

Weather

Prior Knowledge

The student has

1. described evaporation, condensation
2. listed and described three forms of water
3. described the earth's rotation on its axis
4. grouped objects by a given single-digit number
5. counted and constructed sets to 100 and skip-counted by fives and 10s
6. placed two-digit numbers correctly on a place value chart and ordered them
7. measured lines.

Mathematics, Science and Language Objectives

Mathematics

The student will

1. use numbers through 1000
2. skip-count by fives, 10s and 100s
3. write and order two- and three-digit numbers
4. draw a chart to describe a rate such as miles per hour
5. use fractional parts of a set or unit to describe a part of a set or unit
6. convert a rate given in fractions to an equivalent rate, such as $\frac{1}{2}$ inch per hour to one inch in two hours
7. use addition/subtraction and/or grouping by a base to solve problems related to time, distance and volume
8. use appropriate geometric terms to describe objects
9. estimate linear measurements in blocks, feet, yards and miles
10. read and interpret instrument scales
11. measure time, distance and temperature.

Science

The student will

1. list the activity of the sun and the rotation of the earth as major causes of weather
2. describe the earth's atmosphere
3. describe the effects of the sun's heat on land and water on the weather
4. list, describe and give causes for the seasons
5. list and describe the benefits of "good" weather
6. list and describe the disasters caused by "foul" weather
7. list and describe the various types of clouds and the types of precipitation they cause

8. describe different forms of precipitation such as fog, drizzle, ice crystals, snow, hail, dew and sleet
9. describe different forms of air movement such as wind, tornadoes and hurricanes
10. describe the cause of air currents, wind and high winds
11. find the dew point at a given time and location
12. find the relative humidity of a given location at a given time
13. describe weather forecasting.

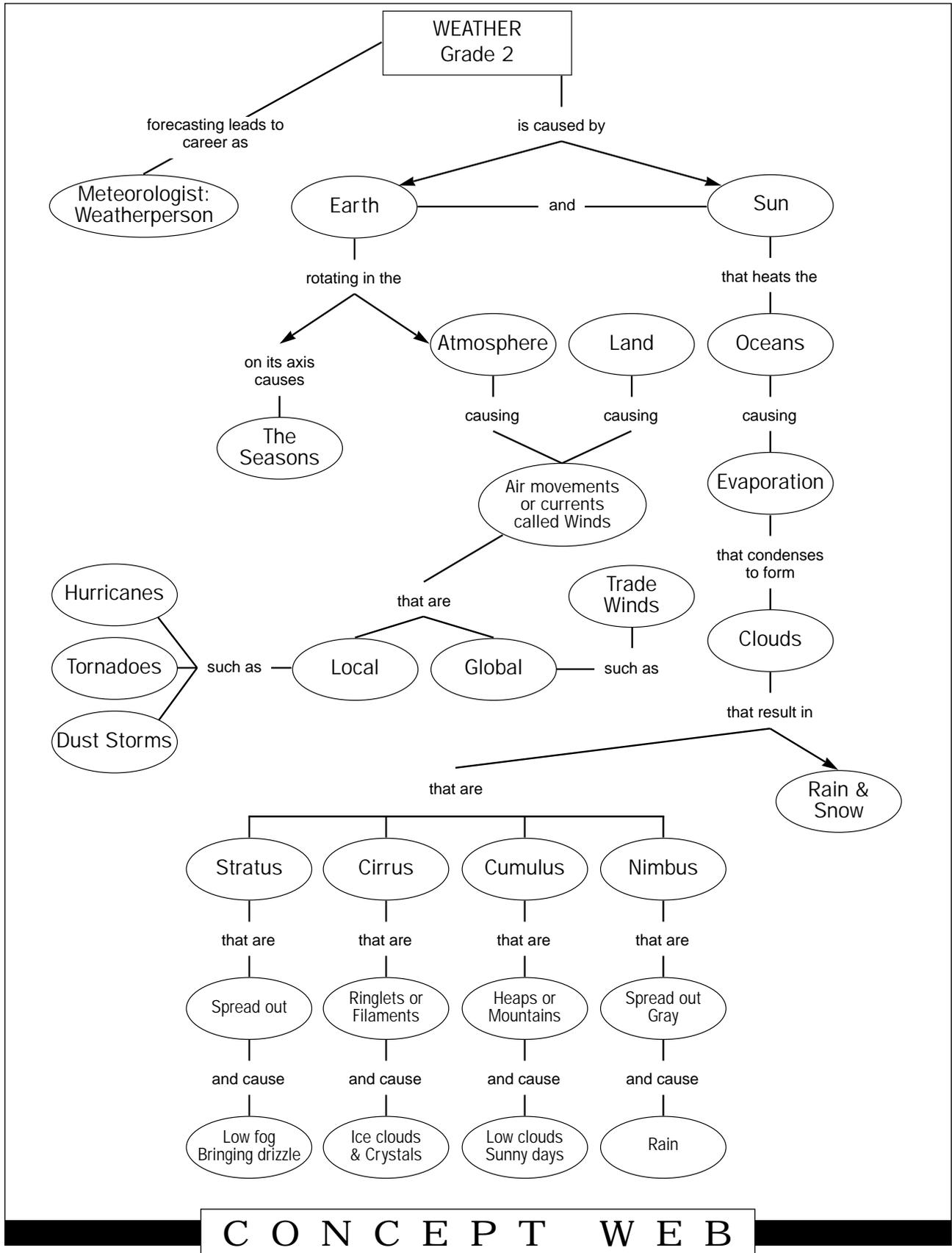
Language

The student will

1. engage in dialogue/discussion
2. engage in observation activities/demonstration
3. record observations about unit activities in a journal
4. identify the main idea of a paragraph
5. create stories using theme-related vocabulary
6. use description to narrate events
7. write complete sentences
8. give reasons to persuade
9. organize information/data
10. use appropriate mathematical expressions and quantities to describe.

V O C A B U L A R Y

weather el tiempo	wind viento	hail granizo	direction dirección	it is warm (cold) hace calor (frío)
distance distancia	cloud (s) nube (s)	rain lluvia	sunny soleado	dust polvo
cloudy nublado	dark oscuro	low bajo (a)	fog neblina	snow nieve
tornado tornado	earthquake terremoto	hurricane huracán	drizzle llovizna	snowflake copo de nieve, pluma
thermometer termómetro	block (city) cuadra	atmosphere atmósfera	current corriente	weather wave or wind sock veleta
time tiempo				



C O N C E P T W E B

Teacher Background Information ● ● ●

The weather is so important that it is a topic of daily conversation everywhere on earth. The weather affects every single person on a 24-hour basis. The amount of food available for humans to eat around the planet depends on the weather, as do the types of food we eat, the types of houses we live in, the kinds of clothes we wear, the kinds of jobs we have, the ways we find recreation, and the weather even affects our moods, whether we feel good, sad, and so on. The trouble with the weather, however, is that no one can do anything about it. Science and technology help us **forecast** the weather, but that is not the same as doing something about it.

In this unit the students will find out in more specific terms about the types of weather all of us have experienced. They draw on these experiences by performing the activities that help them understand what causes clouds and rain, wind and snow and, generally, the seasons. They understand the role that the sun and the earth play in causing the weather. As they develop these understandings they will be able to discuss among themselves and with others, using appropriate terms and quantifiers, the causes of particular types of weather.

The suggested activities require that students participate in whole- or small-group activities that focus on simulations of certain conditions (physical phenomena). Although complex, these atmospheric conditions can become understandable through the use of appropriate analogues. The students will make charts to describe current weather conditions and then try their hands at forecasting the weather on the basis of what they have learned.

It is strongly recommended that students have the opportunity to watch taped segments of the **Weather Channel** on cable television. They can keep track of the forecasts for one to two weeks, make judgments about the accuracy of these reports and use them as a basis for their own forecasts.

L E S S O N F O C U S**■ LESSON 1*****Today's Weather******BIG IDEAS***

Weather affects the way we live, what we eat and wear and how we feel. We can describe weather conditions by using mathematics.

■ LESSON 2***What Makes Weather?******BIG IDEAS***

The sun heating the earth and its atmosphere causes the weather. We feel weather as wind, heat or cold, and humidity in the form of rain, ice and snow.

■ LESSON 3***The Four Seasons******BIG IDEAS***

The seasons develop from the angle of tilt of the earth's axis as the earth revolves in its path around the sun.

■ LESSON 4***Wind: Air in Motion******BIG IDEAS***

Wind, tornadoes, cyclones and dust storms are all moving air, which exerts pressure as it moves.

■ LESSON 5***Clouds, Rain and Snow******BIG IDEAS***

Clouds, rain and snow are all different forms of water vapor; the form of the precipitation depends on the temperature of the surrounding air.

■ LESSON 6***Nature's Light Show******BIG IDEAS***

Huge exchanges of electrical charges produce lightning; rapidly expanding air produces thunder; we count the seconds between a flash and the clap of thunder to estimate the distance, in kilometers, of a thunderstorm.

■ LESSON 7***Weather Forecasting******BIG IDEAS***

Would you like to be a weather forecaster? We base weather predictions on data that we have gathered over many days.

O B J E C T I V E G R I D

Lessons	1	2	3	4	5	6	7
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Mathematics Objectives

1. use numbers through 1000	•		•				•
2. skip-count by 5s, 10s and 100s	•		•		•	•	•
3. write and order 2- and 3-digit numbers	•		•		•	•	•
4. draw a chart to describe a rate such as miles per hour				•	•	•	•
5. use fractional parts of a set or unit to describe a part of a set or unit				•	•		•
6. convert a rate given in fractions to an equivalent rate, such as 1/2 inch per hour to one inch in 2 hours				•		•	•
7. use addition/subtraction and/or grouping by a base to solve problems related to time, distance and volume	•	•	•	•	•	•	•
8. use appropriate geometric terms to describe objects					•		•
9. estimate linear measurements in blocks, feet, yards and miles						•	•
10. read and interpret instrument scales	•		•	•	•	•	•
11. measure time, distance and temperature	•		•	•	•	•	•

Science Objectives

1. list the activity of the sun and the rotation of the earth as major causes of weather			•				•
2. describe the earth's atmosphere	•	•	•				•
3. describe the effects of the sun's heat on land and water on the weather		•		•			•
4. list, describe and give causes for the seasons	•		•				•
5. list and describe the benefits of "good" weather	•			•	•		•
6. list and describe the disasters caused by "foul" weather	•			•	•		•
7. list and describe the various types of clouds and the types of precipitation they cause					•	•	•

Lessons

	1	2	3	4	5	6	7
8. describe different forms of precipitation such as fog, drizzle, ice crystals, snow, hale, dew and sleet					•	•	•
9. describe different forms of air movement such as wind, tornadoes and hurricanes				•		•	•
10. describe the cause of air currents, wind and high winds		•		•			•
11. find the dew point at a given time and location					•		•
12. find the relative humidity of a given location at a given time					•		•
13. describe weather forecasting.	•						•

Language Objectives

1. engage in dialogue/discussion	•	•	•	•	•	•	•
2. engage in observation activities/ demonstration	•	•	•	•	•	•	•
3. record observations about unit activities in a journal	•	•	•	•	•	•	•
4. identify the main idea of a paragraph	•	•		•	•		
5. create stories using theme-related vocabulary	•						•
6. use description to narrate events	•	•	•	•	•	•	•
7. write complete sentences	•	•	•	•	•	•	•
8. give reasons to persuade	•	•	•	•	•	•	•
9. organize information/data	•	•	•	•	•	•	•
10. use appropriate mathematical expressions and quantities to describe.	•	•	•	•	•	•	•

LESSON

1

Today's Weather

BIG IDEAS Weather affects the way we live, what we eat and wear and how we feel. We can describe weather conditions by using mathematics.

