Meteorology Introduction

Meteorology is the study of weather, including all the daily changes in temperature, wind, moisture, and air pressure. Since weather affects what we wear, eat, do, and feel, humans have long tried to understand and predict weather changes.

There are four major elements that interact to produce weather on the earth: sun, air, water, and land. Radiation from the Sun provides the energy for weather changes. Because the Earth is a sphere, the Sun's rays strike the Earth at different angles at each latitude. The greatest warming occurs in the tropics where the angle of the Sun's rays are closest to 90 degrees. Water and land also warm and cool at different rates, thereby heating and cooling the air above them differently. Because warm air rises, and cold air descends, the differently heated air moves, causing wind.

Since air has mass, it also has weight. Air pressure is the force produced by the weight of air pressing down on the Earth. Altitude affects air pressure. As you go higher, the column of air above you becomes less, therefore the weight of air pressing down decreases. Temperature also affects air pressure. Warm air is less dense than cold air and thus exerts less pressure. When different air masses meet, the boundary formed is called a front.

When the heat from the Sun strikes water, some of the water evaporates into the air. The evaporation, condensation, and precipitation of water is an on-going cycle essential to the existence of life on Earth. [The water cycle is further explored in the Water unit.] The evaporation of water into the air produces humidity; its condensation forms clouds. The moisture may fall to the earth as one of the forms of precipitation: rain, snow, hail, or sleet.

Ocean currents are caused and directed by the combined forces of winds, temperature, shape of land masses and the Earth's rotation. They, in turn, have a major effect on weather and climate because the ocean waters hold a large amount of heat.

Temperature, wind, humidity, and air pressure are constantly changing and interacting in complicated ways, making it difficult to accurately predict the weather ahead. Meteorologists use instruments to make observations and look for patterns to help them forecast future weather. Short-term forecasts can have a fairly high degree of accuracy, but forecasts become less reliable as they predict further and further ahead.

Learning about weather in the primary grades focuses on observation and description with very little measurement or gathering of quantitative data. Students can relate changes in weather to their own lives and experiences, asking questions such as "what do I wear when it snows?" or "what do I do when it rains?" Students in the intermediate and middle school grades can measure weather elements, graph and chart changes over time and look for connections between weather elements.

According to the National Science Education Standards (1996), students in grades K-4 should develop an understanding that:

- Weather changes from day to day and over the seasons. Weather can be described by measurable quantities such as temperature, wind direction and speed, and precipitation.

Furthermore, the Standards suggest:

- Emphasis in grades K-4 should be on developing observation and description skills and the explanations based on observations.

- Younger children should be encouraged to talk about and draw what they see and think.

- Older students can keep journals, use instruments, and record their observations and measurements.

Applicable standards for grades 5-8 state that students should understand that:

- The atmosphere has different properties at different elevations.

- Clouds, formed by the condensation of water vapor, affect weather and climate.

- Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

- The Sun is the major source of energy for phenomena on the Earth's surface, such as...winds, ocean currents, and the water cycle.

Introducción a la Meteorología

Meteorología es el estudio del tiempo incluyendo todos los cambios diarios en la temperatura, viento, humedad, y presión del aire. Puesto que el clima afecta lo que nos ponemos, comemos, hacemos y sentimos, la humanidad ha tratado de entender y predecir los cambios del clima por largo tiempo.

Hay cuatro elementos de mayor importancia que interactúan para producir el clima en la Tierra, y que son: Sol, aire, agua y tierra. La radiación del sol provee la energía para los cambios del tiempo. Debido a la forma esférica de la Tierra, los rayos solares la bañan por diferentes ángulos por cada latitud. El calentamiento mayor ocurre en los trópicos donde el ángulo de los rayos solares está cercano a los 90. El agua y la tierra también se calientan y se enfrían en diferentes proporciones, por tanto el calentamiento y enfriamiento del aire sobre ellas es diferente. En virtud de que el aire caliente se levanta y el aire frío se baja, el aire calentado en forma dispareja se mueve, causando el viento.

Puesto que el aire tiene masa, también tiene peso. La presión del aire es la fuerza producida por el peso del aire presionando sobre la Tierra. La altitiud afecta la presión del aire. A medida que uno sube, la columna de aire sobre uno disminuye y por consecuencia el peso del aire que presiona decrece. Finalmente, la temperatura también afecta la presión del aire. El aire caliente es menos denso que el aire frío y por eso ejerce menos presión. Las regiones de aire que tienen mas o menos la misma temperatura, humedad y presión se llaman masas de aire.

Cuando el calor del sol calienta el agua, algo del agua se evapora en el aire. La evaporación, condensación y precipitación del agua es un ciclo en proceso, esencial para la existencia de la vida en la Tierra. [El ciclo del agua se explora mas adelante en la Unidad del Agua.] La evaporación del agua en el aire produce humedad y, la condensación del agua forma las nubes. La humedad puede caer a la Tierra como una de las formas de precipitación: lluvia, nieve, granizo, o aguanieve.

Las corrientes del océano son causadas y dirigidas por las fuerzas combinadas de los vientos, temperatura, forma de las masas de tierra y de la rotación de la Tierra. Éstas, en turno, tienen un mayor efecto en el tiempo y clima porque las aguas de los océanos detienen una gran cantidad de calor.

Temperatura, viento, humedad y presión de aire están constantemente cambiando e influenciándose en formas complicadas, haciendo difícil predecir con precisión el tiempo que se avecina. Los meteorólogos usan instrumentos para hacer observaciones y buscar normas o patrones que los ayuden a pronosticar el tiempo futuro. Los pronósticos a corto plazo pueden tener una precisión moderada de alto grado, pero los pronósticos se vuelven menos confiables cuando se predicen con mucho tiempo por delante.

Aprender sobre el tiempo en los grados escolares primarios enfoca en la observación y descripción con muy poca medida o reunión de datos cuantitativos. Los estudiantes pueden relacionar a sus propias vidas y experiencias los cambios en el tiempo, al hacerse preguntas tales como ¿"Qué me pondré cuando neve?", o, ¿Qué haré cuando llueva?" Los estudiantes en los grados de secundaria pueden medir los elementos del tiempo, anotar y registrar los cambios que se producen en determinado tiempo y buscar las conecciones entre los elementos del tiempo.

De acuerdo a las Normas de Educación Nacional de Ciencia (1996) [National Science Education Standards (1996)], los estudiantes en los grados K-4 deberían desarrollar el entendimiento de que:

- El tiempo cambia día a día, y con las estaciones. El tiempo puede ser descrito en cantidades medidas tales como temperatura, dirección y velocidad del viento, y precipitación.

Más aún, dichas normas sugieren que:

- El énfasis, en los grados K-4, debería ser en las habilidades del desarrollo de la observación y descripción y en las explicaciones basadas en observaciones. Los estudiantes menores deberían ser animados a hablar sobre ello y a dibujar lo que ven y piensan. Los estudiantes mayores pueden llevar anotaciones, usar instrumentos, y registrar sus observaciones y mediciones.

Las normas aplicables para los grados 5-8 estatuyen que los estudiantes deberían desarrollar el entendimiento de que:

- La atmósfera tiene diferentes propiedades a diferentes elevaciones.

- Las nubes, formadas por la condensación de vapor de agua, afectan el tiempo y el clima.

- Las normas o patrones globales del movimiento atmosférico influyen en el tiempo local. Los océanos tienen un mayor efecto en el clima porque el agua de los océanos detiene una gran cantidad de calor.

- El sol es la mayor fuente de energía para los fenómenos atmosféricos sobre la superficie terrestre, tales como ... vientos, corrientes de los océanos, y el ciclo del agua.

MAKING A CLOUD

Grades		
6-8	2-4	40 min.

Note: Appropriate for grades K-5 if done as a teacher demonstration.

Description: Use simple materials to model the process of cloud formation and identify factors necessary for a cloud to form.

Materials for Each Group:
jar or rigid, clear plastic cup
warm water
zipper style bag
ice
matches
black paper

Safety: Use caution and wear eye protection when lighting a match. Perform as a teacher demonstration for younger students.

Procedure:
1. Place 4-5 ice cubes in zipper style bag, close the bag and put it aside.
2. Put about 3/4 inch of warm water in the cup. Light a match. Drop it in the water and quickly cover the top of the cup with the bag of ice.

3. Hold the glass in front of a black piece of paper. Have students describe any changes they see.

4. Remove the ice, observe the glass, then replace the ice. Again, have students describe any changes they see.

Questions to Ask During the Activity:

1. How do we know the visible vapor in the jar is a cloud, and not just smoke from the match? How could we investigate this? Students should discuss possibilities and design a strategy to support their explanations. If they need more guidance, suggest the following variations:

   What would happen if we try it:
   -with an empty plastic bag (no ice)?
   -without lighting the match?
   -with room temperature water?
   -with ice in the cup and warm water in the plastic bag?

   Try each of the above variations as well as others students may think of to show the vapor is a cloud. In each case, record students' observations.

2. Why are the results different in the variations we tried?

3. What conditions are needed for a cloud to form?

4. What else could we use instead of smoke from a match to produce similar results?

Why It Happens: Three things are needed for cloud formation: warm, moist air; cooling of this warm, moist air; and particles for the condensing vapor to hang onto (condensation nuclei). In this activity, the warm water increases the water vapor in the air in the cup. The smoke from the match provides dust particles in the air. The bag prevents the water and dust-filled air from escaping from the cup; and the ice causes the air to cool and condense on the smoke particles. The cloud "swirls" because the cooled, more dense air near the ice sinks while the warm, less dense air rises towards the ice. A mini convection current is formed.

Variations:

1. Without the ice, the air will not cool and condense. Students may observe a small amount of smoke from the match, but this dissipates quickly.

2. Without the smoke, there is not enough dust on which the cooled air can condense, so a cloud will not form.

3. Room temperature water *may* produce a cloud if there is enough water vapor in the glass and if there is enough temperature difference between the air and ice temperature.

4. There is no warm, moist air **in** the cup to condense on the smoke particles, so no cloud will form.

Adaptations for Participants with Disabilities:

- Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.
- Students with visual impairments may need to work with a partner who can describe what is observed.

