principle. If necessary, provide that explanation (see Teacher Information).

2. Group students, distribute a thermometer to each group, and assign each group an identification number. Discuss how to properly use a thermometer to measure temperature.

3. Pose questions to the class such as those that follow. Let students discuss and debate but do not provide answers at this time.
   - If a TV reporter says that the current temperature is 74˚ F, to how large an area does that apply? Is that the temperature in all the locations receiving the broadcast?
   - Are temperatures generally the same or different at various spots—throughout, for example, the area of a state? A county? A city or town? A section of town? Our school grounds?
   - At any given spot, in front of our school for example, does the temperature stay pretty much the same during daylight hours, or does it usually change throughout the day?
   - By how much, if any, do you think the temperature changes at our school between morning and afternoon? (Require that students give quantitative guesses [not responses such as a lot or a little] and tally the predictions on the board.)
   - How much, if any, temperature difference do you think there is within the area of our school grounds? (Again require quantitative predictions and tally the results.)

4. To test predictions, tell groups that they are each to conduct an investigation of temperature variability, or the lack thereof, within the school grounds—in terms of time (throughout the day) and location (various spots throughout the grounds).

5. Assign a specific temperature-measuring site to each group. Try to make your assignments as diverse as possible. Just a few of many possibilities include: chest high in the middle of the playground; chest high under the shade of a tree; shoe-top high over the sidewalk; chest high over the sidewalk; chest high right next to the outside wall of a specific classroom; shoe-top-high over the grass in the yard; shoe-top-high over the blacktop by the flagpole; and chest-high over the bare ground by the swings.

6. Distribute Student Data Sheets to students and have each student record his/her group number and site assignment (Thermometer Location). (Note: the data sheet will accommodate up to 14 groups.)

7. On the chalkboard, write the times that readings are to be taken. One measurement each hour is preferable. Temperatures at all sites are to be taken at the appointed times. Members of each group are to record results for their site in the Hourly Data table. It is best if students transport thermometers to and from the sites for each reading.

8. All members of each group can go to the site to take each measurement, or if desired, different members of each group can rotate the taking of readings.

9. Near the end of the day (after the last reading), each group is to compute its average temperature (assist as necessary) and record that value in the table that you will have drawn on the chalkboard (a duplicate of the Average Group Temperatures table on the Student Data Sheet).

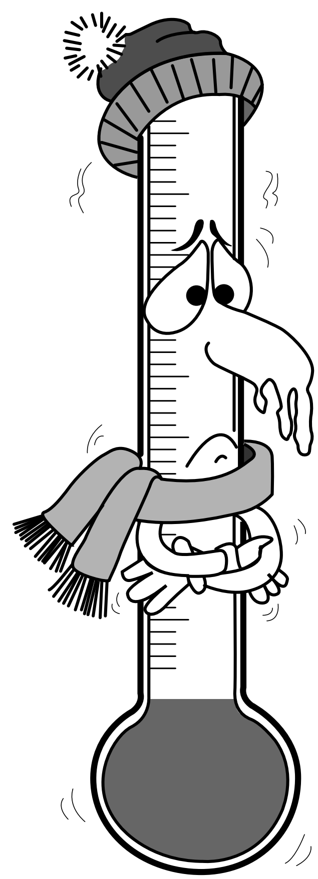
10. Instruct students each to copy the averages from the chalkboard onto their own Average Group Temperatures chart.

11. The next morning, distribute Bar Graph reproducibles to students. Have each student construct a bar graph displaying the average temperatures obtained by the groups at the various sites. Note that the vertical axis on the graph is not labeled in order to accommodate either Fahrenheit or Celsius temperatures. Assist students as necessary with the labeling of that axis.

12. Conduct a session to discuss results and interpretations. Include questions such as:
    - What were your group results regarding temperatures throughout the day? Did they change or stay constant? *(Temperature change over time should have characterized all sites.)*
    - What were the highest and lowest temperatures and the temperature range at each site for the day? *(Results will vary with season and site location.)*
    - How good were your predictions with regard to the amount of daily temperature change? *(Answers will vary.)*
    - In terms of temperature distribution within the area, were the site averages the same or different? *(In all likelihood, variation in site averages will be the rule.)*
    - What was the greatest temperature difference between site averages? The smallest? *(Results will vary with season and site locations.)*
    - How good were your predictions regarding temperature range within the area of the school grounds?
    - Why do you think temperatures vary throughout the day? (see Teacher Information)
    - Why do you think temperatures tend to vary at the same time from location to location, even in a very small area such as our school grounds? (see Teacher Information)

EXTENSIONS AND ADAPTATIONS

1. Groups could take one reading a day at their assigned sites for a month and then compute monthly means and ranges, which can be graphed and compared.
2. You might establish a single permanent temperature-measuring station for the class. Students would measure temperatures at the same time each day for an extended period of time, perhaps the entire school year. This would provide enough data for students to analyze seasonal temperature trends and patterns.
3. You could have students use local media forecasts and data to keep a record of the predicted and the actual daily high and/or low temperatures for a period of time. Let students compare the results and judge the accuracy of the predictions.
4. Related activities What's It Like in There? on page 31 and 'Tis the Season on page 35.



TEMPERAMENTAL TEMPERATURES

STUDENT DATA SHEET

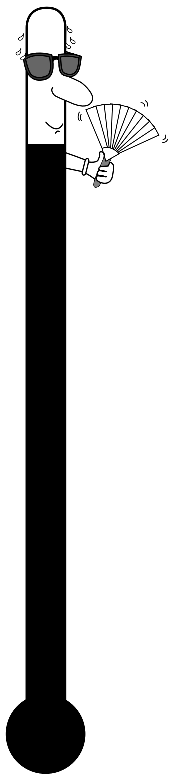
Name ______________________________ **Group Number** __________

Thermometer Location

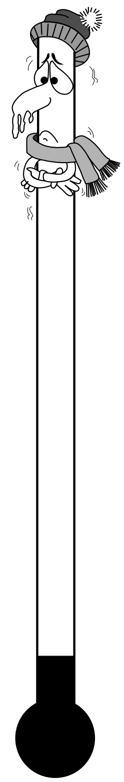
[ ]

Average Temperature

[ ]



HOURLY DATA		
Reading	**Time**	**Temperature**
1		
2		
3		
4		
5		
6		
7		



AVERAGE GROUP TEMPERATURES			
Group #	**Average Temp.**	**Group #**	**Average Temp.**
1		8	
2		9	
3		10	
4		11	
5		12	
6		13	
7		14	

ACTIVITY 8

TEMPERAMENTAL TEMPERATURES

BAR GRAPH

Name ______________________________ **Group Number** __________

GROUP AVERAGE TEMPERATURES