Whole Group Work**Materials**

Books: **Storms in the Night** by M. Stolz, **The Good Rain** by A.E. Gondey or **The Very Windy Day** by E. MacDonald

Chart tablet (divided into columns with labels: Kind of Weather; Clothes; Work; Homes; Recreation; What We Cannot Do, etc.)

Two strips of bulletin board paper for frame sentences

Several books and magazines with illustrations of weather conditions, to place later in the **Library Center**

Word tags: weather, forecast, thermometer, predict

Encountering the Idea

The teacher shows the book **Storms in the Night** to the students and asks them to predict what the story is about. The teacher reads the story aloud, asking students to visualize how it must feel to be in the dark during a thunderstorm. At the conclusion, the teacher asks the students to recall how the thunderstorm affected the grandfather and the grandson. (They remained inside, shut windows, couldn't read or watch TV, had to go to bed early, were afraid of storms, etc.) The teacher and students enter into a discussion of how the weather affects our lives.

Exploring the Idea

In a whole group activity, the students organize and plan a field trip to experience the current weather conditions outside the classroom. They plan their route around the school and into the neighborhood. They list what they want to see, smell and feel. They also plan how far they will walk and how they will measure that distance. Then they will measure or estimate the distance. In preparation for this walk the students, working in groups, design a weather chart to keep the data they collect each day.

At the **Science Center**, the students

1. begin work on **Activity** — Weather Forecasting to continue for approximately three weeks. This activity requires collecting weather data on a daily basis at approximately the same time each day for two to three weeks. At the end of the third week, the students make predictions about the weather for the fourth week. They check their predictions during the fourth week.
2. make a wind sock to carry with them by completing **Activity** — A Wind Sock before going outside. They discuss the function of the wind sock. Has anyone seen a wind sock? How do we use it? (At the airport to tell which way the

wind is blowing, on the side of a mountain pass to warn drivers of high winds.)

At the **Mathematics Center**, the students complete **Activity** — Reading a Thermometer.

At the **Writing Center**, students

1. write a class Big Book on how the weather affects us
2. write frame sentences about the weather on long strips of bulletin board paper:

“If it is _____, then I can (can’t) _____.”

The students complete as many of these as they wish.

Getting the Idea

Students contribute to the chart labeled: Kind of Weather, Clothes, etc. to use in writing in their journals about how weather affects our lives.

Students describe what they can see from the classroom, writing new words they need on a chart. They discuss different experiences they have had in relation to the weather. On returning from the walk, the class discusses what they saw, smelled and felt, using appropriate descriptive terms. The students discuss how the wind sock gave them information about the wind and its direction, and what kind of information the thermometer provided. Was it hot or cold outside? How hot (or cold) was it? How can we find out how hot or cold it was? What do we use to find out? (Thermometer.) The students begin to record the data that they have collected on the weather forecasting chart. Was the wind blowing? Hard? Was it humid? Dry? Answer these last questions by taking students’ opinions. The students describe the conditions as well as they can. Tell them that in later lessons they will learn to measure these conditions and have more accurate ways to describe the weather.

We learned to use a thermometer to tell how hot or cold the outside air is. We don’t have to use words that only tell us if it is hot, cold, very hot or very cold. We can give a more accurate description. How far did we walk? (Blocks, yards.) How did we measure the distance?

Organizing the Idea

The students write about today’s weather and draw pictures in their journals of what they have talked about. They may also write questions about something they would like to know about the weather, thunder, lightning or some other interesting weather phenomenon.

Students can write a story of how the weather has affected their plans at some time. They can illustrate their story and write it in their journals.

Students contribute to a daily class weather report. See **Activity** — My Forecast.

Applying the Idea

The activity on weather forecasting will take at least three to four weeks to complete (two to three weeks to collect data and one week to predict and check). The students collect data as they learn the new concepts and learn how to measure wind direction, wind velocity, air pressure and humidity. They learn also about the different types of precipitation and how to describe them.

The students select a name for their weather forecasting station. See **Activity — Weather Forecasting**.

1. They begin to record the data on the weather chart to keep track of the weather. Remember, weekends count too; draw pictures to tell the weather.
2. Read an outside thermometer every day just before lunch and record the temperature on the weather chart.
3. Learn how to use the windometer made in Lesson 4; take measurements every day just before lunch and record wind velocity on the chart. Record dew point, humidity.
4. Maintain the chart for three weeks. Translate the data from the chart to line graphs, if appropriate, to make predictions. At the end of the third week make a forecast for the fourth week; students check their predictions with their own observations and newspaper or television observations.
5. Review the symbols of the forecasting chart on the first day. The students will add more data every day as they learn to use the instruments.

Closure and Assessment

How far did we walk? How did you measure the distance? (Blocks, feet, etc.) Can we use blocks to tell us how far we walked? Are all the blocks the same length? Can we estimate how far we walked? Can we use blocks to estimate the distance?

Students summarize what new things they learned about the weather focusing on these questions:

1. How did the weather affect us today?
2. Was the weather sunny or cloudy? Windy? Is it raining? Is it foggy? Is it dusty?
3. What instruments did we use to help us describe the weather?
4. Why is it important to use instruments in describing the weather?

Students summarize their experiences in measuring the distance they walked and in collecting data.

If we wanted more than an estimate of how far we walked, what could we use to measure the distance?

List of Activities for this Lesson

- ▲ Weather Forecasting
- ▲ A Wind Sock
- ▲ Reading a Thermometer
- ▲ My Forecast (continued in Lesson 7)

▲ ACTIVITY Weather Forecasting

Objective

The students predict the weather for one week by using the data they collect during the first three weeks of work on the unit.

Materials

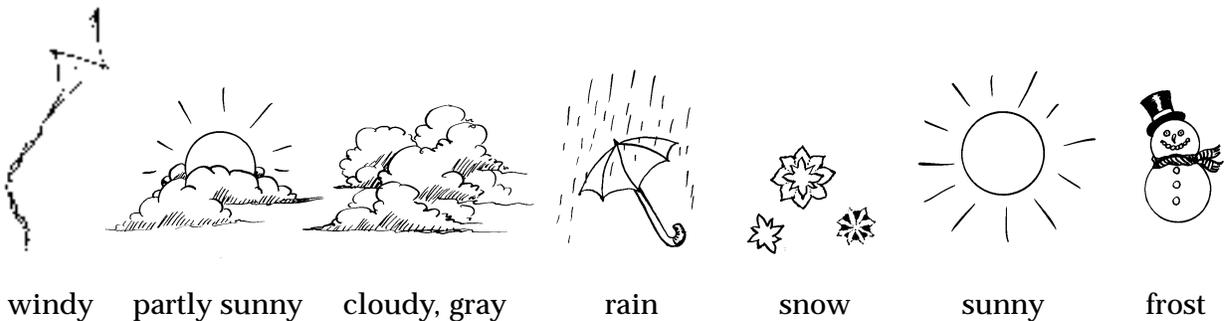
Chart for each student, or one for the entire class.

Procedures

1. Make a weather chart to keep track of the weather.
2. Draw a picture to tell the weather.

		Month						
		Mon.	Tue.	Wed.	Thurs.	Fri.	Sat.	Sun.
Week 1	temperature dewpoint wind direction air pressure clouds? sun?							
Week 2								
Week 3								
Week 4	(student predictions go here)							

Remember: Weekends count too.
Draw the weather conditions as shown below.



▲ ACTIVITY *Weather Forecasting*

Current Conditions

Symbols	Condition	Date	Time	Temp	Air Pressure	Wind Speed	Wind Direction	Humidity	Dew Point
	Sunny, Clear								
	Partly Cloudy								
	Cloudy								
	Rain								
S	Thunderstorm								
	Fog								
Δ	Dust storm								
⊖	Hail								
X	Haze								
Σ	Sleet								

Note: These symbols are not standard weather symbols.

▲ **ACTIVITY**

A Wind Sock

Objective

The student constructs a wind sock and is able to explain its function in describing weather conditions.

Materials

For each child:

Small, cylindrical box (salt, oatmeal) with top and bottom removed

Sheet of paper pre-cut to fit the box

Four pieces of string

Eight to 10 strips of crepe paper or ribbon

Procedures

1. Children decorate the paper that they will fit on the box with appropriate weather pictures.
2. Students attach the paper onto the box by stapling or gluing; they punch four holes near the top to tie pieces of string and tie the four pieces together at the top.
3. Attach the ribbons (streamers) at the bottom.
4. Hold the wind sock at the top by the four strings attached to the box.
5. The wind sock is ready for students to take it outside in the wind. Students can attach the wind sock with more string to a pole and leave it outside a classroom window to observe it.



ACTIVITY *Reading a Thermometer*

Teacher Information

We measure the ambient (room, or outside) temperature by taking the temperature of the air, or some other medium, that surrounds the thermometer. A thermometer is a cylindrical tube filled with either mercury or red-colored alcohol set against a scale reading either in Fahrenheit or in Centigrade (Celsius) degrees.

The basis for the use of a thermometer is that matter usually expands as it absorbs heat. Mercury is a metal in liquid state that expands readily as it absorbs heat. Mercury is more expensive than alcohol; consequently, thermometers usually contain alcohol as the liquid that expands to give the temperature reading.

A thermometer scale is marked in units called degrees ($^{\circ}$), in multiples of 10. The reference points of a thermometer are usually the freezing point and boiling points of water level. Since the ambient temperature may go to below 0°C (the freezing point of water) on some days but does not reach 212°F (the boiling point of water), only those temperatures that are common on earth appear on a room thermometer scale. Thus, the numbers that indicate the ambient temperature range from a low of about 40°F below 32°F to about 120°F .

Each unit is marked with a large slash, in multiples of 10. The unit is usually subdivided with a smaller slash, into five parts. Consequently, each large mark counts for 10 degrees and each small mark counts for two degrees. Thus, students need to count by twos and 10s to take an ambient temperature.

Materials

A room thermometer with Fahrenheit and Celsius scales (usually one scale is shown on either side of the thermometer) for each student

Some ice cubes in a jar of water

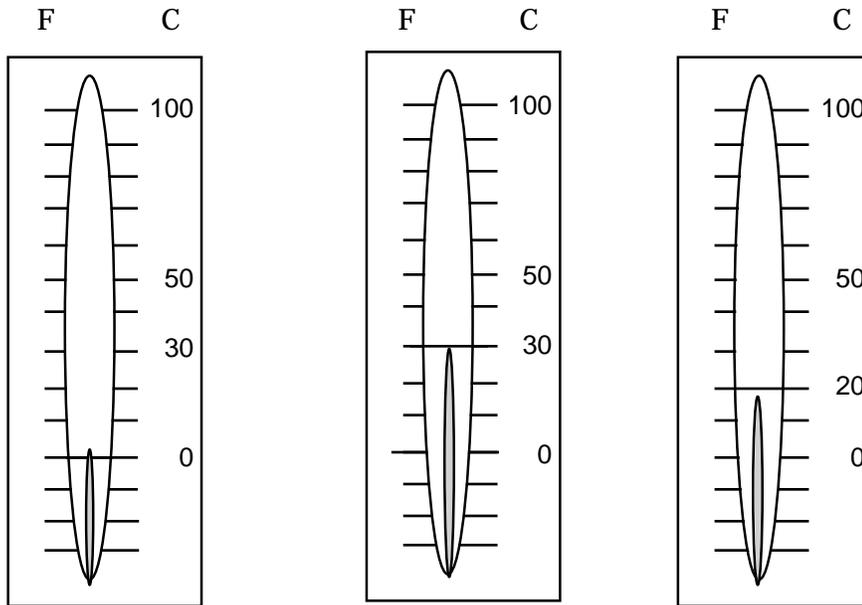
A lighted lamp

Procedures

1. Each student group examines and describes a thermometer, noting the liquid in the cylinder; how the scale is marked; the number of subdivisions; and any other features they may notice. They find the highest number, the lowest number, and where zero is located. They make these observations using both the Fahrenheit scale and the Celsius scale.
2. The students read the thermometer the way they would read a number line, noting that the scale is divided into multiples of 10, and the subdivisions are either a two, four, six or eight. They write the number as $70 + 8 = 78^{\circ}\text{F}$ in reading the thermometer, until they can read it without writing it in expanded notation. They record the room temperature.
3. After they take the room temperature, the students cool the thermometer by placing it in cold water for a few seconds. By keeping the thermometer in the water for a longer or shorter time, they can practice reading different measurements. By leaving the thermometer in the jar with ice cubes until the temperature stops falling, they can read a temperature close to freezing, or 32°F . They take and record the temperatures in Fahrenheit and Celsius.
4. After they take the temperature of the water, the students let the thermometer warm a little and then place the thermometer near — but not touching — the

lighted lamp. They take and record the temperature. They take different measurements by varying the amount of time they leave the thermometer close to the lamp.