Extensions: To study what particles are in the air which water could condense on, cut 1 cm x 1 cm holes in several index cards. Cover the holes with tape and place the cards outdoors with the sticky side of the tape facing out. Place the cards in a variety of locations, facing different directions. Write the location on the cards. After several days, collect the cards and seal them in plastic bags. Examine them with a hand lens or a microscope.

Observe clouds in the sky. Make cloud pictures using cotton balls on blue construction paper. The cotton can be pulled into different shapes and thicknesses to better represent the clouds being observed.

Observe the sky and estimate the cloud cover and classify:

>50% clouds	partly cloudy
>75% clouds	mostly cloudy
<50% clouds	slightly cloudy
<25% clouds	mostly sunny

Write cloud poems.

Write a story: "A Day in the Life of a Cloud" or "My Life as a Cloud Water Droplet".

Use a cloud chart to identify types of clouds and the type of weather with which each is associated.

References: Gartrell, Jack E., Jane Crowder, and Jeffrey C. Callister. Earth: The Water Planet. Arlington, VA.: National Science Teachers Association, 1992.

Making a Cloud
Student Activity Page

Boats sail on the rivers,
And ships sail on the seas;
But clouds that sail across the sky
Are prettier far than these.

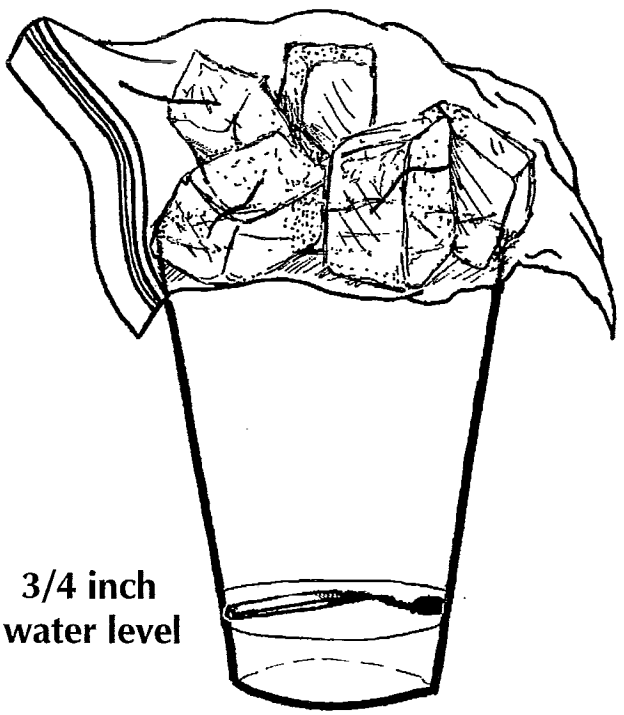
—Christina Georgina Rossetti

Description: You will model the formation of a cloud and determine what is needed for a cloud to form.

Materials for Each Group:
jar or rigid, clear plastic cup
warm water
zipper style baggie
ice
matches
black paper

Safety: Use caution and wear eye protection when lighting a match.

Procedure:
1. Place 4-5 ice cubes in zipper style bag, close the bag and put it aside.
2. Put about 3/4 inch of warm water in the cup. Light a match. Drop it in the water and quickly cover the top of the cup with the bag of ice.



3. Hold the glass in front of a black piece of paper. Describe any changes you see.

4. Remove the ice, observe the glass, then replace the ice. Describe any changes you see.

5. How could you show that the visible vapor in the jar is a cloud, and not just smoke from the match? Describe below what you did and what happened.

What We Did	What Happened

Questions: 1. Why are the results different in the variations you tried?

2. What conditions are needed for a cloud to form?

3. What else could we use instead of smoke from a match to produce similar results?

FABRICANDO UNA NUBE
Hoja de Actividades para el Estudiante

Los botes navegan en los rios,
Los barcos navegan en los mares;
Pero las nubes que navegan por el cielo
Son mucho mas hermosas que aquellos.

—Christina Georgina Rossetti

Descripción: Se modelará la formación de una nube y se determinará qué se necesita para formarla.

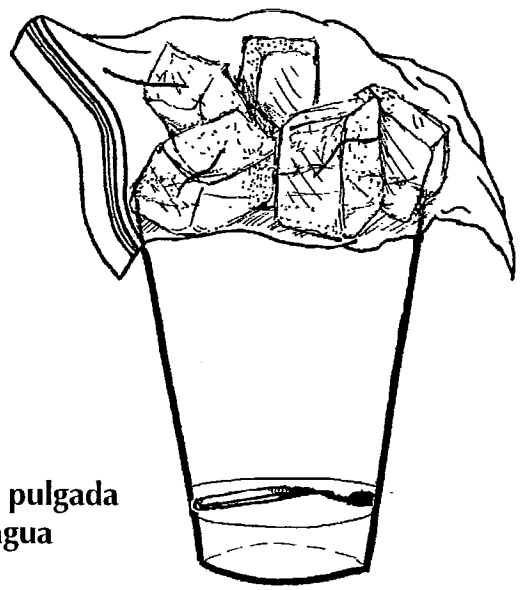
Medidas de Seguridad: Tener precaución y usar lentes protectores cuando se encienda un cerillo.

Materiales para el Grupo:
un frasco o envase de plástico duro transparente
agua tibia
una bolsita con cierre
hielo
cerillos
papel negro

Procedimiento:

1. Poner 4-5 cubos de hielo en la bolsita con cierre, cerrar la bolsa y dejarla a un lado.

2. Poner aproximadamente 3/4 de pulgada de agua tibia en el envase. Encender el cerillo. Dejarlo caer en el agua y rápidamente cubrir el envase con la bolsa de hielo.



3/4 de pulgada de agua

3. Sostener el envase enfrente de una hoja de papel negro. Describir cualquier cambio que se vea.

4. Quitar el hielo, observar el envase, luego recolocar el hielo. Describir cualquier cambio que se vea.

5. ¿Cómo se podría demostrar que el vapor visible en el envase es una nube y no solo el humo del cerillo? Describir abajo lo que se hizo y lo que pasó.

Lo que se Hizo	Lo que Pasó

Preguntas:

1. ¿Porqué los resultados son diferentes en las variaciones que se trataron?

2. ¿Que condiciones son necesarias para la formación de una nube?

3. ¿Qué otra cosa se podría usar en lugar del humo del cerillo para producir resultados similares?


PROYECTO
FUTURO

HOW TO READ A THERMOMETER

Grades		
K-2	Pairs/ Whole Class	30 min.

Description: Students will construct a model thermometer and will practice reading thermometers.

Materials for Each Group:
model thermometer worksheet
strip of red construction paper
scissors
cup of warm water
cup of ice water
student thermometer (Note: if thermometer has both Celsius and Fahrenheit scales, use tape to cover up one of the scales to reduce student confusion.)
large demonstration thermometer for teacher

Safety: Students should use care in handling scissors. DO NOT use mercury thermometers (silvery liquid); use thermometers which contain red alcohol.

Procedure:

1. Distribute the appropriate "Model Thermometer" worksheet (Celsius or Fahrenheit to match student thermometers) and the materials to make the thermometers.

2. Lead the students through the construction of their thermometers. Students can assist each other as needed.

3. Model how to "find the temperature" by moving the red construction paper up and down. Provide several practice examples for the students.

4. Have students guess the temperature of the room; record their guesses.

5. Distribute real thermometers. Use your large demonstration thermometer to show them how to read the thermometer.

6. Ask students to set their model thermometer to the temperature shown on the real thermometer. Compare the actual room temperature to their guesses.

7. Ask students to predict what will happen if the thermometer is placed in warm water. In cold water?

8. Distribute cups of water. Have students touch the water to feel its temperature, then use their thermometer to measure the temperature.

9. Have students go outside and measure the temperature with their real thermometers and use their models to "record" the temperature. Students should be sure not to hold thermometers by the bulb and to protect the thermometer from direct sunlight and high wind. Decide as a class what the outside temperature is and record on a wall chart.

10. Students can measure and record the temperature several times in one day and at the same time for several days.

Questions to Ask During the Activity:

1. Why is it important to measure temperature?

2. What happens to the liquid in the thermometer when it gets hot outside? when it gets cold? Show this on your model thermometer.

Why It Happens: A thermometer is an instrument used to measure temperature. The liquid in the bulb of the thermometer expands when it is heated and rises up the column of the thermometer.

A temperature scale is simply a way to designate key points (such as the temperature at which water boils) on a thermometer and to divide the intervals between them into useful units. Two common temperature scales used are Fahrenheit and Celsius. Fahrenheit is used extensively in this country in weather reports in newspapers and on television. On this scale, water freezes at 32º F and boils at 212º F. The Celsius temperature scale is very common throughout the rest of the world and is used extensively in science. On this scale, water freezes at 0º C and boils at 100º C. Both of these temperature scales are named for the scientist who first designed each scale.

Adaptations for Participants with Disabilities: Students with hearing impairments will have no trouble performing this activity with appropriate modifications in communicating the instructions.

Extensions: Indicate a temperature on the demonstration thermometer. Ask students to show with pictures or by using "dress-up" clothes in the classroom how they would dress if the temperature outside was the temperature you were showing.

Show any temperature on the demonstration thermometer and ask a student to show any **warmer** temperature on it. Have another student show a **colder** temperature than the first student's choice. Repeat with other temperatures.

Challenge the students to go outside and find two places with different temperatures (in sun vs. in shade; near water vs. on the pavement, etc.).

Recite the following poem with appropriate motions:

WEATHER
Sometimes it gets hot outside
And the sun shines brightly down (fan face as if hot)
Sometimes it gets cold outside
And the snow lies white aroun' (shiver)
Other times a cloud can fall
And fog comes rolling (wave arms ahead; walk as if blinded)
Or thunder and lightning kick the sky
And make us laugh and grin (smile, clap).

Sing the following songs:

Weather Song: sung to "B-I-N-G-O"
There was a time when we got wet; and rainy was the weather,
R-A-I-N-Y, R-A-I-N-Y, R-A-I-N-Y; and rainy was the weather.

There was a time when we got hot; and sunny was the weather
S-U-N-N-Y, S-U-N-N-Y, S-U-N-N-Y; and sunny was the weather.

There was a time when we got cold; and snowy was the weather,
S-N-O-W-Y, S-N-O-W-Y, S-N-O-W-Y; and snowy was the weather.

There was a time when we were blown; and windy was the weather,
W-I-N-D-Y, W-I-N-D-Y, W-I-N-D-Y; and windy was the weather.
Sister Linda Karma R.S.M., Pitts., PA

Rain Rain Falling Down: sung to "Row Row Row Your Boat"
Rain, rain falling down
Falling on the ground
Pitter, patter, pitter, patter
What a lovely (squishy, noisy, silly, etc.) sound.
Susan A. Miller, Kutztown, PA

Reference: Project Storyline: Science, Weather. The California Science Implementation Network, University of California, Irvine, 1992.

NatureScope, Wild About Weather. Washington, D. C.: National Wildlife Federation, 1989.

Weather Wise Riddles

Can you guess the riddles ? (We've given you the first one.)

1. Warm air rising up so high
   Cools, condenses, and
   makes me "fly."
   C L O U D

2. You cannot see me with
   your eyes,
   But I make trees move when
   I go by.

   _ _ _ _ _

3. We have six sides and many
   brothers,
   But each one's different from
   all the others.

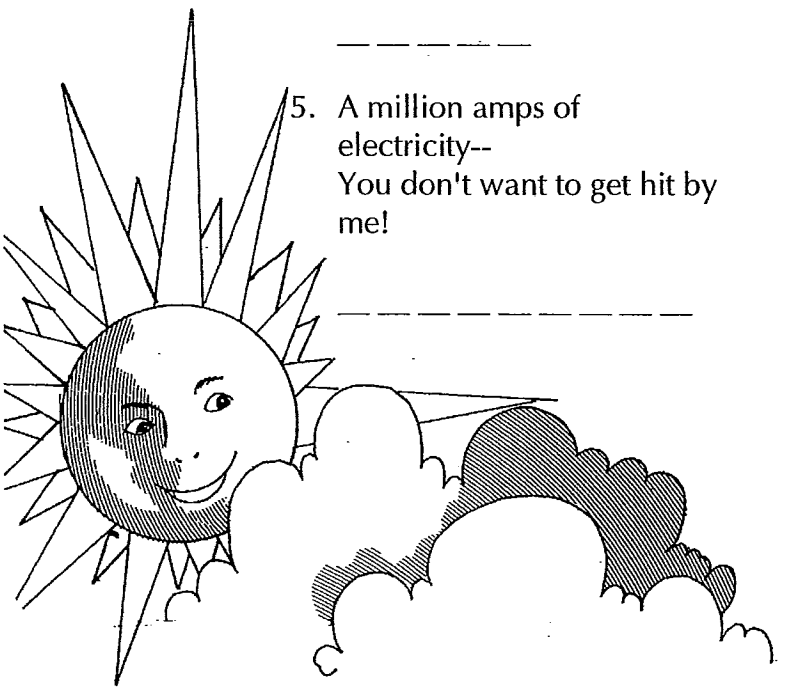
   _ _ _ _ _ _ _ _ _ _ _ _

4. I fall to earth and then I
   freeze,
   Coating pavement, fields,
   and trees.

   _ _ _ _ _ _

5. A million amps of
   electricity--
   You don't want to get hit by
   me!

   _ _ _ _ _ _ _ _ _ _ _



6. Layers of ice freeze till I fall,
   Small as a pea or big as a
   ball.

   _ _ _ _ _

7. Lightning heats the air so
   fast
   That you can hear my
   mighty blast.

   _ _ _ _ _ _ _ _ _

8. My eye is calm, but just
   watch out
   My winds mean
   trouble--there's no doubt!

   _ _ _ _ _ _ _ _ _ _ _

9. Two hundred miles an hour
   I whirl,
   Causing great damage
   wherever I twirl!

   _ _ _ _ _ _ _ _

10. Up in the North is where I
    prowl,
    With blinding snow and
    winds that howl.

    _ _ _ _ _ _ _ _ _

11. Most clouds form up high in
    the sky,
    But down near the ground is
    where I lie.

    _ _ _

Directions
Constructing a Thermometer

1. Cut on the dotted line.
   Cut out the whole rectangle.

2. Fold on line **A**. The line should be on the outside of the fold.

3. Fold on line **B**. The line should be on the outside of the fold.

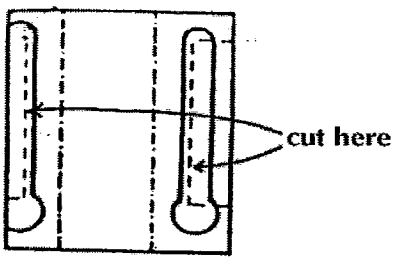
4. Tape the thermometer together at the top and bottom.

5. Color the bulb red.

6. Slide a 3" by 11" strip of red construction paper through the center of the folded "sleeve."

7. Move the red paper up and down to change the temperature.

1



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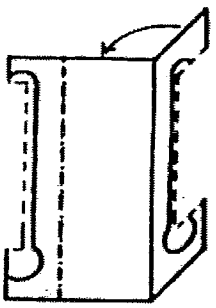

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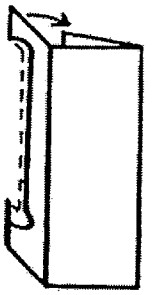

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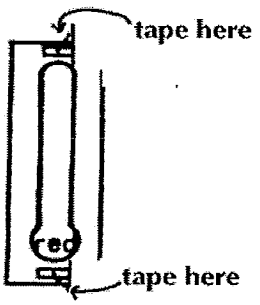

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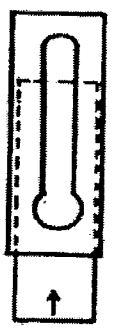
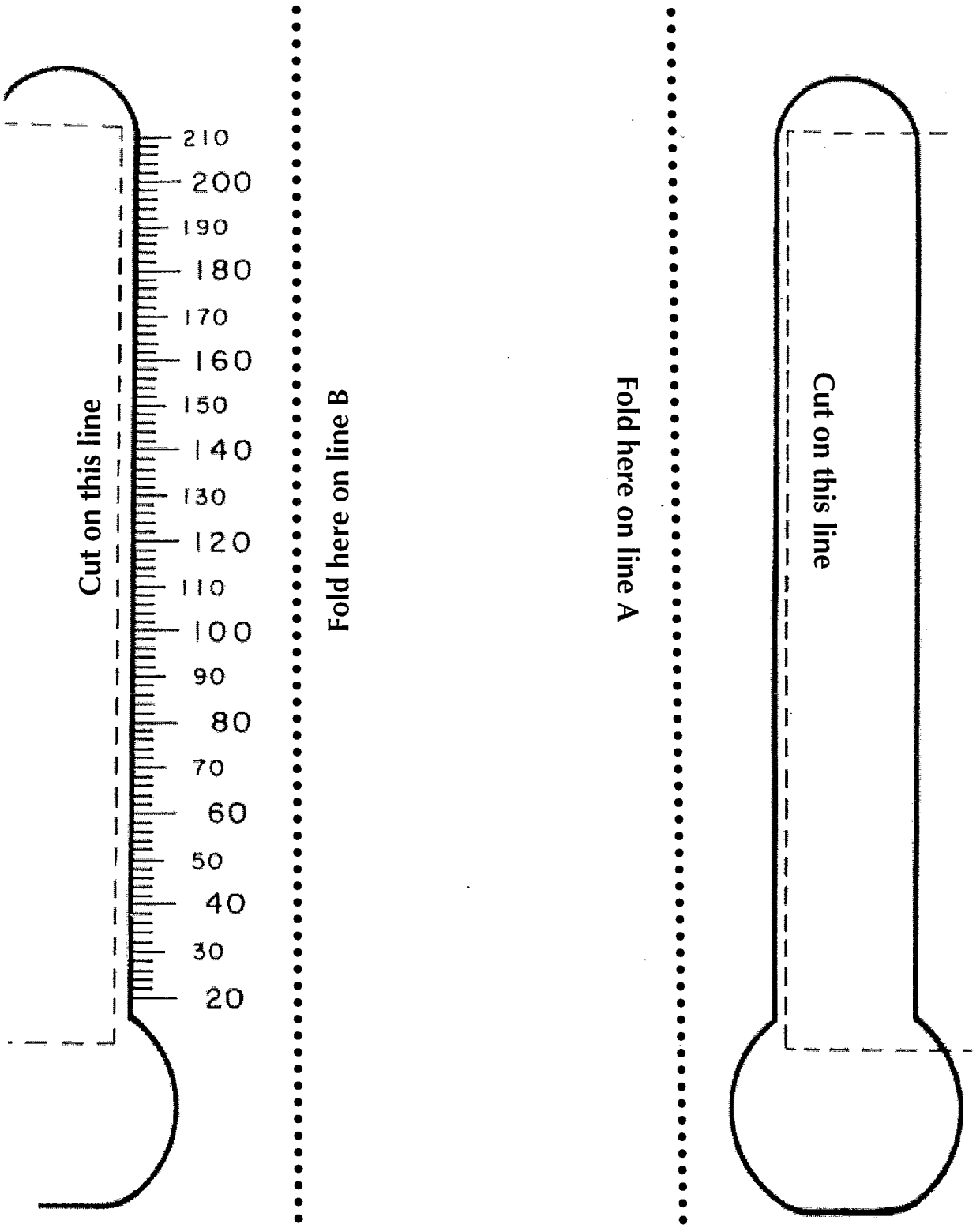
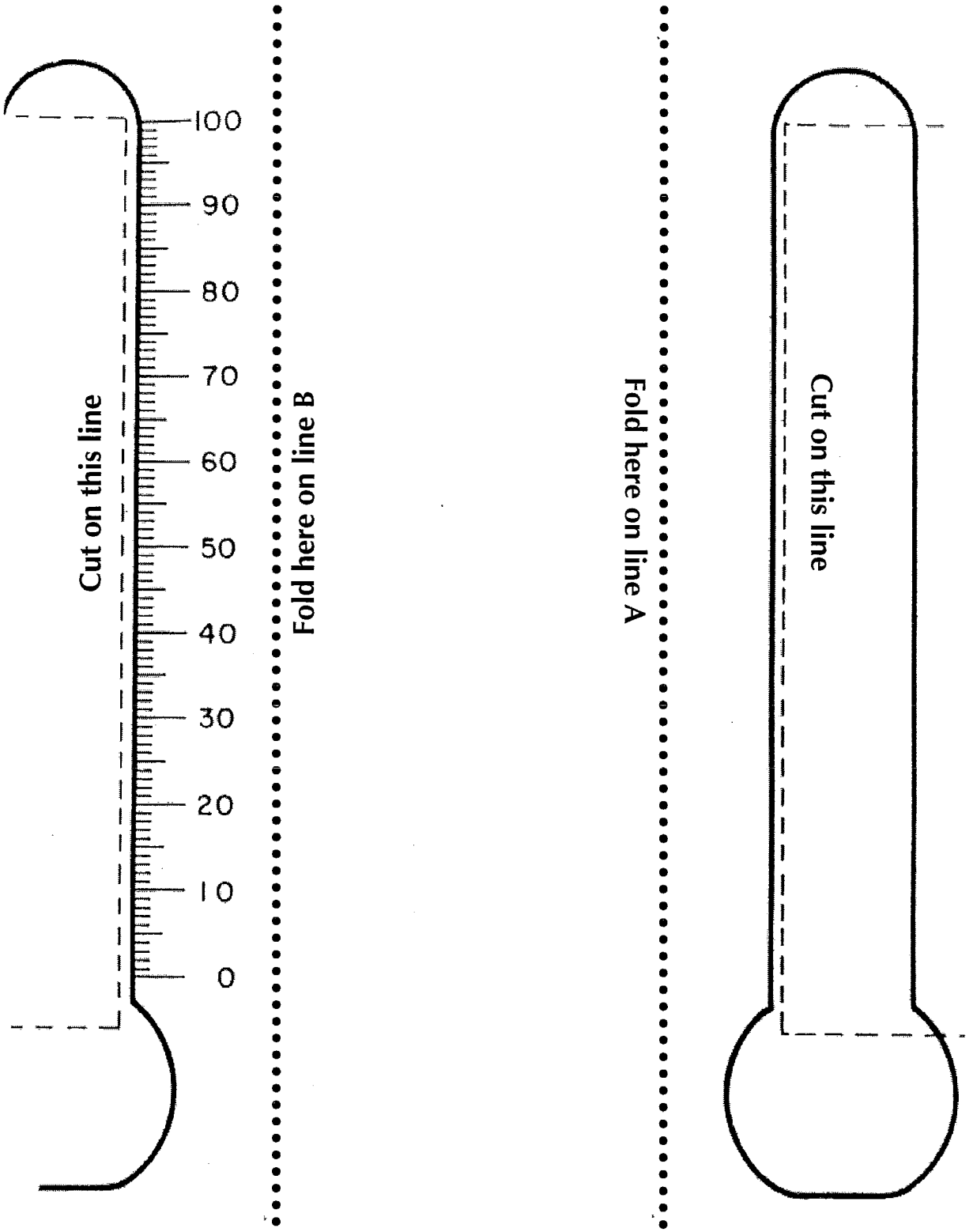