- After taking several measurements of the temperature of the cold water and the air near the lighted lamp, the students order the temperatures from lowest to highest, find a middle temperature, state the range of temperatures and describe them in any other way they choose, for both the Fahrenheit and Centigrade scales.
- Students read the picture thermometers in both Fahrenheit and Centigrade.



LESSON

2

What Makes Weather?

BIG IDEAS The sun heating the earth and its atmosphere causes the weather; we feel weather as wind, heat or cold, and humidity in the form of rain, ice and snow.

Whole Group Work

Materials

Large chart tablet for new words provided by class
Large world globe
Plastic jar with colored water
Reference books on weather
Thermometer
Current copy of a daily newspaper
Wind socks

Encountering the Idea

The teacher asks students to gather as much data as they can with the instruments they have learned to use (wind socks; thermometers) to describe the current weather conditions. Students can suggest using the thermometer to measure the temperature and using the wind sock to measure the direction of the wind. What are some other weather conditions that can occur? Tell the students they will explore making weather conditions right in the classroom. After they explore these ideas, they are to hypothesize about what causes different weather conditions. They will also make suggestions on how to gather data to be more accurate in their descriptions of weather.

Exploring the Idea

In this lesson, students will discover how nature produces wind and precipitation. Give the first activity involving **air currents** in two parts. By using talcum powder, the students can see the powder moving in an air current. In the second part, heating the air around a light bulb produces air currents that move a paper swirl above the bulb.

At the **Science Center**, students

1. complete **Activity** — Air Currents
2. complete **Activity** — Rain in the Classroom
3. complete **Activity** — Water Tornado, as shown below.

Water Tornado

Fill a plastic jar halfway with lightly colored water. Do not cover it with a lid. A student vigorously stirs the water in the plastic jar and looks down through the top of the jar to see a water tornado.

Discussion

In making a water tornado, what happens when you move your hands back and forth in the water? Slowly? Rapidly? Can you push the water away from you?

What caused the tornado in the bottle? (You moved the water rapidly with your hand.) What do you think causes a **wind tornado**? (The sun heats air that begins to move rapidly, causing air currents to swirl.)

Getting the Idea

Using a world globe, the teacher demonstrates and discusses the following ideas.

1. The earth has a deep layer of air that surrounds it. This layer of air we call the **atmosphere**. Weather develops usually from the sun heating the land on earth and the earth's atmosphere while as the earth rotates on its axis. As the earth rotates, it rotates in a layer of air and causes the air to move. These movements of air we call **air currents**. The currents make wind. In the meantime, however, the sun is heating the land and the oceans on the earth as well. As the sun heats the land, the land reflects some of the heat it gets from the sun into the atmosphere, heating it more. This process causes more air currents.
2. As the sun heats the water in the oceans, it causes **evaporation** of the water. The evaporation then forms **clouds**. Clouds are a form of **water vapor** that has **condensed**. The water in the clouds turns to rain, snow, sleet, frost and other forms of water and water vapor, depending on the temperature of the air. We will see this happening when we make rain in the classroom.
3. Usually we feel weather conditions as movement of air, or wind, how dry the wind is, or its humidity, and its temperature. We can measure each of these conditions. That's what makes accurate weather prediction possible.
4. We can study the use of the wind sock. What is its purpose? The wind sock tells us the direction the wind is blowing. But, the wind sock does not tell us how fast the wind is blowing. We will learn how to measure wind velocity in another lesson.
5. What is the purpose of the thermometer? Does the temperature have anything to do with the movement of the wind sock? (No, only the direction and velocity of the wind affect the wind sock.) How do we use the two instruments together?

Organizing the Idea

At the **Writing Center**, the students write and illustrate how the sun's heat causes weather. The description includes information about the atmosphere (air around the earth) and about air currents.

At the **Mathematics Center**, the students

1. examine the data collected for the weather forecasting activity
2. again, compare the high and low temperatures and note the differences by subtracting the two temperatures using both Fahrenheit and Celsius scales
3. find the temperature on both scales by reading them off the thermometer — **not by converting** — but simply reading the two scales.

Applying the Idea

In their school library, students research books or almanacs or the daily newspaper for the number of days of sunshine in their city, the inches of rainfall and the wind velocity; students compare these data with data from other cities in the nation. The students can also research how we measure a day of sunshine, as well as how we measure rainfall and wind velocity. They report these findings to the class.

Sample reports:

For City _____, the weather conditions were _____ on (date). The high temperature was _____, while the low temperature was _____. It's rainfall (or snowfall, etc.) was _____. The wind was blowing from _____ at _____ miles per hour. The relative humidity was _____.

Closure and Assessment

Oral interview

1. How important is the sun in affecting our weather? What does it do to affect the weather?
2. Wind is moving air. What causes air to move fast?
3. Show your teacher your up-to-date weather forecasting chart. Interpret your chart for your teacher or your partner.

Performance Assessment

1. Demonstrate what causes rain.
2. Demonstrate one of the causes of wind currents.

List of Activities for this Lesson

- ▲ Air Currents
- ▲ Rain in the Classroom

▲ **ACTIVITY**

Air Currents

Objective

Students say that as air gets hot it begins to move upward, above colder air, causing wind currents.

Materials

100-watt light bulb

Six-inch paper circular disk

Small amount of talcum powder (about 1/2 teaspoon)

Procedures

1. The teacher turns on the light bulb and allows it to get hot.
2. Ask students to feel **the air around the bulb but not the bulb itself.**

Talcum Powder activity

3. Sprinkle small amounts of talcum powder over the bulb.
4. Students watch the motion of the powder as it swirls above the bulb.

Discussion

What surrounds the bulb? (Hot air.) Is the bulb hot? What about the air around it? What makes the powder swirl? (Air currents of hot air.)

Paper Swirl activity

5. Cut the paper disk along the lines shown in Fig. 1 to make a paper swirl.
6. Tie a small piece of string around the top of the swirl and hold the swirl above the light bulb at a height of about four inches.
7. The students watch the motion of the swirl above the bulb.

Discussion

Same questions as for the powder.

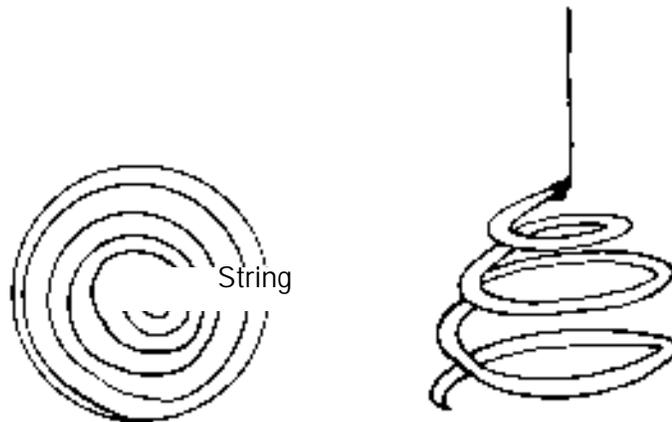


Fig. 1

▲ ACTIVITY *Rain in the Classroom*

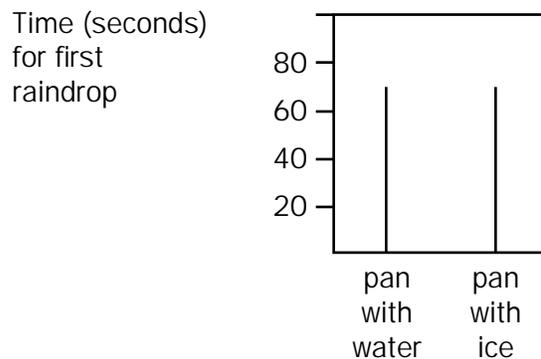
Note: This is a teacher demonstration to avoid having the students work with hot water.

Materials

Skillet or hot plate; pie pan; sponge; water; clock; ice cubes; clear glass large-mouth gallon jar

Procedures

Place a pot of water on a skillet or hot plate to boil. Hold a pie pan that has a wet sponge in it over the boiling water. Students observe the bottom of the pie pan to see when condensation begins to form on the pan. Students time and record how long it takes for the first raindrop to fall from the pan. Repeat the experiment with ice in the pan and record the results. Students compare the lengths of time it took for each activity. Students suggest reasons for the difference in times.



Clouds in the Classroom

Heat a pot of water on a hot plate. Hold a clear glass large-mouth gallon jar upside down over the pot of water to collect the hot air as it rises. Cover several ice cubes with a wet paper towel and place on top of the inverted jar. As the hot air reaches the top of the jar, clouds begin to form. The clouds may become cold enough to condense and “cause rain.”

Discuss the water cycle the students observed. They may duplicate the rain pattern with claps, finger snaps or pictures of evaporation, condensation and precipitation.

Discussion

1. Let's talk about the forms of water we saw in this experiment. (Liquid, steam and ice).
2. How did these changes happen? (We heat water; when the steam hit the jar it condensed back into water.)
3. Can you state a rule about this? (Water has different forms.)
4. What was the **same** about the pans? What was different? Why did the pan with ice make the steam condense faster?
5. What causes rain and clouds to form?

LESSON

3

The Four Seasons

BIG IDEAS The seasons develop from the angle of tilt of the earth's axis as the earth revolves in its path around the sun.

Whole Group Work**Materials**

Current year-long calendar; world globe; flashlight (pen light preferred); thermometers; wind socks; copies of questions from **Activity** — Mathematics of the Seasons

Word tags: season, summer, winter, spring, fall, tropics, hemisphere, northern, southern, equinox

Encountering the Idea

Begin the lesson by asking the students to review what the main cause of weather is (Lesson 2). Ask them to keep this in mind as they hypothesize as to the cause of the seasons. The students name the seasons and describe what they know about them. What is special about each season? Students are to hypothesize about the following.

Why does it get cold in the winter and hot in the summer? What happens during the spring and the fall? As the children express their ideas, write some of the more plausible ones on a chart tablet, for students to use later in writing their explanations of the seasons in the **Writing Center**. Tell them that you will conduct two demonstrations using a flashlight to simulate the sun as a source of light and heat and using the globe as the earth. After the two demonstrations, students again hypothesize as to what causes the seasons.

Exploring the Idea

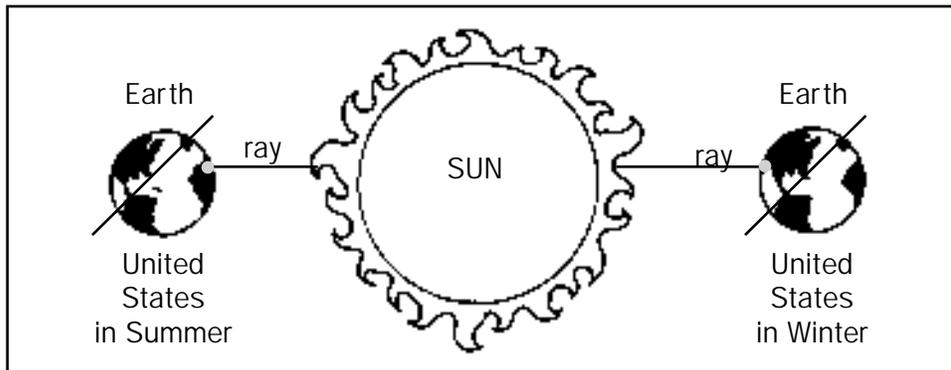
At the **Science Center**, students

1. complete **Activity** — Temperature and Distance. It is important for students to go through this activity first so they can see the earth's tilt in relation to the distance from the sun of a specific area on earth.
2. complete the following activity.

Using the flashlight to simulate the sun as a source of light and heat and using the globe as the earth, ask a student to hold the globe at an angle, as shown in the picture below. (Place a styrofoam ball at the end of a stick to hold it at an angle, as shown.) The student rotates the earth (globe) while keeping it tilted in the approximate angle shown in the illustration below; at the same time the earth revolves around the "sun." The flashlight's rays follow the globe (earth) as it rotates in an elliptical path.

The winter months in the Northern Hemisphere (usually November, December, January and February) do not correspond to the winter months in the

Southern Hemisphere (usually May, June, July and August). The students can see this by experimenting with a globe and moving it around a light bulb or a flashlight to show that when the angle of the tilt of the earth's axis changes, the distance that a ray of sun travels from the sun's surface to the earth's surface varies. In the tropics, however, the seasons remain relatively unchanged, except for periods of increased rain.



At the **Mathematics Center**, the students in groups of four complete **Activity** — Mathematics of the Seasons.

Getting the Idea

Ask the student groups to justify, in their own words, their answers to the questions for **Activity** — Mathematics of the Seasons. After the discussion, tell the students the following ideas, using a globe to demonstrate how the seasons occur.

The seasons are divisions of the year that occur in cycles. Tell students, in general, the kind of weather to expect for each season. In the past, people associated the seasons mostly with the cycle of sowing and harvesting cultivated plants. Winter is the dormant period of most plants, while we associate spring with germination and sowing. Summer is the period of growth, and autumn is the time of harvest.

Outside of the **tropics**, we note the seasons for extreme changes in weather from a minimum of warmth in the winter to a maximum in the summer. The other two seasons, spring and fall are transitional periods. Only the extreme seasons have very different characteristics. Although we cannot make absolute statements about the weather in any one season, it is convenient for us to divide the year into four separate parts that describe the weather in general.

Changes in the angle of the sun's rays striking the earth and in the length of day cause the seasons. The amount of solar radiation (heat) absorbed by the earth's surface and by the atmosphere changes as the earth revolves around the sun. As the earth moves in its orbit, its axis maintains a nearly constant orientation in space, inclined at about a 66° angle to the plane of the orbit.

Organizing the Idea

Students write about and illustrate the causes of the seasons.

At the **Music** or **Listening Center**, the students can listen to a tape of Vivaldi's **Four Seasons**. In this composition the music depicts the composer's feelings

about winter, spring, summer and autumn. The students try to identify those parts of the music that remind them of a winter storm or a summer day.

Applying the Idea

Problem Solving

1. Can you show on the world globe where the area of the **eternal night**, or the **eternal day**, could be? (At the poles.) What does **eternal** mean? What causes a day to be that long? Students demonstrate this with the globe and flashlight.
2. Can you show on the world globe where there might be **eternal summer** on earth? (In the tropics.) **Eternal winter?** The students demonstrate this.

Closure and Assessment

1. The students illustrate the tilting of the earth's axis and its relationship to the seasons along with a drawing of a seasonal activity.
2. Students write a poem about their favorite season.
3. Students can justify their answers to questions on **Activity** — Mathematics of the Seasons.
4. Students write a rule that relates distance from a heat source (the sun or a light bulb) to the temperature of an object.

List of Activities for this Lesson

- ▲ Mathematics of the Seasons
- ▲ Temperature and Distance

▲ ACTIVITY *Mathematics of the Seasons*

Objective

Using the topic of the seasons, the students use whole number operations to solve problems.

Materials

Copy of a year-long calendar for the current year

List of questions

World globe

Flashlight, if necessary

Procedures

Groups of four students work on the following calendar activities.

Make a chart with a list of facts.

On the chart make a heading for each of the four (4) seasons. Under each season list the months of the year that go with that season for the Northern Hemisphere.

On the chart make a fact list of the seasons.

1. There are ____ days in the Winter.
 There are ____ days in the Spring.
 There are ____ days in the Summer.
 There are ____ days in the Fall.
2. The shortest day of the year is _____ in the Northern Hemisphere.
 It is _____ hours long.
 The night is _____ hours long.
3. The longest day of the year is _____ in the Northern Hemisphere.
 It is _____ hours long.
 The night is _____ hours long.
4. The word "equinox" means _____.
5. The two days of the equinox are _____ and _____.
6. There are _____ hours of _____ and _____ hours of _____ on the equinox.
7. On the globe find Argentina. What month is it in Argentina when it is December in the United States? (Same month.) In Argentina, in what season does Christmas occur? Explain.

Do the same for the seasons in the Southern Hemisphere.

▲ **ACTIVITY**

Temperature and Distance

Objective

Students demonstrate with a world globe and a flashlight how the distance of a specific place, like the United States, changes in relation to the sun because of the tilt of the earth, and how the distance affects the amount of heat that places on earth receive from the sun.

Materials

Lighted lamp; 100-watt bulb; measuring tape; clock; world globe; flashlight; thermometer at room temperature

Activity 1— Since the 100-watt light bulb can become very hot, do this activity under the teacher's close supervision.

1. Place an **unlighted** 100-watt bulb in a stationary position on a table.
2. Measure a distance of 12 inches from the bulb; mark the distance with a piece of masking tape marked "12 inches."
3. Measure and mark a distance of 20 inches from the bulb with masking tape marked "20 inches."
4. After the bulb has been lit for approximately five minutes, place a thermometer that has been at room temperature for at least 1/2 hour (record this temperature) at the distance marked 12 inches.
5. Time how long it takes for the thermometer to rise 3° F. Record the length of time.
6. Record the room temperature of the thermometer after it has cooled to room temperature. Place the thermometer at the distance marked 20 inches. Record the time it takes for the temperature to rise 3° F. Record the time.

Activity 2

1. Using the flashlight to simulate sunlight and using the world globe, the students take turns showing each other how the tilt of the earth brings some areas of earth closer to the sun than others.
2. The students explain to each other how the tilt of the earth causes summer, winter and the other seasons.

LESSON

4

Wind: Air in Motion

BIG IDEAS Wind, tornadoes, cyclones and dust storms are all moving air, which exerts pressure as it moves.

Whole Group Work**Materials**

Book: ***Iva Dunit and the Big Wind*** by C. Purdy

Blow-dryer with two temperature settings (slow and fast) and a no-heat setting

Wind socks

Thermometers

For each student group: drinking straws, cotton balls, pieces of paper, pieces of tissue

Encountering the Idea

The teacher presents the book ***Iva Dunit and the Big Wind*** to the students and asks them to predict the plot of the story. The teacher reads the story and then asks: Is this story meant as a **tall tale**? Why? Do you think the wind was strong? What made you think this?

The teacher tells the students they will discover how wind causes weather and the kind of weather conditions it produces. The following activities will help them learn about the strength of the wind.

Exploring the Idea

At the **Science Center**, the students perform the following activities.

Activity 1: Using Wind Socks

Using the wind socks made in Lesson One, the students again go outside to describe the current wind conditions. They can describe the direction from which the wind is blowing and whether they believe it is a strong wind or a light breeze. Ask students to think of a way to determine the direction of the wind with more accuracy than by merely identifying one of the four directions of the compass.

Activity 2: Air Exerts Pressure

Children explore one of the important characteristics of air — it exerts pressure. As it moves from one place to another, it pushes against itself and against things. That is how we can see air. In this activity, children can see how air pressure is created by blowing or sucking through a straw. The air pressure affects objects.

Materials

For each child: A drinking straw, a cotton ball, a piece of paper, a piece of tissue

Procedures

Students working in small groups

1. blow through the straw against their hand
2. blow against the cotton ball to make it move

3. pick up a sheet of paper using only the straw
4. pick up a piece of tissue using only the straw.

Discussion

1. What did you feel against your hand when you blew on the straw ? (Air.)
How do you know that it is air? Can you see air? Can you feel air? Why can you feel it?
2. Why did the cotton ball move? (Air pushed it.)
3. Can you make the piece of paper stay on the end of the straw? What is making it stay there? (Air is pulling on it.)

Students name at least two other situations that require the use of air (cooling food, drying clothes fast).

Activity 3

Students complete **Activity** — Making a Windometer and **Activity** — Make Your Own Barometer.

Activity 4

Students explore air pressure. Do **Activity** — Colliding Balls. Do **Activity** — Air Pushes in All Directions.

At the **Mathematics Center**, the students complete **Activity** —Destructive Wind.

Getting the Idea and Organizing the Idea

Air that is in rapid motion causes many changes in the weather. We can experience wind as a pleasant cooling or warming breeze, but when its velocity is great we experience it as a **tornado** (a whirling wind seen as a funnel-shaped cloud traveling in a narrow area over land) or a **cyclone** (a strong wind traveling in a wide circle around a center and often bringing much rain). In each of these natural phenomena, air pressure is an important component of the storms, for example, in the calm in the eye of a storm.

1. Students discuss the wind conditions they have measured. The students use their windometer to take some more measurements of the current wind conditions. They talk about the velocity of the wind and its direction.
2. Students discuss ways to determine the wind's direction with more accuracy than only one of the compass directions. If the students don't suggest it, the teacher suggests the idea of a weather vane, and how we could construct one.
3. Students also discuss the air pressure experiment. The teacher asks the students to think of ways that we could use air pressure.

4. When you have been running and get hot, what do you do? (Drink water, etc.)
You want to get some AIR to cool you off by fanning yourself. Why?
If you have wet hair and want to dry it quickly, what do you do? Blow-dry it.
Does the air have to be hot for your hair to dry? No, but it's faster. Put a wet washcloth on a student's arm. With the blow dryer on low, and no heat, blow on the washcloth. Now, set the dryer on high, no heat, and blow on the washcloth. The student describes the difference. (If there is no blow-dryer, fan a cardboard slowly and then quickly.)

The students **make a rule** about air and cooling, for example, the harder the wind blows, the colder the temperature.

5. After using the windometer, the students discuss the wind velocity as shown by the data they collected and discuss whether the Beaufort scale describes the current conditions accurately. They write in their journals about the cur-

rent weather conditions including their experiences with air pressure, the wind sock, the weather vane and the windometer.

6. At the **Writing Center**, the students write about air pressure, how we measure it and how we measure the velocity of the wind.
7. What information does a barometer give us to help us forecast the weather? (A barometer measures the pressure that air is exerting at a particular location at a specific time. It also tells us if the pressure is increasing or decreasing.)

Applying the Idea

Students complete **Activity** — Go Fly A Kite!

Students begin to summarize the collected data, as time permits. See **Activity** — Data and Line Graphs, Lesson 7.

Problem Solving

Can you make a piece of tissue stay on the end of a straw? Is it harder to make the piece of tissue stay on the end of the straw than the piece of paper, or is it easier? What about the cotton ball? Is it easier or harder to keep it on the end of the straw than the piece of tissue? How many cotton balls can you make to stay on the end of the straw?

Closure and Assessment

1. Show what causes tornadoes.
2. What is a cyclone?
3. How does air pressure affect the weather?
4. What is wind?
5. What did we do today to show that air exerts pressure?
6. How do we measure the velocity of the wind?
7. What is a weather vane? Is it the same as a wind sock? How are they different?
8. What makes a kite fly?
9. What did you record on your weather chart for today? (Temperature; wind direction and velocity; air pressure; cloud/clear conditions; precipitation.)

List of Activities for this Lesson

- ▲ Making a Windometer
- ▲ Make Your Own Barometer
- ▲ Colliding Balls
- ▲ Air Pushes in All Directions
- ▲ Destructive Wind
- ▲ Go Fly A Kite!