Fahrenheit Scale



Celsius Scale



Construyendo un Termómetro
Direcciones

1. Cortar sobre la línea quebrada a los márgenes del papel. Recortar el rectángulo completo.

2. Hacer un doblez sobre la línea A. La línea deberá quedar en la parte exterior del doblez.

3. Hacer un doblez sobre la línea B. La línea deberá quedar en la parte exterior del doblez.

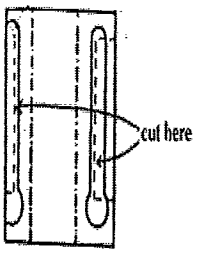
4. Pegar el termómetro en la parte de arriba y de abajo.

5. Colorear de rojo la ampolleta del termómetro.

6. Deslizar una tira de papel constructivo rojo de 3″ x 11″ por el centro del doblez.

7. Mover la tira de papel rojo para arriba y para abajo para simular el cambio de temperatura.

1



cortar en la linea quebrada

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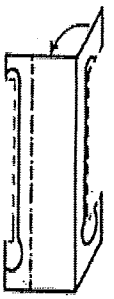

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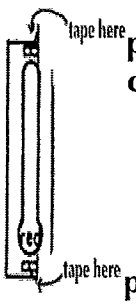

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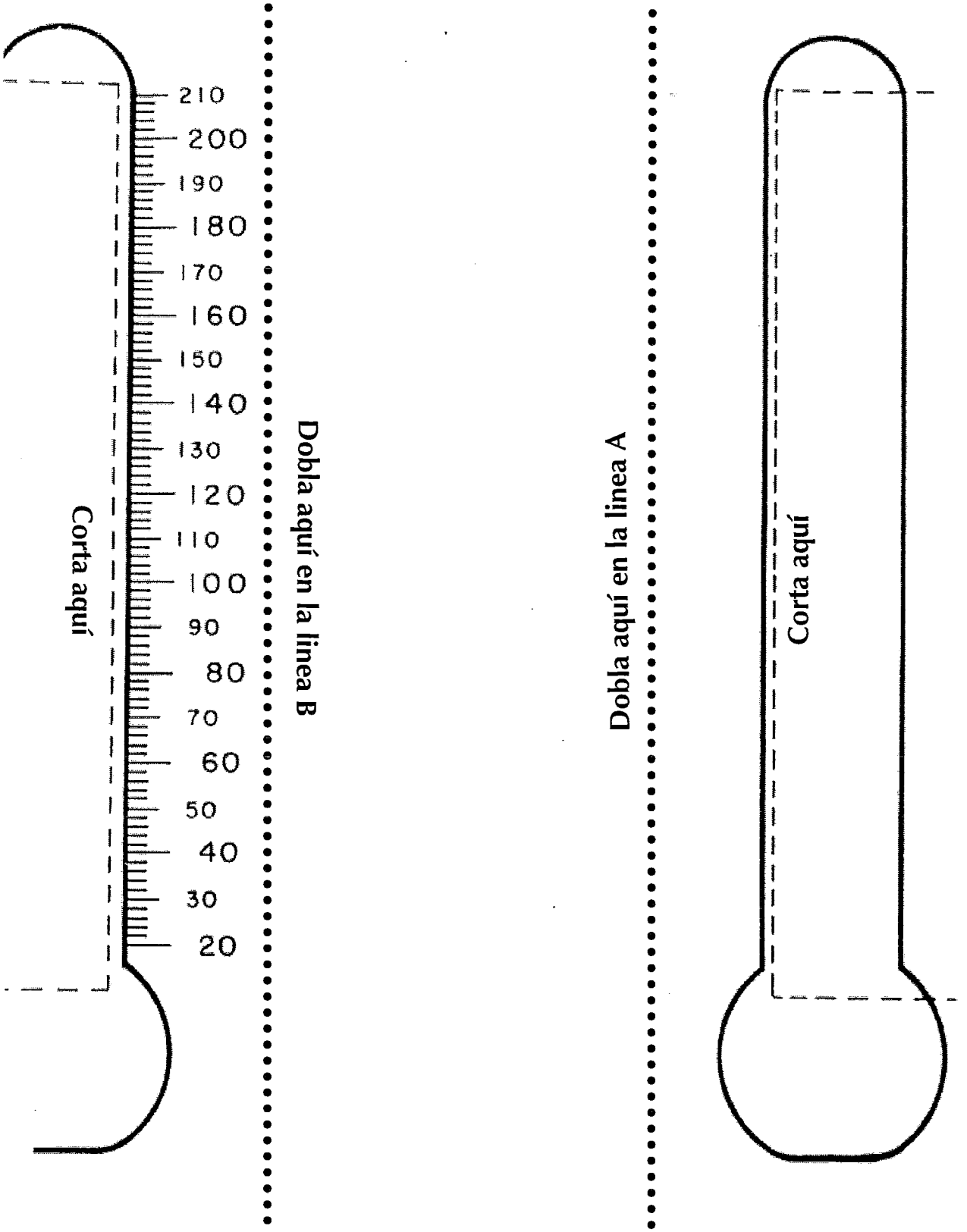
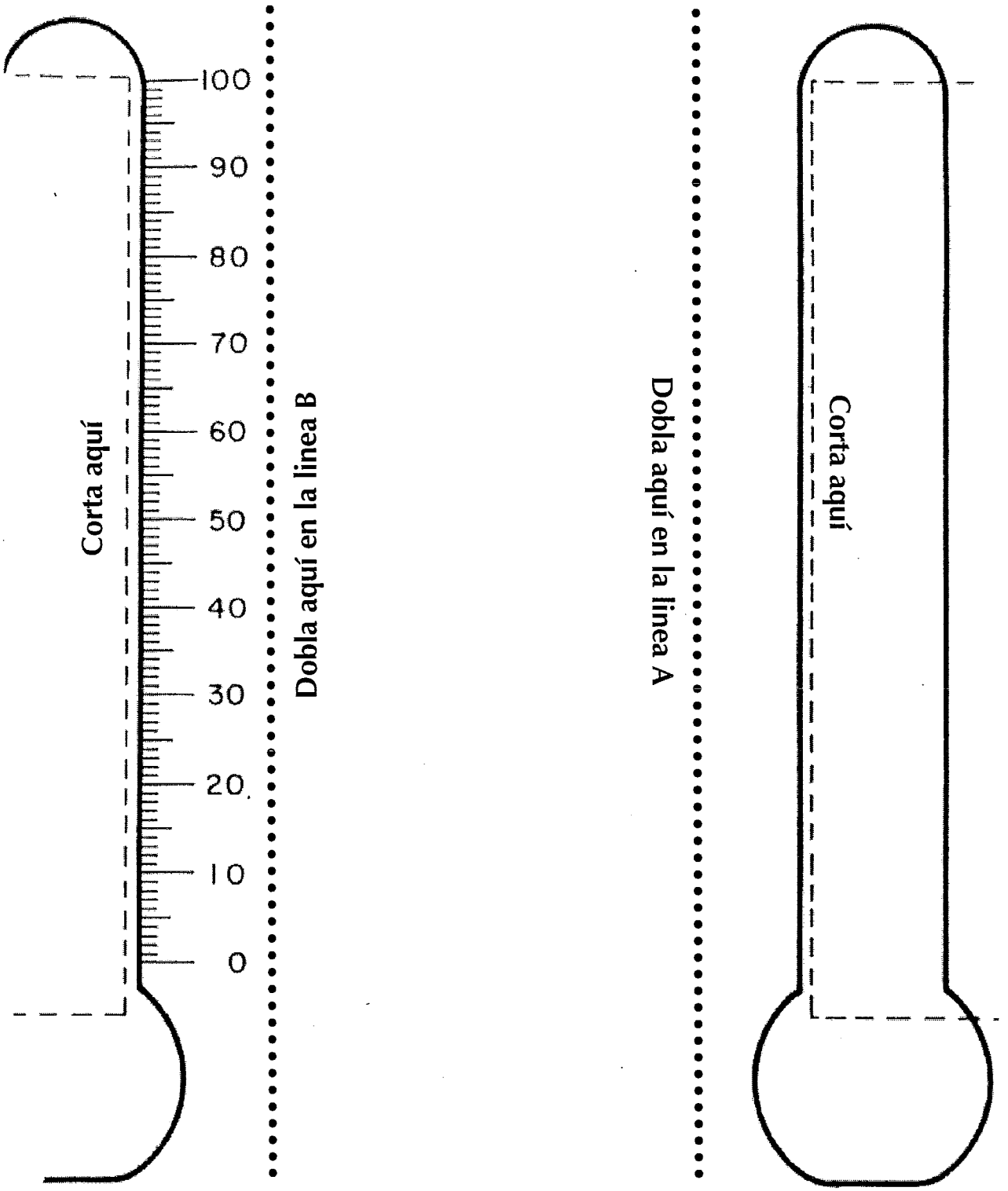
Escala Fahrenheit