▲ **ACTIVITY**

Making a Windometer

A Windometer Measures Wind Velocity

A windometer is an instrument that measures wind velocity. Students can make in the classroom a simple one that will provide fairly accurate information.

Materials

For each group of students:

1. Cut a posterboard in the shape of a protractor with a handle as shown on the drawing. Mark the protractor shape in degrees, in multiples of five.
2. Attach a ping pong ball as shown on the figure.
3. Use a piece of string about 33 cm; the string should measure 30 cm from the attachment on the windometer to the top of the ball.
4. Copy on the handle the scale associating windspeed in miles per hour (mph) and angle in degrees. See below.

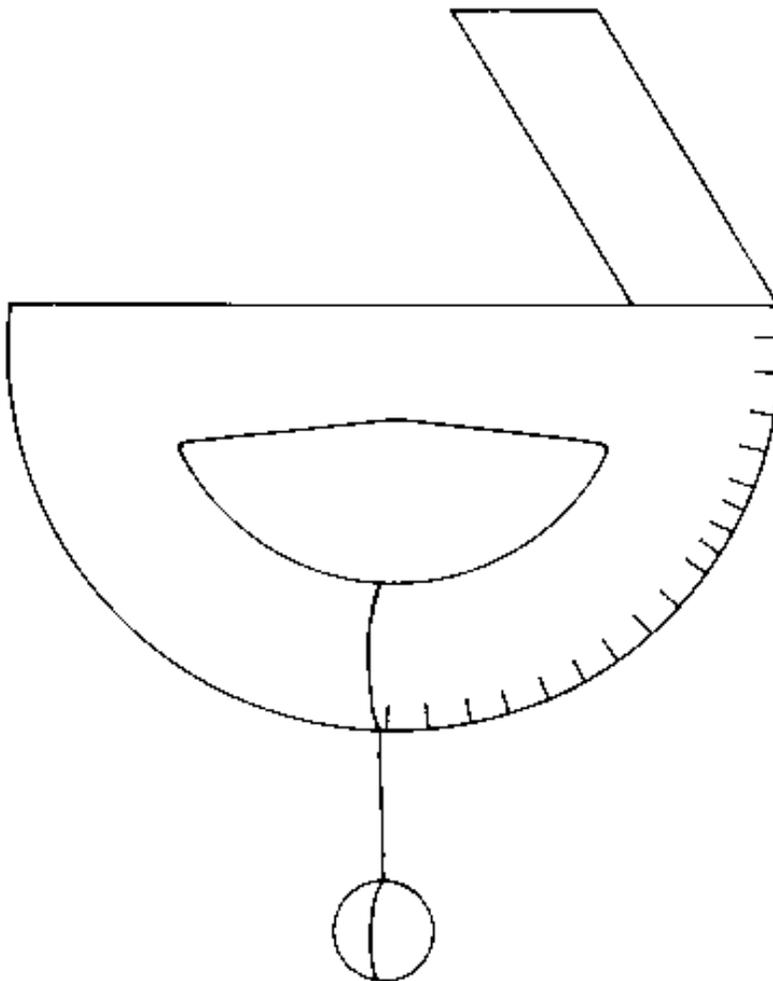
Procedures

1. Holding the windometer by the handle, point it **into** the wind.
2. Hold the windometer so that the ball is free to move along the scale.
3. Read and record the angle the string marks on the protractor.
4. Read the mph (miles per hour) associated with that angle.

Angle	Miles per hour
90	0
85	5.8
80	8.2
75	10.1
70	11.8
65	13.4
60	14.9
55	16.4
50	18.0
45	19.6
40	21.4
35	23.4
30	25.8
25	28.7
20	32.5

The **Beaufort Scale** associates a number, the Beaufort number, with a wind speed in mph that then translates into a description of how that wind velocity affects climate conditions outdoors.

Beaufort #	Observation	Description
0	Smoke rises vertically	Calm zero to one mph
1	Smoke drifts slowly	Light breeze two to three mph
2	Leaves rustle	Slight breeze four to seven mph
3	Twigs move, flag extends	Gentle breeze eight to 12 mph
4	Branches move, dust and papers rise	Moderate breeze 13-18 mph
5	Small trees sway	Fresh breeze 19-24 mph
6	Large branches sway, wires whistle	Strong breeze 25-31 mph
7	Trees in motion, walking difficult	Moderate gale 32-38 mph
8	Twigs break off trees	Fresh gale 39-40 mph
9	Branches break, roof damaged	Strong gale 41-54 mph
10	Trees snap, damage evident	Whole gale 55-63 mph
11	Widespread damage	Storm 64-72 mph
12	Extreme damage	Hurricane 73-82 mph



▲ ACTIVITY *Make Your Own Barometer*

Objective

Students experiment with air pressure by constructing a simple barometer; students relate barometric readings with weather conditions.

Materials

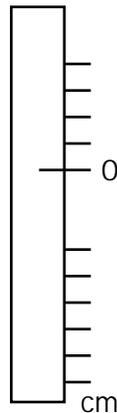
- Reference (encyclopedia) on air pressure
- Narrow-mouth bottle filled with water
- Clean clear glass or plastic bowl
- Two small pieces (same size) wood or plastic to balance the bottle
- Tape to mark water levels

Procedures

1. Fill the bottle with water. Hold the bowl over the bottle and tilt the bottle and bowl together quickly.
2. Tilt the bottle to let in air until the bottle is about 1/3 full of air.
3. Rest the bottle on the two pieces of plastic or wood.
4. Mark the water level both on the bowl and on the bottle. Take readings of the water level at least twice a day and record weather conditions.

	Day	1	1	2	2	3	3	4	4	5	5
Water level (Bottle)		__cm									
Weather Today (sunny or cloudy?)		_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
Water level (Bowl)		__cm									
Weather Today (sunny or cloudy?)		_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

5. Make two copies of the ruler below on paper. Glue one ruler on the outside of the bottle and the other one on the outside of the bowl. Be sure to put the zero mark on the first mark you put on the bowl and on the bottle.



Getting the Idea

The students answer these questions before reporting to the class.

1. What happens when the level in the **bottle** goes up? (Air pressure is pushing the water into the bottle and out of the bowl.)
2. What happens when the level in the **bowl** goes up?
3. What is making the water go up into the bottle? (Air pressure is decreasing so the water in the bottle goes down into the bowl.)
4. How can we use air pressure to do work?
5. How does air pressure relate to weather? (Look in a book and report.)

Applying the Idea

1. Use your barometer to find the current air pressure.
2. Enter your data for the air pressure on a daily basis onto your weather forecasting chart.

▲ **ACTIVITY**

Colliding Balls

Objective

Students say that moving air pushes less than nonmoving air.

Materials

Tape; ruler

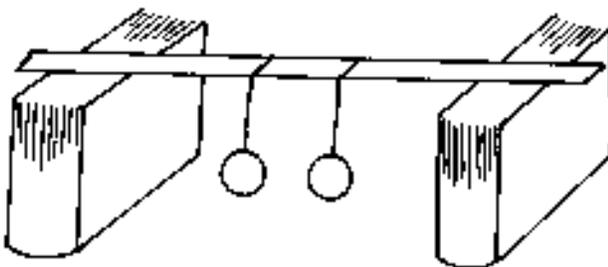
One board or stick about 20 inches long; two pieces of string, each about six inches long

Two books each about six to eight inches high

Two balls — ping pong or nerd balls are best, and apples or lemons work too

Procedures

1. Tape the string to each ball.
2. Set up the books and ruler.
3. Tape one end of the string to the stick so that the balls are one inch apart. Tape the other end to the balls. Make sure the balls swing freely without touching the tabletop.
4. Blow between the two balls. What do you think will happen? Do they move apart or collide? Make sure you blow straight between the balls.
5. Move one of the strings so that the balls are about 1 1/2 inches apart. Blow again. Do the balls still move?
6. Repeat Step 5 moving the balls 1/2 inch farther apart each time.
7. Keep moving the balls apart until they no longer move.



Getting the Idea

Tell the students that the air on the outside of the balls is not moving. But the air between the balls is moving. Moving air pushes less, because it exerts less pressure.

1. Students will predict what will happen before they blow between the balls. Then they write what actually happened and if they predicted correctly or not.
2. After teacher discussion, students explain in their journals why the balls moved in the direction that they did.

ACTIVITY *Air Pushes in All Directions*

Objective

The student says that air pushes in all directions.

Materials

Clean duplicating fluid can; eight-ounce glass; hot plate; 5 inch x 8 inch index card; cup of water; water

Phase I

Procedures

1. Put one cup of water into a clean ditto fluid can.
2. Boil the water **with the lid off**.
3. Remove the can from the stove and put the lid on tightly.
4. Students observe and record results.

Phase II

Procedures

1. Fill the glass with water (not too full).
2. Put the index card over the mouth of the glass.
3. Hold the card with one hand, the glass with the other.
4. Turn the glass upside down and slowly remove your hand from the card.
5. Slowly turn the glass right side up, but don't touch the card.
6. Students observe and record results.

Getting the Idea

Discussion

1. Say what you think crushed can.
2. Say what you think kept the water from falling out.
3. Write and illustrate your explanations in your journal.

Teacher Information

When heated, the water changes to steam and drives most of the air from the can. When you put the lid on tightly, no air can get back in. As the steam inside the can cools, it condenses and returns to a liquid, and a vacuum is created. The air pressure outside the can will become much greater than the air inside and will gradually crush the can.

▲ ACTIVITY *Destructive Wind*

Objective

Students compare and order numbers by subtraction.

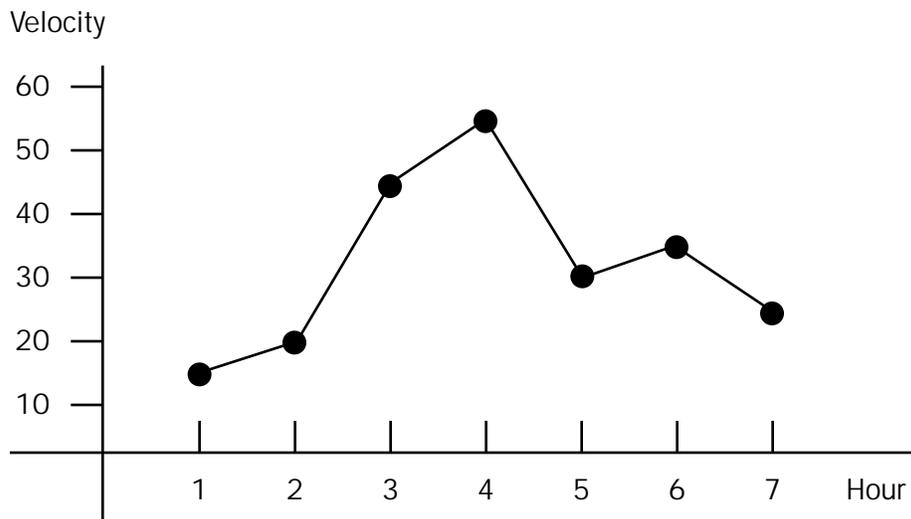
Materials

- Set of questions
- Chart with description of effect of wind
- Counters
- Trading Chip Board

In a wind storm in west Texas during the Spring, the velocities were measured over a 35-hour period every five hours. The first reading showed a wind speed of 15 miles per hour, the second reading 23 miles per hour, the third 45 miles per hour, the fourth 53 miles per hour, the fifth 32 miles per hour, the sixth 36 miles per hour, and the seventh 28 miles per hour. Make a line graph showing the velocity of the wind over the 35-hour period.

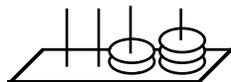
Problems

1. Order the velocities from greatest to least.
2. What was the least destructive velocity?
3. What was the difference between the greatest and least velocities? Can you show the difference on the line graph?
4. What was the difference between the two smallest velocities?
5. What damage does a 53 mile per hour wind cause?
6. What effect does a 15 mile per hour wind have?
7. What was the greatest velocity during the storm? How can you see it on the graph?