Escala Celsius



Weather Station Activities

Each of the following activities is designed to give students the opportunity to construct simple weather instruments and to use them to collect information about the weather.

Each activity can be done separately, with students collecting information with each device by itself, or they can be done in combination to allow students to notice connections between weather data. If used alone, each instrument can be used several times in a day or once a day over several days. On each student activity sheet there is a data chart that students can use for these types of observations.

If you wish to use the information to look for relationships and patterns, you can have students construct a weather observation chart to compile several different weather data over time. A sample chart is found at the end of these activities. For instance, is there a relationship between a change in barometric pressure, wind direction, or wind speed? This observation chart can be designed to allow students to collect whatever weather information is most appropriate for your class.

The weather instruments made in these activities are not designed to withstand heavy, continual use, but with care they should be durable enough for students to develop an understanding of their function and the weather principles behind them.

Adaptations for Participants with Disabilities

Each of the activities is designed to be completed by small groups of students who can assist each other. Students with physical impairments may need assistance with collecting data outside.

Grades		
4-8	2-3	30 min.

MAKING A BAROMETER

Description: Students will construct and use a simple barometer to observe changes in air pressure over several days.

Materials:

For each group:

1 wide-mouth jar
1 balloon
rubber band
drinking straw
index card
tape
scissors

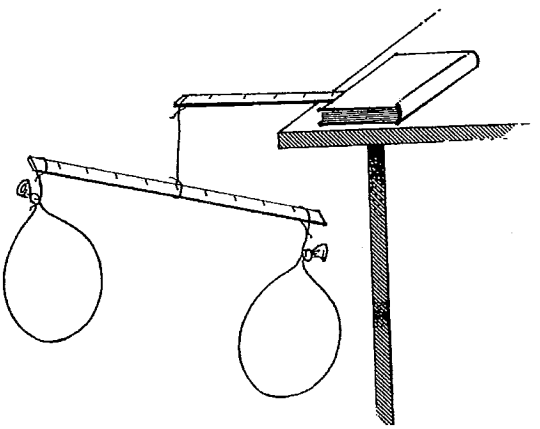
For teacher demonstration:

2 meter sticks
2 balloons
string

Safety: Students need to use care in handling the glass jar.

Procedure: 1. Do the following demonstration:

- Blow up two balloons. Use about 6 inches of string to tie one balloon to each end of a meter stick. Be sure to use the same amount of string on each balloon.
- Tie another 6 inch piece of string to the middle of the meter stick. Tie the end of this string to the end of a second meter stick.
- Use books to anchor the end of the second meter stick to the edge of a table so that the meter stick with the balloons is balanced and hanging below the table.



- Pop one balloon with a pin. Have students describe what happens.

2. Have students make the barometer according to the insturctions on the Student Activity Sheet.

3. Students can use the barometer once a day or several times in one day and record how many marks above or below zero the straw pointer has moved. [Note: if a storm is predicted, check the barometer several times in a day.]

Questions to Ask During the Activity:

1. [Demo]: What caused the meter stick to tilt when the balloon popped?

2. What would cause the straw on the barometer to move up? down?

3. What types of weather changes do you think might change where the straw points?

4. Why did we need to use a flexible cover on the jar? Would another material work?

Why It Happens: Air has weight and exerts pressure. In the demonstration, the meter stick becomes unbalanced when one balloon includes the weight of the air inside of it and the other does not.

Air pressure is the weight of the air in the atmosphere pressing on the earth's surface. Air pressure varies with altitude, latitude, and temperature. A barometer is a device which measures air pressure. When air pressure increases, the balloon will bend downward into the jar; when air pressure decreases, the balloon will bulge outward from the jar. These changes cause the straw to move up and down respectively.

Often as a front moves in, the barometric pressure changes. Rising air pressure often brings warm, dry weather and low pressure often signals the coming of wet, cooler weather. With the late afternoon thunder storms common in Albuquerque during the summer, it is possible to notice a change in air pressure within a couple of hours.

This type of barometer allows students to record a change in pressure. The starting mark represents the air pressure at the time the barometer is constructed. It is best, therefore, to do this activity when the air pressure is neither extremely low nor extremely high. You can call for local weather at 821-1111 to get the current air pressure.

Extensions: Compare barometric observations to wind speed and direction and types of clouds present. Can you observe a connection between these different weather observations?

Calibrate your barometer by comparing its readings to those on a commercial barometer and marking it accordingly.

References: Riding out the Storm. Boston, MA: Museum of Science, Science-By-Mail, 1994-95.

Making a Barometer
Student Activity Sheet

Description: You will construct and use a simple barometer to observe changes in air pressure over several days.

Materials For Each Group:
1 wide-mouth jar
1 balloon
rubber band
drinking straw
index card
tape
scissors

Safety: Be careful in handling the glass jar to ensure it does not drop and break.

Procedure:

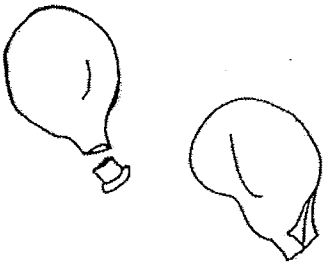
1. Cut off the neck of the balloon. Cut a slit from the edge of the balloon towards the center so that you can spread the remaining balloon flat.

2. Spread the opened balloon tightly over the mouth of the jar; there should be no wrinkles or bulges on the surface. Attach the balloon firmly to the jar with a rubber band, doubling it if necessary. No air should be able to get out of the jar.

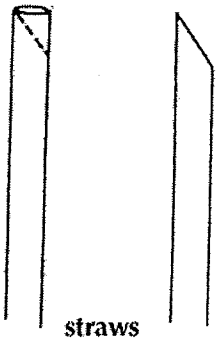
3. Cut one end of the straw to form a point. Tape the uncut end to the middle of the balloon so the straw is horizontal. This will be the pointer on your barometer.

4. Use the index card to make a gauge. Use a ruler to mark gradations on the card. Mark every centimeter. Position the card on a wall or a cardboard stand behind the barometer so the straw is pointing at a middle mark. Label this mark start (or zero). Do not place the barometer in direct sunlight.

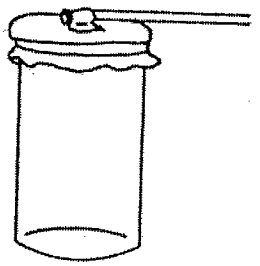
5. Observe the barometer every day and record how many marks above or below zero the straw pointer has moved. [Note: if a storm is predicted, check the barometer several times in a day.]



balloons



straws



barometer

DATA

Date	Time	Barometer Reading	Date	Time	Barometer Reading

Questions: 1. Did you notice a relationship between changes in air pressure and weather?

Fabricando un Barómetro
Hoja de Actividades para el Estudiante

Descripción: Se construirá y se usará un barómetro simple para observar, por algunos días, los cambios en la presión del aire.

Materiales para su grupo:
1 frasco de boca ancha
1 globo
1 liga
1 popote
1 tarjeta tipo index
cinta adhesiva
tijeras

Medidas de Seguridad: Tener precaución en el manejo del frasco de vidrio y asegurarse de que no se caiga o se rompa.

Procedimiento:

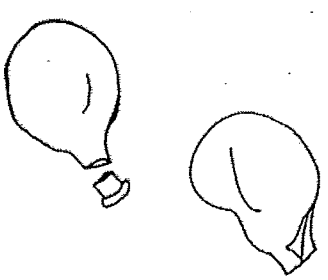
1. Cortar el cuello del globo. Hacer un corte en el globo desde su cuello hasta el centro, de manera que se pueda extender.

2. Extender el globo ya abierto, bien apretado, sobre la boca del frasco; no deberá haber pliegues o protuberancias en la superficie. Con la liga, atar el globo firmemente al frasco, haciendo un doblez si se hace necesario. Nada de aire deberá escapar del frasco.

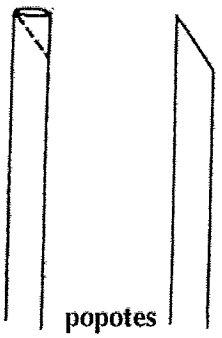
3. Cortar en forma diagonal uno de los extremos del popote para formar una punta. Pegar el extremo del popote no cortado en la mitad de la cubierta de globo, de manera que el popote quede en forma horizontal. Esto será el marcador en su barómetro.