¹To subtract 2-digit numbers, students may want to use counters (either as single counters, or by grouping into 10s and ones) to represent the velocities

²Trading Chip Board - demonstrates 10s and ones to subtract



8. After answering the questions, the students write or draw and explain their answers. Students may use
1. a Trading Chip Board to perform the subtraction.
 2. an expanded notation format to help them subtract using the idea of “renaming” instead of “borrowing”, e.g.,

5 tens 3 ones	renamed to	4 tens 13 ones
-1 ten 5 ones		-1 ten 5 ones
		3 tens 8 ones

Use a laminated chart with 10s and ones labels and erasable markers.

Assessment

Paper and Pencil Assessment

1. Use the numerals 1,2,3 only once each to write as many different numbers as you can. For example, 123 is one number and 312 is another.
2. Put the numbers in order from least to greatest.

Performance Assessment

1. Use a counter, a Trading Chip Board or a Place Value Chart to show which number is greater 29 or 34, 71 or 66? Explain your answer to your teacher.
2. On a set of cards write the following numerals on one side of the card and these letters on the back of each card, respectively.
3. The students order the numbers and then turn the cards with the letter-side up. If the order is correct, they can read a sentence.

3	6	14	19	21	36	48	51	62	79	81	92	95
y	o	u		a	r	e		r	i	g	h	t



ACTIVITY

Go Fly a Kite!

Objective

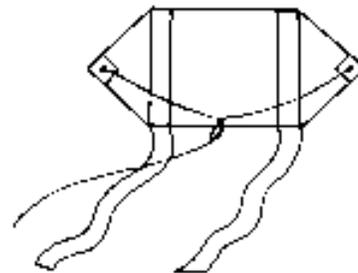
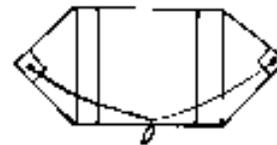
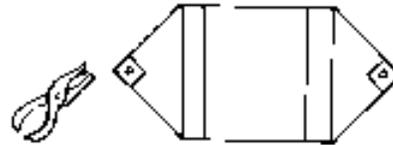
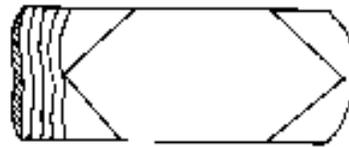
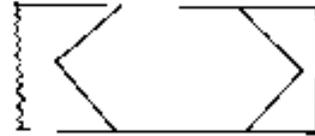
The students construct a kite following these directions.

Materials

Two drinking straws; masking tape; garbage bag; kite string; large paper bag; pattern cutout as shown; the kite is as wide as the straws are long

Procedure

1. Cut a pattern from paper in this shape.
2. Trace the kite pattern onto a plastic garbage bag with a permanent marker. Leave room at the end to cut two kite tails.
3. Cut two loops of the plastic bag in one place to make two tails. Cut out the two kites with scissors.
4. Lay two straws on the sticky side of wide masking tape. Trim off excess tape. Invert the tape and straws onto the kite and attach them, as shown.
5. Put a piece of tape on each side of the kite. Punch a hole through both the tape and the plastic.
6. Tie one end of a thin string through each of the holes. Tie a loop in the center of the string to attach your long kite string.
7. Tape a tail to the kite at the bottom of each straw.
8. Decorate your kite with permanent markers. Tie on a kite string.



LESSON

5

Clouds, Rain and Snow

BIG IDEAS Clouds, rain and snow are all different forms of water vapor; the form of the precipitation depends on the temperature of the surrounding air.

Whole Group Work

Materials

Thermometer; stopwatch/digital clock marking seconds; glass tumbler with frozen water; two washcloths; piece of string

References on the Dust Bowl in the United States; reference books on precipitation

Word tags: snow, cloud, rain, precipitation, freezing, dew point, condensation, evaporation, names of the types of clouds, humidity

Prior Preparation

Very early in the day, students working in small groups fill a bottle **almost** to the top with water and then cap it to prevent water from leaking. A piece of tape marks the top of the water level on each group's bottle.

Place the filled bottles in the freezer. Put a piece of clear tape around the top of each bottle so if the cap is opened the tape will pull off. The students can see that no additional water went into the bottle.

After the water has had an opportunity to freeze, the students hypothesize as to the cause of the increase in volume of the water that is now frozen. **Caution:** If students fill the bottle to the top or very close to the top, the bottle will break and may cause an injury. Before removing the bottles from the freezer, check to see that none are broken. If one has broken, the teacher removes the bottle and the pieces.

Encountering the Idea

A few minutes before beginning this lesson, bring out the bottles with the frozen water. Ask the students to predict what will happen if you leave the bottle outside the freezer for several minutes. As they offer answers, have them watch the outside of the bottles carefully. Soon, frost will begin to collect on the sides. Ask students what it is. Yes, it is frost, but what is frost? (Water, water vapor.) Where did it come from? It is in the air. Water vapor is one of the gases in the air we breathe. Sometimes there is more water vapor in the air than at other times, and sometimes less. The water vapor in the air we call **humidity**. Humidity is one of the conditions we feel in weather. High humidity in the air can make us feel hotter at a particular temperature than we would feel at the same temperature if the air were not humid. We will learn how to measure the humidity in the air.

Showing pictures of different types of clouds, ask the students what a cloud is. Write the correct responses such as water, water vapor, rain, etc. on the chalkboard for further use.

Look outside the classroom and ask the students if they can see clouds. If there are clouds, the students go outside to describe the clouds. Students note the different shapes, colors, size, number (many, few, or just one large one covering a large area, etc.) and as many other weather conditions as possible.

On returning to the classroom ask what makes clouds have different colors. What makes clouds have different shapes? Size? Ask students what makes rain. Where does the water come from that makes rain? When does rain turn to snow? Yes, when it gets cold. What is snow? How are rain, snow and clouds different? Are rain, snow and clouds the same in any way? Tell students that they will discover what makes clouds, why clouds have different shapes and what rain and snow are.

Exploring the Idea

At the **Science Center**:

1. Before letting the students work on their own in the center, ask a student to take a wet washcloth, place it on his/her arm and secure it with a piece of string. Place and secure the other wash cloth on the other arm. The student swings his/her arms around rapidly. The student describes what he/she feels. The students hypothesize as to the reason for the sensation of cold. Students discuss their experiences of getting out of the swimming pool or shower and feeling cold when wet but warm when dry. Ask the students to think about this as they complete the activities in the learning centers.
2. Complete **Activity** — Making a Hygrometer
3. Complete **Activity** — Clouds
4. Complete **Activity** — The Dew Point
5. Complete **Activity** — Six-sided Snowflakes.

Getting the Idea

After students have had an opportunity to complete the activities, ask:

1. Why does a wet washrag feel cold on your arm?
2. What makes rain? Where does the water come from that makes rain? (Water, in the form of water vapor, is always in the air. As warm air rises, it condenses into small droplets of water that come down as rain.) Review the experiment in which students made rain and clouds in the classroom. The students may wish to repeat the activity. When does rain turn to snow?
3. Did you discover what makes clouds have different colors? Guess what it might be.
4. What makes clouds have different shapes? Size?
5. What is snow? How are rain, snow and clouds different? Are rain, snow, clouds and water vapor the same in any way? If so, how?
6. From the experiments we completed, what would you guess are the main things, or factors, that make rain, snow and clouds? (Humidity and temperature of the air.) Give students the names of the clouds and a general description of the clouds' appearance.
7. What word is used to refer to clouds, rain, drizzle, fog, snow, hail, frost, ice and so on? (Precipitation.)
8. What happened to the water that was frozen overnight? What made the volume (the space that it took up in the bottle) of the water increase? Did we put

more water in the bottle? How do you know someone didn't put more water in the bottle? (Water expands as it freezes. At 4° C water has its lowest density.)

Cloud Types

Cirrus (curl, “churro”) — high, ice crystal clouds that look like wispy curls, are often signs of bad weather.

Cumulus (heap, collection) — fluffy puffs that look like cauliflowers, appear in sunny, summer skies.

Nimbus (rain, “neblina”) — thick, dark gray clouds that bring rain or snow.

Stratus (layer) — low, gray blanket that often brings drizzle, cover high ground and cause hill fog.

Fog — condensed water vapor in the air, usually lying close to the ground.

Hail — ice crystals in a cumulonimbus cloud can form hail. The ice crystals are tossed around in the cloud, and caps of frozen water form on the crystals like skins on an onion. When they get big and heavy, the hailstones fall to the earth.

Dust Bowl — when there is no rain in a region for a long time, the soil becomes so dry that the wind blows it away easily.

Snow — the solid form of water that freezes and grows while floating, rising or falling in the free air of the atmosphere. Snow is a crystal of six sides. Snowflakes usually have the shape of plates, or of stars.

Organizing the Idea

After students complete **Activity** — Clouds, they make a chart showing the differences and likenesses among the different types of precipitation. (Air temperature is an important factor as is the humidity in the air.)

Applying the Idea

Problems

1. Why does frost form on ice cubes in the refrigerator?
2. Why do the insides of car windows get cloudy if you blow on them in cold weather? (The frost that forms in ice cube compartments of refrigerators and in freezers develops from the water vapor condensing on surfaces that are below 0° C, the temperature at which water freezes. The more often we open the door, the more warm, moist air gets in. The insides of auto windows are cold; warm, moist breath condenses and, if it is cold enough, turns to frost.)
3. Research and report on the causes a “Dust Bowl.” (The lack of humidity in the air and the lack of plants to secure the soil.)

Problem Solving

1. Draw a picture of a frozen lake in the winter. What can people **do and not do** on a frozen lake? Explain your answer.
2. Will a river freeze? When?
3. What happens to the fish under the lake?
4. What would happen if the lake froze from the bottom to the top, instead of freezing on the surface first?

Closure and Assessment

1. The student constructs a hygrometer (or another of the instruments to collect weather data that students have constructed) and explains to his/her partners and/or the teacher how it works. The student also explains what information about weather conditions a hygrometer (or other instrument) provides.
2. Student describes and/or draws a snowflake. The student explains how snowflakes (and/or other forms of precipitation) form.

List of Activities for this Lesson

- ▲ Making a Hygrometer
- ▲ Clouds
- ▲ The Dew Point
- ▲ Six-sided Snowflakes

▲ ACTIVITY *Making a Hygrometer*

Objective

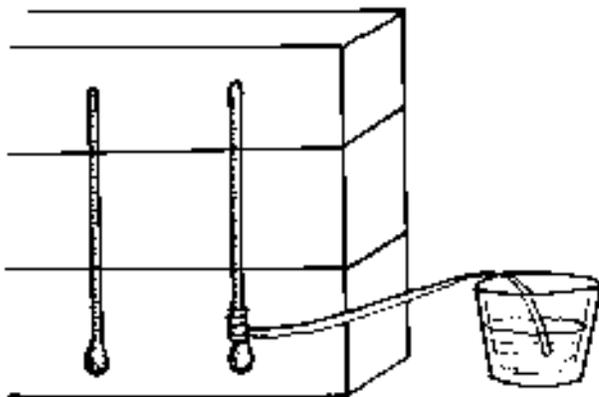
Students construct a hygrometer and read the relative humidity.

Materials

Two identical thermometers; shoelace (with tips cut off) 20 cm. (eight in.) long; two rubber bands; piece of styrofoam 12 x 6 inches long

Procedures

1. Use the rubber band. Fasten the two thermometers side by side on the styrofoam about four inches apart with the rubber bands.
2. Moisten the shoelace and wrap one end around the bulb of one thermometer. Put the other end of the shoelace in the glass of water.
3. After about five minutes, compare the temperatures of the thermometers.
4. What do you think caused the temperature to drop? Convert the wet-dry difference in temperature to relative humidity.