4. Usar la tarjeta o ficha para hacer un marcador. Usar una regla para marcar las gradaciones en la tarjeta. Marcar cada centímetro. Colocar la tarjeta sobre una pared o sobre una pizarra portátil por detrás del barómetro, de manera que el popote esté apuntando a la marca de enmedio. Rotular esta marca como "empiezo" (o cero). No exponer el barómetro directamente a la luz solar.

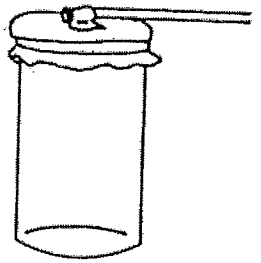
5. Observar el barómetro diariamente y registrar cuántas marcas se ha movido el popote marcador sobre y bajo cero. [Nota: Si se predice tormenta, revisar el barómetro varias veces en el día.]



globos



popotes



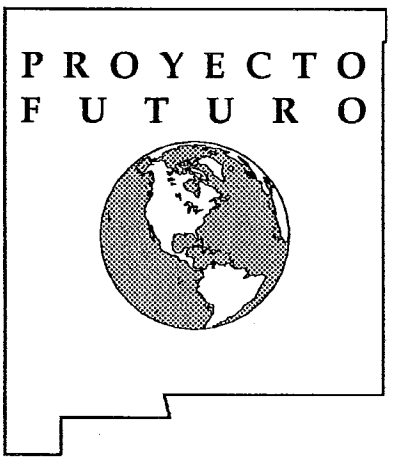
barómetro

Datos

Registar sus observaciones en las gráficas de enseguida.

Fecha	Hora	Lectura del Barómetro	Fecha	Hora	Lectura del Barómetro

Pregunta: 1. ¿Se notó alguna relación entre los cambios en la presión del aire y el clima?


PROYECTO
FUTURO

MAKING A WIND VANE

Grades		
3-8	2-3	20 min.

Description: Students will construct a simple wind vane and use it to determine the direction of the wind.

Materials for Each Group:
straw
tag board or index cards
tape
pin
pencil with an eraser

Safety: Use care when poking the pin through the straw.

Procedure:

1. Have students construct a wind vane according to the instructions on the Student Activity Sheet.

2. Take students to an open area, away from obstructions, to determine the direction of the wind. Students can determine the direction of the wind by referring to a familiar structure, such as a school building, or with standard compass directions. You can identify north for them, referring to a structure (north is towards the gym), or have students use compasses to locate north.

3. Have students record wind directions each day at the same time for a week.

4. Have students compare their data and identify the prevailing wind direction for the week.

Questions to Ask During theActivity:

1. Feel the wind on your face. Does it <u>feel</u> like it's coming from the direction the wind vane is pointing? [It should! If it doesn't, have students check to be sure their wind vane can turn freely and that they are not blocking the wind with their bodies. If the wind is very gusty or if it is affected by the location of buildings, it may be difficult to determine the exact direction of the wind.]

2. What other indicators in the environment do you see which show the direction from which the wind is blowing? [Students may see a moving flag, leaves, blowing dirt, clouds, etc.]

3. Do you think it matters how high we are when determining wind direction? [Near the ground, obstructions such as buildings and trees can affect the direction and speed of the wind. In some locations there are distinct currents of air which travel in different directions at different altitudes. This is one of the ways hot air balloonists can change direction.]

Why it Happens: The Sun's radiation strikes the Earth at an angle and heats the atmosphere unevenly. In addition, land heats and cools quickly, while water heats and cools slowly also contributing to the uneven heating of the atmosphere. Warm air is less dense and rises while cool air sinks. It is this uneven heating of air which causes winds.

Extensions: Research global air currents such as the jet stream. What direction does the air move? How do these air currents affect weather?

Make a *nephoscope* to observe the wind at high altitudes. Place a piece of paper on a table outdoors. Find and mark north on the paper. Place a mirror on the paper and observe the reflection of the clouds. Mark which direction the reflected clouds are moving—that's the direction of the winds aloft.

References: Leftwich, Virginia P. Earth Science Series—Meteorology and Climatology. Milliken Publishing Co.

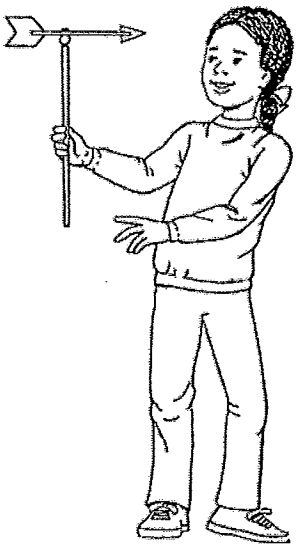
Van Cleave, Janice Earth Science for Every Kid. New York, John Wiley & Sons, 1991.

Making a Wind Vane
Student Activity Sheet

I often wish that I
Could be a kite up in the sky,
And ride upon the breeze and go
Whichever way I chanced to blow.
—author unknown

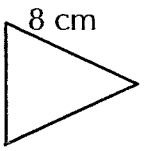
Description: You will make a wind vane and use it to determine the direction from which the wind is blowing.

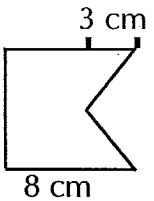
Materials for Each Group:
1 straw
tagboard or 2 index cards
1 straight pin
1 pencil with an eraser
tape



Safety: Use care when poking the pin through the straw.

Procedure: 1. Make two cut-outs from the index cards as shown below.





2. Tape one cut-out to each end of the straw.

3. Find the balance point of the straw. Stick a pin through this point into the top of a pencil eraser so that the straw spins easily.

4. Take the wind vane outside and hold it straight up in the air. The arrow will point in the direction from which the wind is blowing. Winds are recorded in the direction from which they blow.

5. Find out where north is. Record the direction your arrow is pointing; this is the wind direction. Repeat at the same time each day for a week.

Data

Date	Time	Wind Direction	Date	Time	Wind Direction

Questions: 1. What was the prevailing wind direction for the week?

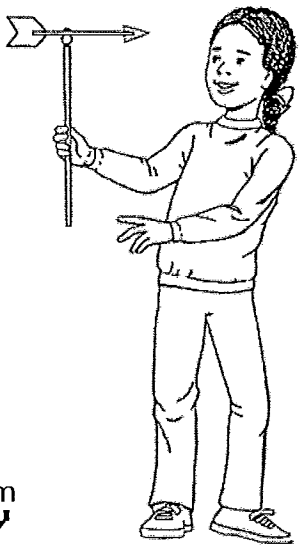
2. Observe the clouds. Are they all moving in the same direction? Are they moving in the direction indicated by your wind vane?

Fabricando una Veleta
Hoja de Actividades para el Estudiante

A menudo quisiera ser
Un papalote volando en los cielos,
Y pasear con la brisa
E ir por doquier al soplo del viento
-autor anónimo

Descripción: Hacer una veleta y usarla para determinar la dirección en la que está soplando el viento.

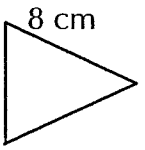
Materiales para su Grupo:
un popote
etiqueta o 2 tarjetas o fichas
un alfiler recto
un lápiz con borrador
cinta adhesiva

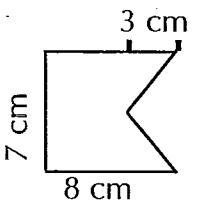


Medidas de Seguridad: Tener precaución al pinchar el popote con el alfiler.

Procedimiento:

1. Recortar dos figuras de las tarjetas, como se muestra en el dibujo.





2. Pegar una figura a cada extremo del popote.

3. Encontrar el punto de balance del popote. En este punto, introducir un alfiler que pase a través del borrador del lápiz de tal forma que el popote gire fácilmente.

4. Llevar la veleta afuera y sostenerla verticalmente en el aire. La fecha deberá apuntar en la dirección en la que el viento está soplando. Los vientos se registran en la dirección de donde soplan.

5. Localizar el Norte. Registrar la dirección en la que su flecha está apuntando; esta es la dirección del viento. Repetir esto diariamente y a la misma hora por una semana.

Datos

Fecha	Hora	Dirección del Viento	Fecha	Hora	Dirección del Viento

Preguntas: 1. ¿Cuál fué la dirección del viento prevale ciente durante la semana?

2. Observar las nubes. ¿Se están moviendo todas en la misma dirección? ¿Se están moviendo en la dirección que indica la veleta?

RELATIVE HUMIDITY

Grades		
4-8	2-3	30 min.

Description: Students will compare readings from wet and dry bulb thermometers and use a table to determine relative humidity.

Materials for Each group:
2 thermometers
1 tubular shoelace (or cotton gauze)
water

Safety: Students will need to use care when waving their thermometers around. DO NOT use mercury thermometers (contain silvery, metallic liquid).

Procedure:

1. Review how to read a thermometer with students (if needed). Have them read and record the temperature of the air in the classroom. This is their dry bulb thermometer. All temperature readings will be in degrees Celsius.

2. Have students prepare their wet bulb thermometer as described on the Student Activity Sheet. If using cotton gauze, wrap the bulb with the gauze and secure it with a rubber band. Use room temperature water to help counter the misconception that the water is colder than the air and is making the wet bulb cooler.

3. Students **gently** wave their wet-bulb and dry bulb thermometers in the air for about 3 minutes. Caution them to not drop their thermometers nor swing them into something or someone. After three minutes, they should read and record the temperature shown on the wet-bulb and dry-bulb thermometers.

4. Demonstrate for the students how to use the relative humidity chart on their activity sheets. Have students determine the relative humidity in the classroom.

5. Take students outside to find the relative humidity outdoors. Students should keep their thermometers protected from direct sun and wind as much as possible.

Questions to Ask During the Activity:

1. What do people mean when they say it is humid outside? How does a humid day feel?

2. When your skin gets wet, does it feel the same temperature as when it is dry? [Generally, their skin should feel cooler as the water evaporates.]

3. Do you expect the wet-bulb thermometer to read the same temperature as the dry-bulb thermometer? Why? [Students can make predictions based on previous experience.]

4. After reading the dry and wet-bulb temperatures, why is there a difference? [The wet bulb will show a lower temperature due to the heat loss from evaporation of the water.]

5. Do you think the humidity outside will be the same as it is inside? [It may not be, largely depending on what type of cooling or heating is being used indoors.]

Why It Happens: Water absorbs heat from its surroundings as it evaporates. As the water around the bulb of a wet-bulb thermometer evaporates, the bulb cools and the temperature reading of the thermometer goes down. Water evaporates at different rates, however, depending on the amount of water vapor in the surrounding air. The more water vapor in the air, the slower the evaporation because the surrounding air already contains more water vapor. Therefore, the more humid the air, the smaller the difference in temperature between the two thermometers. Humidity is usually reported in percents. One hundred percent is the total amount of moisture air can contain.

A sling psychrometer is an instrument which holds wet and dry-bulb thermometers, which can then be whirled around safely to measure relative humidity.

Extensions: Have students demonstrate how an evaporative cooler works and why this type of cooling is only effective in dry climates.

References: Tolman, Marvin N. and James O. Morton. Earth Science Activities for Grades 2-8. West Nyack, NY: Parker Publishing Company, 1986.

Weather Instruments Teacher's Guide. A Delta Science Module. Hudson, NH: Delta Education, Inc., 1988.

Relative Humidity
Student Activity Sheet

Description: You will use wet and dry bulb thermometers to determine the relative humidity of the air.

Materials for Each Group:
2 thermometers
1 shoelace
room temperature water
scissors

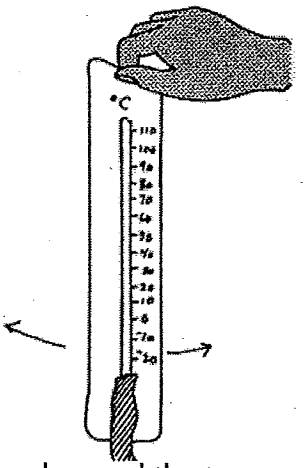
Safety: Use caution when waving thermometers in the air. DO NOT use mercury thermometers (silvery, metallic liquid).

Procedure:

1. Cut a piece about 3 cm long from the middle of the shoelace and slip it over the bulb of one thermometer.

2. Dip the thermometer into the room temperature water until the shoelace is thoroughly wet. This is your wet-bulb thermometer.

3. **Gently** wave both the dry and the wet-bulb thermometers in the air for 3 minutes. Be careful not to drop the thermometers or to swing them into something or someone.



4. After three minutes read and record the temperature on each thermometer. Subtract the wet bulb temperature from the dry bulb temperature to find the difference.

5. Use the chart below to determine the relative humidity of the classroom.

6. Moisten the shoe lace again. Go outside and repeat steps 3-5 to determine the relative humidity outside. Repeat and record for seven days.

Dry-Bulb Temp. (in°C)	RELATIVE HUMIDITY (in %)																			
	Difference Between Wet-Bulb and Dry-Bulb Temperatures (in°C)																			
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
15	90	80	71	61	53	44	36	27	20	13	6									
16	90	81	71	63	54	46	38	30	23	15	8									
17	90	81	72	64	55	47	40	32	25	18	11									
18	91	82	73	65	57	49	41	34	27	20	14	7								
19	91	82	74	65	58	50	43	36	29	22	16	10								
20	91	83	74	66	59	51	44	37	31	24	18	12	6							
21	91	83	75	67	60	53	46	39	32	26	20	14	9							
22	92	83	76	68	61	54	47	40	34	28	22	17	11	6						
23	92	84	76	69	62	55	48	42	36	30	24	19	13	8						
24	92	84	77	69	62	56	49	43	37	31	26	20	15	10	5					
25	92	84	77	70	63	57	50	44	39	33	28	22	17	12	8					
26	92	85	78	71	64	58	51	46	40	34	29	24	19	14	10	5				
27	92	85	78	71	65	58	52	47	41	36	31	26	21	16	12	7				
28	93	85	78	72	65	59	53	48	42	37	32	27	22	18	13	9	5			
29	93	86	79	72	66	60	54	49	43	38	33	28	24	19	15	11	7			
30	93	86	79	73	67	61	55	50	44	39	35	30	25	21	17	13	9	5		
31	93	86	80	73	67	61	56	51	45	40	36	31	27	22	18	14	11	7		
32	93	86	80	74	68	62	57	51	46	41	37	32	28	24	20	16	12	9	5	
33	93	87	80	74	68	63	57	52	47	42	38	33	29	25	21	17	14	10	7	
34	93	87	81	75	69	63	58	53	48	43	39	35	30	28	23	19	15	12	8	5
35	94	87	81	75	69	64	59	54	49	44	40	36	32	28	24	20	17	13	10	7

Data

Date	Wet-Bulb Temp.	Dry Bulb Temp.	Difference Between Temps.	Relative Humidity (%)

Questions: 1. Does the humidity of the air change throughout the day? What evidence do you have to support your answer?

2. Why is humidity reported as a percent?

Humedad Relativa
Hoja de Actividades para el Estudiante

Descripción: Se usarán termómetros de depósito húmedo y de bola seca para determinar la humedad relativa del aire.

Materiales para su Grupo:
2 termómetros
1 agujeta
agua a temperatura ambiente
tijeras

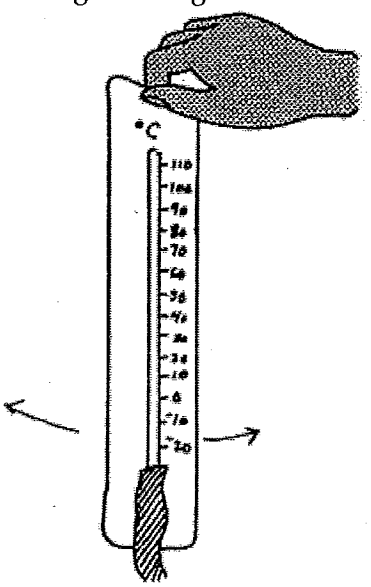
Medidas de seguridad: Tener precaución al agitar los termómetros en el aire. NO usar termómetros de mercurio (líquido metálico, plateado).

Procedimiento:

1. Cortar una pieza de aproximadamente 3 cm de largo de la mitad de la agujeta y deslizarla por encima de la ampolleta o depósito de un termómetro.

2. Meter el termómetro en el agua, la que debe estar a temperatura ambiente, hasta que la agujeta esté bien mojada. Esto es su termómetro de depósito húmedo.

3. Agitar **suavemente** en el aire ámbos, el termómetro de depósito húmedo y el de bola seca, por tres minutos. Tener cuidado de no dejar caer los termómetros o de no golpear algo o a alguien con ellos.



4. Después de tres minutos leer y registrar la temperatura de cada termómetro. Sustraer la temperatura del termómetro de depósito húmedo de la temperatura del termómetro de bola seca para encontrar

la diferencia.

5. Usar la gráfica abajo para determinar la humedad relativa del salón de clase.

6. Mojar de nuevo la agujeta. Salir afuera y repetir los pasos 3-5 para determinar la humedad relativa del exterior. Repetirlo y registrarlo por siete días.

Datos

Fecha	Temperatura del Depósito Húmedo	Temperatura del Depósito Seco	Diferencia Entre las Temperaturas	Humedad Relativa (%)

Preguntas: 1. ¿Cambia la humedad del aire durante el día? ¿Qué evidencia se tiene para apoyar esto?

2. ¿Porqué la humedad se reporta en porcentaje?

Temp. de Bola Seca (en°C)	HUMEDAD RELATIVA (en %) Diferencia Entre las Temperaturas del Depósito Húmedo y de Bola Seca (en°C)																			
	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
15	90	80	71	61	53	44	36	27	20	13	6									
16	90	81	71	63	54	46	38	30	23	15	8									
17	90	81	72	64	55	47	40	32	25	18	11									
18	91	82	73	65	57	49	41	34	27	20	14	7								
19	91	82	74	65	58	50	43	36	29	22	16	10								
20	91	83	74	66	59	51	44	37	31	24	18	12	6							
21	91	83	75	67	60	53	46	39	32	26	20	14	9							
22	92	83	76	68	61	54	47	40	34	28	22	17	11	6						
23	92	84	76	69	62	55	48	42	36	30	24	19	13	8						
24	92	84	77	69	62	56	49	43	37	31	26	20	15	10	5					
25	92	84	77	70	63	57	50	44	39	33	28	22	17	12	8					
26	92	85	78	71	64	58	51	46	40	34	29	24	19	14	10	5				
27	92	85	78	71	65	58	52	47	41	36	31	26	21	16	12	7				
28	93	85	78	72	65	59	53	48	42	37	32	27	22	18	13	9	5			
29	93	86	79	72	66	60	54	49	43	38	33	28	24	19	15	11	7			
30	93	86	79	73	67	61	55	50	44	39	35	30	25	21	17	13	9	5		
31	93	86	80	73	67	61	56	51	45	40	36	31	27	22	18	14	11	7		
32	93	86	80	74	68	62	57	51	46	41	37	32	28	24	20	16	12	9	5	
33	93	87	80	74	68	63	57	52	47	42	38	33	29	25	21	17	14	10	7	
34	93	87	81	75	69	63	58	53	48	43	39	35	30	28	23	19	15	12	8	5
35	94	87	81	75	69	64	59	54	49	44	40	36	32	28	24	20	17	13	10	7

FINDING AIR SPEED:
Making an Anemometer

Grades		
3-8	2-3	40 min.

Description: Students will construct an anemometer and use it to determine wind speed.

Materials for Each Group:
2 straws
4 dixie cups (smallest size)
1 straight pin
1 pencil with an eraser
markers or crayons
tape
watch with a second hand

Safety: Students should use caution when pushing the pin through the straws and eraser.

Procedure:

1. Have students construct the anemometer according to the directions on the Student Activity Sheet.

2. Take students to a clear area to use their anemometers. Students can count the number of turns in 60 seconds and record their results. If the wind is very gusty, they may need to do several trials and use the average number of counts. If the wind is very strong, their anemometers may not survive.

3. Have students observe the effect of the wind and approximate its speed using the Beaufort Scale. They can then compare their "cups per minute" count to the Beaufort Scale and approximate the speed as measured by their anemometers.