Getting the Idea

Tell students that, after a few minutes, the wet bulb will have a lower temperature. This is a wet-dry bulb hygrometer. The shoelace cools from the evaporation of the water on it into the air. Humidity is the amount of moisture the air contains compared to the amount it *can* contain. The less moisture the air contains, the greater the amount it can absorb. As the ability to absorb water increases, the temperature drops. The greater the difference in temperature between the wet and dry bulbs, the lower the humidity (amount of moisture already in the air). Or the greater the difference in temperature between the wet and dry thermometers, the greater the amount of moisture the air can still absorb.

▲ **ACTIVITY**

Clouds

Draw these clouds in your journal and label them.

Stratus — spread out; low fog that brings drizzle



Cumulus — look like heaps or mountains; low clouds bring sunny spells



Cirrus — curly; ringlet; ice crystals high in the sky



Nimbus — rain clouds; bring mist; gray



Record the cloud conditions on your weather chart each day, labeling and describing the clouds as you observe them.

ACTIVITY *The Dew Point*

Objective

Students find the dew point of the air in the classroom.

Materials

Two identical metal cans without labels

Two thermometers

Ice water in a container for at least one hour at room temperature

Procedures

Students work in small groups.

1. Take and record the temperature of the air in the room (rounded to the nearest degree Celsius).
2. Fill one shiny can with water from a container. This is Can 1.
3. Insert a thermometer in the container, take a temperature reading and record; have student pairs read and check each other's reading.
4. Half fill a second can (Can 2) from the **same** supply of water and place a second thermometer in it; take temperature reading and record. Both readings should be the same.
5. Fill Can 2 with ice, and wipe the surfaces of both cans with a paper towel to be sure they are dry.
6. As soon as droplets of water appear on the surface of Can 2 containing ice and water, take and record the temperature of both cans. Students discuss:
 - (1) where the droplets of water came from
 - (2) why we need two cans
 - (3) why it is important not to get our breath (warm, moist) on the can
 - (4) under what conditions they have noted similar events in everyday life.
7. What is the dew point?

Getting the Idea

Tell the students that the amount of water vapor (an invisible gas) in the air varies with atmospheric conditions, as does **the dew point, the temperature at which water vapor condenses**. Since metals are good conductors of heat, the surfaces of the can are essentially the same temperature as the water inside the cans. The can of water at room temperature (on which dew does not form) shows that the droplets on the other can are not leaking or "sweating" through the can and must be forming from the air.

TEMPERATURE RECORD

Air in Room	Water in Can 1 (No Ice)	Water in Can 2 (No Ice)	Water and Ice in Can 2 Dew Point
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First Reading

Second Reading

Hot, Humid Day

Cool, Dry Day



ACTIVITY

Six-sided Snowflakes

Objective

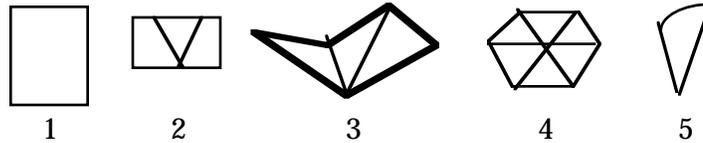
Student describes snowflake patterns.

Materials

Sheet of paper for each student; protractor to measure angles; scissors

Procedures

1. Fold a square piece of paper in half, on the diagonal. (Fig. 1)
2. Locate the midpoint of the folded edge. Draw two 60° angles from the midpoint of the diagonal. (Fig. 2)
3. Fold the piece of paper in thirds along the lines drawn for the two 60° angles. (Fig. 3) (The edges will not be straight.)
4. Cut the folded sheet across the lowest part (or the shortest side) of the paper. (On unfolding the paper, you will see a six-pointed shape that is the base for the snowflake.) (Fig. 4)
5. With the paper folded in thirds, and then again in half, students can cut out shapes on each side. (Fig. 5)
6. Open the paper to see the snowflake.



Usual Shapes

Discussion

1. How many different lines of symmetry can you find in a snowflake?
2. How many sides do snowflakes have?

LESSON

6

Nature's Light Show

BIG IDEAS Lightning is produced by huge exchanges of electrical charges; thunder is produced by expanding air; we can estimate the distance of a thunderstorm.

Whole Group Work**Materials**

Small pieces of tissue; piece of rabbit fur or wool cloth; paper sack; inflated balloon; piece of carpet, 2 x 2 feet; rubber mat; chart showing the distance/time relation

Encountering the Idea

Ask students if any of them have ever walked on a thick carpet across a room, then touched the television set or some other object and had a spark hit them. The spark was an electrical discharge, like lightning. Take the inflated balloon and pop it with a pin. Ask the students what they think caused the noise. What happened to the air in the balloon when the balloon popped? Tell the students that by doing the following experiments they will discover some of the conditions that cause lightning and thunder.

Exploring the Idea

Ask a student to stand on the piece of carpet close to a metal object (like a drinking fountain) and shuffle her/his feet briskly on the carpet, then reach out to touch the piece of metal. What happened? Take the piece of fur, rub it briskly on the glass rod and then pick up pieces of tissue with the rod. (The rod acts like a magnet and attracts the pieces of tissue. As the glass rod is over the paper, the rod may even crackle and spark.) Both of these actions — walking on a carpet and the piece of fur — have the same thing in common: both of them involved rubbing. Ask the students to hypothesize as to the reasons for the spark. Write the ideas on a chalkboard.

A student stands on a rubber pad. Another student rubs the first student's back briskly with the piece of fur. Place the glass rod over the student's head. What happens?

Take the paper sack and pop it with your hand. Take the soda pop bottle, shake it and then open it. Again, ask the students what they think caused the noise. They can hypothesize about the cause of the noise.

Students complete **Activity** — Estimating the Distance of a Thunderstorm.

Getting the Idea

Lightning is a form of electrical energy. When clouds move against each other, one of the clouds receives electrical charges from the other cloud. The cloud with

extra charges is now at a different energy level than the other cloud and/or the earth. This difference in the number of electrical charges between the clouds we call “static electricity.” Static electricity builds up in a thundercloud and releases as a brilliant flash of light into the ground, or into another cloud, in order to obtain a balance with the electrical charges.

Sound waves traveling in the air cause noise. When air heats, it expands, and when it expands rapidly, it causes sound waves in the surrounding air. Rapid heating of air, because it is expanding like the air released from the balloon, causes the noise. Lightning causes thunder as it heats the air in its path to 30,000° C (54,000° F), which is five times hotter than the sun’s surface. As the air expands very rapidly, the speed of the moving air causes the booming noise called thunder.

Thunderstorms usually occur when the air is humid and warm. Cumulonimbus clouds form and, as these clouds form, the air begins to move rapidly, causing gusty winds. Lightning can occur between the earth and a cloud, or from cloud to cloud.

Organizing the Idea

If you have listened to Vivaldi’s **The Four Seasons**, were you able to detect the lightning and thunderstorm the composer included in the music? In what season did the thunder appear? Try to find the thunder in the music. Can you imagine the thunderstorm? Is Spring usually the season for thunderstorms? Why?

At the **Writing Center**, write a poem that describes your favorite season, for example, how “April showers bring May flowers” or about Frosty the Snowman.

Applying the Idea and Assessment

In the activity on estimating the distance of a thunderstorm, read the line graph to answer the following questions.

1. How far is the lightning if you see the flash and hear the clap of thunder almost immediately after?
2. If you are four kilometers from a thunderstorm, how long will the noise of thunder take to reach you after you see the lightning?

List of Activities for this Lesson

- ▲ Estimating the Distance of a Thunderstorm

▲ ACTIVITY *Estimating the Distance of a Thunderstorm*

Objective

Students read and interpret a graph.

Materials

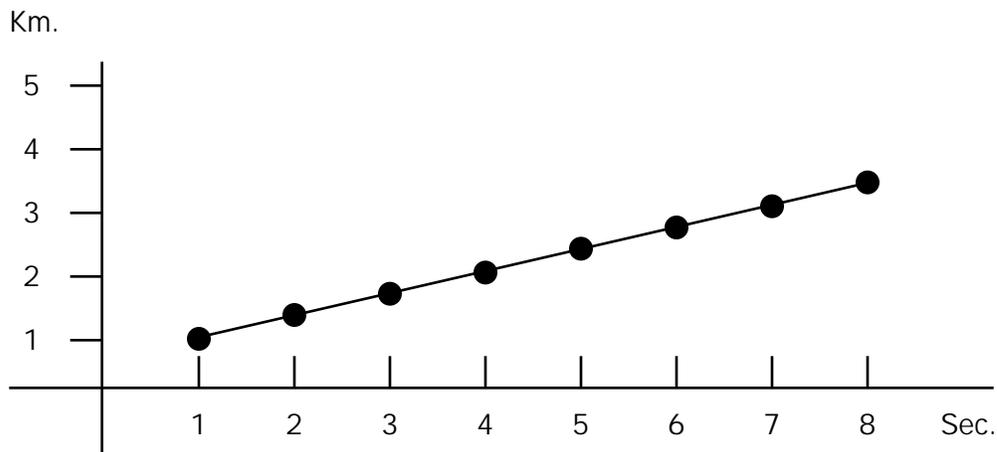
A copy of the graph for each student group.

Procedures

1. Explain to students the difference between the speed of sound and the speed of light.
2. Students study the line graph.
 - What does the horizontal line (axis) tell us? (Seconds it takes the thunder to reach the listener after the lightning.)
 - What does the vertical line tell us? (The kilometer.)

Lightning and the ensuing clap of thunder occur at the same time. We sometimes think the lightning occurs first because we see it first, and then we hear the thunder. The reason for this delay is that light travels much faster than sound.

If you see a bolt of lightning and begin to count the number of seconds it takes to hear the clap of thunder, the storm is a little less than half that number of kilometers away. For example, if you hear thunder six seconds after you see the flash, the storm is about three km away. You can estimate the number of seconds by counting one thousand one, one thousand two, one thousand three, one thousand four, and so on, or time them on a watch with a second hand.



You can use this chart to estimate the distance between you and a thunderstorm.

3. How far is a thunderstorm if it takes eight seconds for the sound of thunder to reach you after you see the flash?
4. How far is a thunderstorm if it takes three seconds for the sound of thunder to reach you after you see the flash?

LESSON

7

Weather Forecasting

BIG IDEAS Would **you** like to be a weather forecaster? We base weather predictions on data that we have gathered over many days.

Whole Group Work**Materials**

Chart from **Activity** — Groundhog Weather Station and **Activity** — Data and Line Graphs

Markers

All the data collected to date

All the instruments used in collecting weather data

Encountering the Idea

Tell the students that they will now become weather forecasters at **Groundhog Weather Station** (or any name they wish to give to their weather station — name of school, school mascot, etc.) They will predict the weather for the next week and compare their forecast to the radio or television forecast, one day at a time.

Ask students to suggest ways of making a weather prediction for the next day. What information will they use? Why? What temperature will they predict for tomorrow? Air pressure? And so on.

Exploring and Organizing the Idea

If the students do not suggest it, suggest that since the class has been keeping records of weather conditions such as outside temperature, dew point (humidity), air pressure (barometer), precipitation, wind direction (wind sock) and speed (windometer), they can use this data to make predictions, to make a forecast. In making their predictions, the students must defend their forecast with reasons based on the data.

At the **Groundhog Weather Station** (GHWS), the students complete

1. **Activity** — Data and Line Graphs
2. **Activity** — Weather Forecasting, continued from Lesson One.

Using the idea suggested in **Activity** — Data and Line Graphs, the students summarize the data collected on the previous days into line graphs.

Getting the Idea

1. Discuss making decisions based on data, as given in the activities.
2. The class may wish to invite a local meteorologist to review the work of the class and to give further explanations. The meteorologist may want to discuss forecasting the weather as a career.
3. The students design, organize, write and draw weather maps for a daily television program to forecast the next day's weather.

Closure and Assessment

1. At the **Music Center**, the students may want to sing and listen to a tape of **Oh, What a Beautiful Morning!** The students write a paragraph telling about how the weather affects their feelings during a beautiful day or during an ugly, cold, wet day.
2. The entire lesson may serve as a final unit assessment, involving oral, performance and written activities that indicate the level of a student's understanding of the concepts and the level of performance in the various skills required in the unit.
3. Individual assessments can be made on the chart for **Activity** — My Forecast.

List of Activities for this Lesson

- ▲ Data and Line Graphs
- ▲ Weather Forecasting (see Lesson One)
- ▲ My Forecast

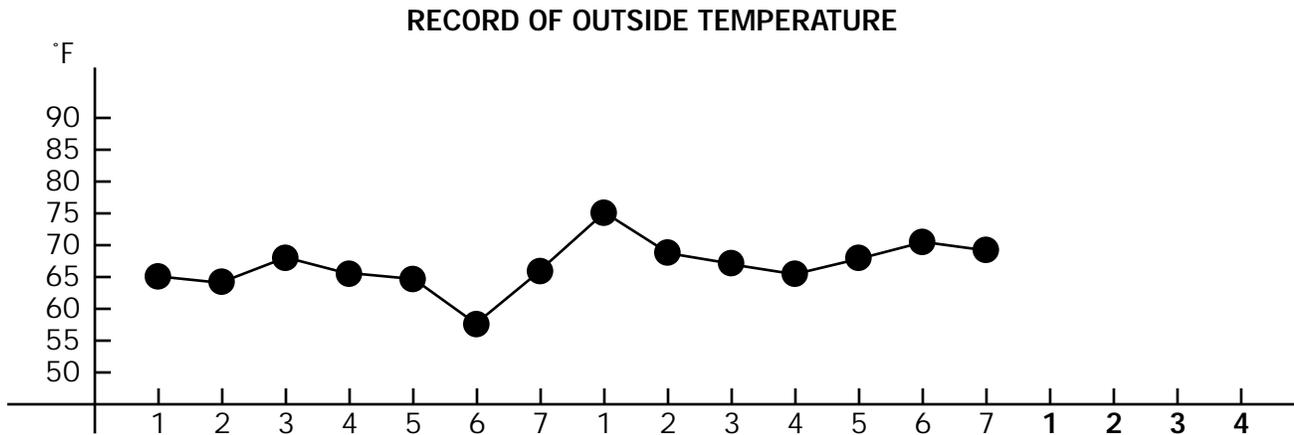
▲ ACTIVITY *Data and Line Graphs*

Objective

Students show summarized data on a line graph.

Procedure

Rewrite the information on a graph that shows the date and the temperature at the same time.



Information to consider:

1. Which is the most frequent, or common, temperature?
2. Which is the highest temperature? What other weather conditions occurred at that time? Was it sunny? Air pressure?
3. Which is the lowest? What other weather conditions occurred at that time? Was it cloudy? Air pressure?
4. What is your temperature forecast for tomorrow?

UNIT ASSESSMENT

Students answer the following, using the words **evaporate**, **cold**, **warm**, **rain** to complete the sentences.

Oral or Written Assessment

1. When water vapor cools we get _____.
2. When water vapor becomes _____, it will evaporate.
3. When the water in the lake becomes warm, it will _____.
4. When water vapor becomes _____, it will condense.

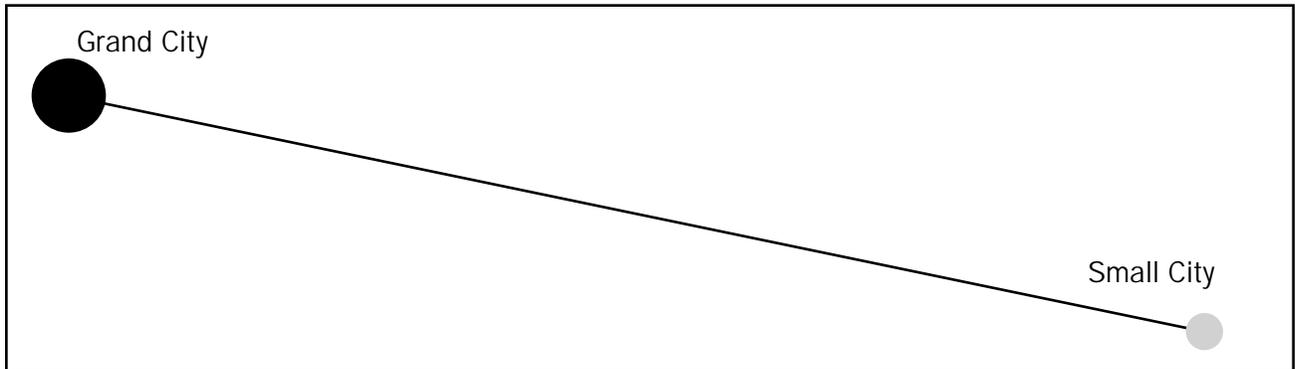
Performance Assessment

1. A snowstorm is moving at 45 miles an hour. Complete this chart to show how far the storm will have traveled after five hours.

hours	½	1	1 and ½	2	2 and ½
miles	45				

2. Draw a snowflake and describe it to your teacher. Be sure to use the geometric terms you learned in this unit when you describe your snowflake.
3. Describe the current weather conditions to your teacher. Tell your teacher what you predict the weather will be for tomorrow. Be sure to take all the information you can find about the weather outside your classroom with you before you talk to your teacher; use a chart to help you summarize your report. (E.g., outside temperature, wind direction, wind velocity, type of cloud cover, and **prediction of the conditions that are likely to prevail**, etc.)
4. A weather map shows that Grand City and Small City are 3 ½ inches apart. If ½ inch represents (stands for) each 80 miles, how many miles apart are **Grand City** and **Small City**? You may want to draw a chart to help you explain how you decided on the distance between the two cities.

inches	1	1 and ½	2	2 and ½	3	3 and ½
miles	(80)	(160)	(240)	(320)	(400)	(480)



5. **Snow City** is 240 miles from **Grand City**. How many inches apart are the two cities on the map? Use the same table that you used for #4, to help you decide. Draw **Snow City** anywhere on the map using the same scale as in problem #4 above.
6. Explain to your teacher what causes rain. You may use any materials you need from the **Science Center** to help you in your explanation. Or, you may draw a set of pictures to explain what causes rain.
7. Additional assessment items are available in **Activity** — Weather Forecasting and **Activity** — My Forecast.

References

Annotated Children's Books

- Branley, F. M. (1962). *Air is all around you*. New York: Thomas Y. Crowell.
A basic book about air. It contains very simple text.
- Branley, F. M. (1983). *Rain and hail*. New York: Thomas Y. Crowell.
Contains a clear explanation of the formation of rain and hail.
- Branley, F. M. (1985). *Flash, crash, rumble, and roll*. New York: Thomas Y. Crowell.
Explains formation of thunder clouds, occurrence and dangers of lightning, and the causes of sound of thunder.
- Branley, F. M. (1985). *Hurricane watch*. New York: Thomas Y. Crowell.
Contains descriptions of the origin and nature of hurricanes. It also suggests ways of staying safe when in hurricane areas.
- Branley, F. M. (1986). *Snow is falling*. New York: Thomas Y. Crowell.
Explains the ecology of snow and includes some simple experiments for grades PK-2.
- Branley, F. M. (1987). *It's raining cats and dogs: All kinds of weather and why we have it*. New York: Houghton Mifflin.
Describes strange weather condition such as pink and green snowstorms, mixed with scientific explanations of the weather.
- Branley, F. M. (1988). *Tornado alert*. New York: Harper Collins Childrens Books.
This K-4 volume provides explanation of the tornado.
- Broeckel, R. (1982). *Storms*. Chicago: Children's Press.
Illustrated for grades 1-4, this contains causes and effects of storms.
- Busch, P. S. (1971). *A walk in the snow*. New York: J. B. Lippincott.
Shows winter scenes, enabling children to raise and answer questions about snow. It is recommended for grades 2-4.
- Catherall, E. (1991). *Exploring weather*. Austin, TX: Steck-Vaughn.
A textbook-style volume, which contains questions, a glossary, books to read, and an index. It addresses air currents, temperature, air pollution, and other topics.
- De Paola, T. (1975). *The cloud book*. New York: Holiday House.
Illustrated by the author, this K-3 volume provides information on the 10 most common types of clouds.
- Dickinson, T. (1988). *Exploring the sky by day: The equinox guide to weather and the atmosphere*. Ontario: Camden House.
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- Dorros, A. (1989). *Feel the wind*. New York: Thomas Y. Crowell.
Explains causes, effects and usefulness of wind.
- Editorial Molina. (1971). *Mi primera biblioteca básica: El aire*. Barcelona: Author.
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- Ellentuck, S. (1968). *A sunflower as big as the sun*. Garden City, NY: Doubleday & Company.
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- Evans, E. K. (1965). *The snow book*. Boston: Little, Brown and Company.
In addition to defining and explaining snow formation, the author addresses how snow affects different segments of our population.
- Gibbons, G. (1987). *Weather forecasting*. New York: Four Winds Press.
Provides a tour of a weather station during the four seasons.
- Goudey, A.E. (1950). *The good rain*. New York: E. P. Dutton.
This is the story of what the lack of rain can mean both to a city and a country child. For shared reading or just for sustained reading.
- Hood, F. (1966). *One luminaria for Antonio*. New York: G. P. Putnam's Sons.
Story about Antonio, a poor boy, who finds a blessing on Christmas Eve.
- Horton, B. S. (1992). *What comes in spring?* New York: Alfred A. Knopf.
The story describes events in the different seasons, including how a baby grew inside her mother as the seasons changed.
- Larrick, N. (1961). *Rain, hail, sleet and snow*. Champaign, IL: Garrard.
Offers clear explanations of the formation of hail, sleet, dew, frost, and many other weather conditions. Contains a simple illustration of the water cycle.
- MacDonald, E. (1992). *The very windy day*. New York: William Morrow and Company.
Humorous tale of how four people running errands on a very windy day lose their possessions by the force of the wind, and by the same force, regain them.

- Munsch, N. (1984). *Millicent and the wind*. Ontario: Annick Press.
Story of a young girl whose only playmate is the wind.
- Newton, J. R. (1983). *Rain shadow*. New York: Thomas Y. Crowell.
Contains an explanation of how the “rain shadow” or dry environment develops on the leeward side of many high mountain ranges.
- Purdy, C. (1985). *Iva Dunnit and the big wind*. New York: Dial Books for Young Readers.
A tall tale about a pioneer women with six children and their experience with a windstorm.
- Simon, S. (1969). *Wet & dry*. New York: McGraw-Hill.
This volume poses questions and suggests projects for young readers.
- Simon, S. (1989). *Storms*. New York: Morrow Junior Books.
This book is an excellent way to introduce children to meteorology.
- Stolz, M. (1988). *Storm in the night*. New York: Harper Collins.
A fictional story for ages 5-8 tells of how a grandfather and his grandson sit through a thundersorm and get to know more about each other.
- Webster, V. R.(1982). *Weather experiments*. Chicago: Childrens Press.
Provides a simple explanation of how weather evolves.
- Wyler, R. (1986). *Science fun with peanuts and popcorn*. New York: Julian Messner
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- Zim, H. S. (1952). *Lightning and thunder*. New York: William Morrow and Company.
Presents a good explanation of lightning and thunder. Contains do's and don'ts during a lightning and thunder storm.

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- Ross, F. Jr. (1965). *Weather: The science of meteorology from ancient times to the Space Age*. New York: Lothrop, Lee & Shepard.
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- Schneider, H. (1961). *Everyday weather and how it works*. New York: McGraw-Hill.
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- Vasquez, Z., & Montelongo, J. (1980). *Cuentos del abuelo: El naranjo que no daba naranjas*. Mexico: Trillas.
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