Questions to Ask During the Activity:

1. What are some benefits or uses of wind? [power source to generate electricity, assist in air travel...]

2. What are some hazards associated with wind? [destruction from violent wind storms such as hurricanes and tornadoes]

3. Why would anyone need to know the speed of the wind? [safe travel by air or boat, weather prediction]

Why it Happens: The uneven heating of the earth's atmosphere causes the air near the surface of the earth to move. The boundary where air masses meet is called a front. Colliding air masses can give rise to very strong winds. Air masses are regions of air that have about the same temperature, moisture, and pressure.

Extensions: Research how violent storms such as hurricanes and tornadoes form.

References: Van Cleave, Janice. Earth Science Activities for Every Kid. New York: John Wiley & Sons, 1991.

Finding Air Speed: Making an Anemometer
Student Activity Sheet

Who has seen the wind?
Neither I nor you:
But when the leaves hang trembling
The wind is passing thro'.

—Christina Rossetti

Description: You will construct an anemometer and use it to determine wind speed.

Materials for Each Group:
2 straws
4 Dixie cups (smallest size)
1 straight pin
1 pencil with an eraser
markers or crayons
tape
Beaufort Scale

Safety: Use caution when pushing the pin through the straws and eraser.

Procedure:

1. Use tape to attach a Dixie cup to each end of the straws. The Dixie cups should be on their sides facing right angles to the straw. The cups on each end of a straw should be facing opposite directions.

2. Hold the two straws to form a cross. Find the balance point for the straws and use tape across the middle to hold the straws together.

3. Push the pin through the middle of the straws and into the pencil eraser so that the straws spin on top of the pencil eraser. You may need to enlarge the pin hole to make the straws spin easily.

4. Color one of the cups. This will be your index cup. See illustration on following page.

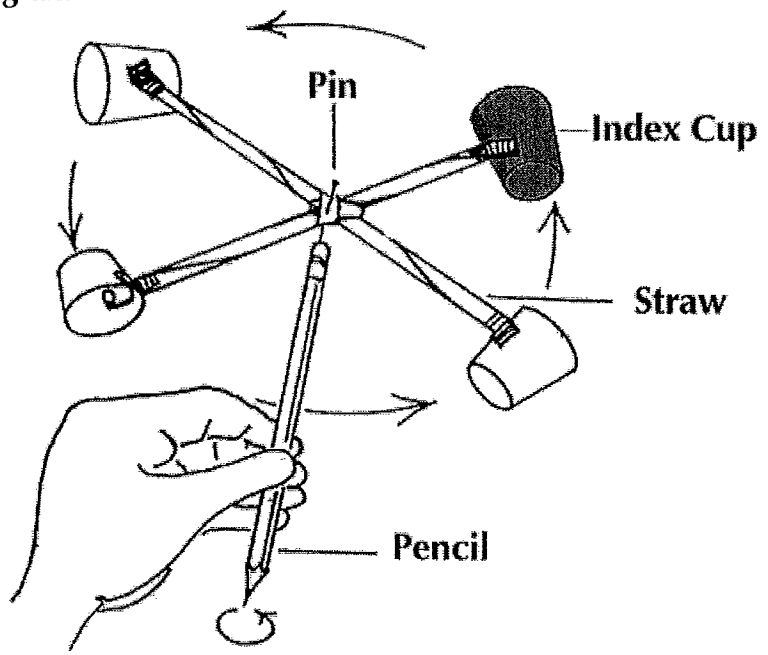
5. Take the anemometer to a clear area outside. Hold the pencil of the anemometer straight up in the air and allow the wind to spin the cups. Count how many times the index cup spins around in one minute. Record the number.

6. Observe the effect of the wind on objects in the environment. Look at the "Criteria Over Land" column on the Beaufort Scale and try to classify the wind.

Data

Date	Time	Cups/Minute	Wind Effect	Estimated Speed

Diagram



Beaufort Scale of Wind Force and Equivalents

Beaufort No.	Name	Criteria over land	miles/hr	cm/sec
0	Calm	Smoke rises vertically	1	45
1	Light air	Smoke drifts with air	1-3	45-134
2	Light breeze	Wind felt on face; leaves rustle	4-7	179-313
3	Gentle breeze	Leaves and small twigs in motion; light flags extend	8-12	358-536
4	Moderate breeze	Raises dust and loose paper; moves small branches	13-18	581-805
5	Fresh breeze	Small leaves in tree sway; raises chop on inland waters	19-24	849-1073
6	Strong breeze	Large branches in motion; telephone wires whistle	25-31	1118-1386
7	Moderate gale	Whole trees in motion; inconvenience walking in wind	32-38	1430-1699
8	Fresh gale	Breaks twigs off trees; walking difficult	39-46	1743-2056

Weather Chart

Key ✳		Date	Time	Temp	Wind Speed	Wind Direction	Humidity	Air Pressure	Tomorrow's Forecast				Today's Actual Weather
Symbol	Condition								Class	Commercial	Weather Bureau TV, Radio, News	Farmers Almanac	
○	Clear Sky												
◑	Partly Cloudy												
●	Rain												
✳	Snow												
⚡	Thunder Storm												
◕	Drizzle												
≡	Fog												
◡	Warm Front												
◭	Cold Front												
⚡	Dust Storm												
▽	Showers												
✳ ▽	Hail												
△	Sleet												
⬭	Smoke												
∞	Haze												

✳ (not an official key)

●● more symbols — stronger conditions

✳
▽ symbol above symbol — mixed conditions

Encontrando la Velocidad del Aire: Fabricando un Anemómetro

Hoja de Actividades para el Estudiante

¿Quien ha visto el viento?
Ni tú ni yo:
Mas cuando las hojas cuelgan trémulas
El viento está pasando

—Christina Rossetti

Descripción: Se construirá un anemómetro y se usará para determinar la velocidad del viento.

Materiales para su Grupo:
2 popotes
4 vasos deshechables "Dixie" (el tamaño más pequeño)
1 alfiler recto
1 lápiz con borrador
marcadores o colores de cera (crayones)
cinta adhesiva
Escala de Beaufort

Medidas de Seguridad: Tener precaución al empujar el alfiler a través de los popotes y del borrador.

Procedimiento:

1. Usar la cinta adhesiva para pegar un vasito deshechable a cada uno de los extremos de los popotes. Los vasitos deberán estar de lado orientados en ángulo recto al popote. Los vasitos en cada extremo del popote deberán estar orientados en dirección opuesta.

2. Sostener los dos popotes para formar una cruz. Buscar el punto de balance para los popotes y ponerles cinta adhesiva atravezándolos por la mitad para mantenerlos juntos.

3. Empujar el alfiler por enmedio de los popotes y del borrador del lápiz de tal manera que los popotes giren sobre el borrador. Puede ser que se necesite agrandar el agujero donde entra el alfiler para hacer que los popotes giren mas fácilmente.

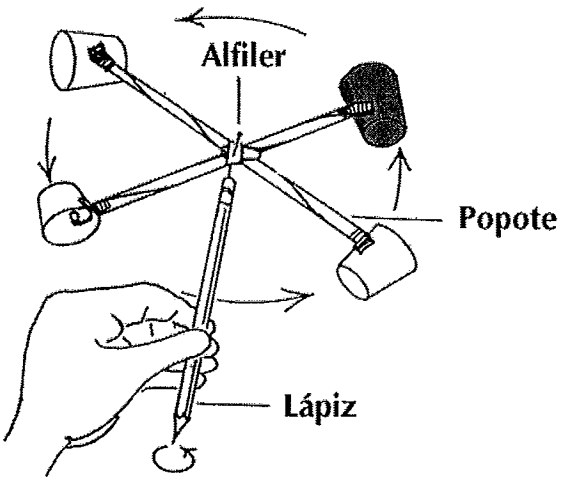
4. Colorear uno de los vasitos. Este será su vaso de referencia.

5. Llevar afuera el anemómetro a un área despejada. Sostener verticalmente el lápiz del anemómetro y dejar que el viento haga girar los vasitos. Contar las veces que el vaso de referencia gira en un minuto. Registrar el número.

6. Observar los efectos del viento sobre los objetos en el ambiente. Ver la columna de "Criterio Sobre Tierra" de la Escala de Beaufort y tratar de clasificar el viento.

Datos

Fecha	Hora	Vasos por Minuto	Efecto del Viento	Velocidad Estimada



Fuerza del Viento y sus Equivalentes en la Escala de Beaufort

No. de Beaufort	Nombre	Criterio Sobre Tierra	millas/hora	cm/seg
0	Calma	El humo sube verticalmente	1	45
1	Aire ligero	El humo flota con el aire	1-3	45-134
2	Brisa ligera	El viento se siente en la cara; las hojas susurran	4-7	179-313
3	Brisa suave	Las hojas y ramitas están en movimiento; ligero ensanchamiento de alas	8-12	358-536
4	Brisa moderada	Se levanta polvo y papel suelto; se mueven pequeñas ramas	13-18	581-805
5	Brisa reciente	Oscilación de las hojas de arbolitos; agitación de las aguas de lagos	19-24	849-1073
6	Brisa fuerte	Movimiento de ramas grandes; chiflar de los cables telefónicos	25-31	1118-1386
7	Ventarrón moderado	Movimiento de árboles enteros; incomodidad al caminar con el viento	32-38	1430-1699
8	Ventarrón reciente	Se quebran las ramitas de los árboles; se dificulta el caminar	39-46	1743-2056

Gráfica Meteorológica

Clave ✳									Pronóstico para Mañana				Tiempo Actual
Símbolo	Condición	Fecha	Hora	Temp.	Vel. del Viento	Dir. del Viento	Humedad	Presión del Aire	Clase	Comercial	Centro de Inf. Meteorológica	Almanaque	
○	Cielo Claro												
◑	Nublado Parcial												
●	Lluvia												
✳	Nieve												
⚡	Tormentas Eléctricas												
🌦	Llovizna												
≡	Bruma												
	Frente Cálido												
	Frente Frío												
	Torm. de Arena												
▽	Chubasco												
◈	Granizo												
△	Aguanieve												
⬭	Humo												
∞	Niebla												

✳ (no es una clave oficial)

●● Más símbolos - condiciones más feurtes

✳/▽ símbolo sobre símbolo - condiciones mixtas