SCIENCE
Earth and Space Science
Grade 4
Weather Patterns

Overview

Patterns occur in many aspects of nature, and the discovery and investigation of these patterns in weather is a primary concern of meteorologists since weather occurs everyday and affects many aspects of our lives: what we wear, whether we will have to go to school or work, even what we have to eat.

This unit can be used to develop students' science content knowledge by observing the weather and exploring the weather patterns that occur over time. It also can be used to develop science process skills, providing a context for using data and graphs to convey our observations to others. Inquiry skills associated with making scientific measurements using proper equipment extend the information (data) we collect with our senses. The unit should be done initially over two days early in the school year and then periodically revisited (at least monthly) throughout the school year.

Benchmarks

ESS-E-A4 investigating, observing, measuring, and describing changes in daily weather patterns and phenomena

SI-E-A4 employing equipment and tools to gather data and extend the sensory observations

SI-E-A5 using data, including numbers and graphs, to explain observations and experiments

Teacher Preparation

Weather varies from day to day, depending on time of the year, time of the day, prior weather phenomena, location, and many other factors—including some we do not understand or even know about at this time. Careful observations of the atmosphere show that patterns occur in the weather and that these patterns are similar within a season over a long period of time.

For example, over any given week during the winter, it is not uncommon for high pressure to the west of a location to produce a period of cold weather with clear skies and winds coming out of the north. As the high moves eastward and low pressure approaches from the west, winds turn and blow out of the south and a slow warming trend, accompanied by increasing cloudiness, occurs. Eventually precipitation falls and the winds shift out of the north as a cold front moves through the area. Temperatures then decrease and skies clear as high pressure

moves in again. During summer, depending on your location, thunderstorms may occur nearly every afternoon as the sun heats a moist atmosphere, causing air to rise and clouds (that eventually develop into thunderstorms) to form.

As this discussion indicates, weather patterns occur as high and low pressure systems and fronts form, intensify, weaken, and dissipate while moving around the globe. Rather simple observations of the occurrence and amount of precipitation, sky cover, and temperature can reveal these patterns, although they may not occur exactly as described above since the atmosphere is a complex system. Quantitative observations of these variables can be made using a simple weather station that includes a maximum and minimum thermometer and a rain gauge—all of which can be purchased for under $100. If this equipment is not available, the information can be obtained from the local newspaper or TV station or from several sites on the Internet.

Materials/Equipment

- Overhead transparency made from Activity Sheet 1
- Copy of Activity Sheet 1 for each student pair
- Copies of Weather Observation sheet for each week of the school year
- Copies of Weather Summary sheet for each month of the school year
- Minimum-maximum thermometer and rain gauge *or* daily weather summaries (Internet, daily newspaper, or television)
- Dry-erase markers
- Permanent markers or crayons
- Straight edge
- Tape
- Graph paper

Set or Opener

Day 1 (45 minutes):

- To start the students looking for patterns, use Activity Sheet 1 to make worksheets for the students and an overhead transparency.
- Have the students work in pairs to complete the sheet. Ask them to fill in the blanks for each of the problems, but do not mention that they should be looking for patterns.
- After 10 minutes, have pairs combine to make groups of four. Ask the groups to take turns explaining to each other how they knew what went into the blanks.
- After 5 minutes, use a whole-group discussion to fill in the blanks on the transparency. Be sure to have the groups justify their answers.
- When all the blanks have been filled in and the answers explained by the students, do a whole-group discussion using the question “What did each

of these problems have in common?" Look for a response that indicates that patterns determined what correctly filled in the blanks.

- Ask the group to brainstorm where they see patterns in nature, writing their answers on the blackboard or on another transparency. Hopefully, one of them will mention weather. If not, ask them if they have ever noticed patterns in the weather.
- As an extension of this exercise, ask the students to cut out and bring in for the next class a newspaper, magazine, or Internet article that reports how weather has affected people somewhere in the world recently.

Day 2
(60 minutes)

Materials List

World map
Pins with colored heads (found at local variety store)

Opener

- Place a world map on a bulletin board in your classroom before class starts.
- Begin the class by having each student briefly report about his/her article.
- After each student has completed reporting, have him/her place a pin in the world map showing where the weather event occurred. (Different colored pins can be used for different types of weather events if desired.)

Body

1. Discuss how the effects of weather are quite varied and occur over vastly different portions of the world, so that nobody is really ever immune from its effects.

2. Discuss how people might prepare themselves for these events. Then tell them that meteorologists (weathermen) try to predict such events so that people can either escape being hurt or minimize the danger from natural disasters. To do this, meteorologists observe the weather and look for patterns that indicate what may happen next. Among the items they observe are temperature, rainfall, cloud amount (how cloudy the sky is), and present weather (thunder, fog, lightning, snow, hail, etc.).

3. Tell the students that they are going to keep track of the weather for the rest of the school year by taking an observation each day at the same time, just like meteorologists. (Note to the teacher: It is important that the observations be made at the same time each day because time of day is one variable that influences the weather observation. You can rotate this task among the students, but have each observer perform her duties for at least one week so that you minimize any inconsistencies that may result from having more than one person collecting your data.)

4. Agree on the terms used for cloud cover (e.g., clear, partly cloudy, mostly cloudy, overcast) and on their definitions. Also generate a list of terms for present weather (rain, snow, hail, thunder, sleet, etc.) that will be used throughout the year.

Day 3

Day 3 and through the end of the year:
(10 minutes each day; 45 minutes at end of month)

1. At the specified time each day, have the student assigned to take the weather observations for the week go outside and determine the current weather conditions (minimum and maximum temperature, cloud amount, present weather, and precipitation amount). If you do not have the necessary instruments to make these observations at your school or during weekends and holidays when nobody is at the school, an assigned student can obtain the observations from a nearby weather station via the Internet, a local newspaper, or a local TV station.

2. The student then should record the appropriate values in the Weather Observation sheet and on the temperature and rainfall graphs.

Note to the teacher:

- A single sheet of rectangular graph paper can be used for a line graph of a month's minimum and maximum temperature by drawing one line for the maximum temperature and another line for the minimum temperature.

- The lines may be of different colors and should connect points from one day to the next with straight lines.

- Another sheet should be used for the month's rainfall, present weather, and sky cover since the precipitation scale is quite different from that of temperature.

- The day of the month can be written from left to right across the x-axis of each graph and an appropriate range of values used along the y-axis. If the first guess for this range does not prove sufficient, simply tape on more graph paper to extend the range as needed.

- Be sure to provide a title for each graph.

- A line graph is used for minimum and maximum temperature since they represent continuous values over time. Use a vertical bar chart for rainfall since your measurements represent discrete values for a 24-hour period.

- Symbols or words selected at the beginning of the project can be used for present weather and sky cover and placed above the rainfall bars.

- Make sure that the increments along the x-axis are the same in all graphs so that it will be easy to make comparisons among the variables.

3. At the end of the week, review the weather with the students and discuss changes that may have occurred. For example, has it been getting colder lately? Has fog started to occur more frequently? Have thunderstorms stopped occurring?

4. Keep each week's observations on display in the room so that the students may see them. You can also create a continuous graph of the weather elements by taping the monthly graphs together sequentially.

5. At the end of the month, summarize the maximum and minimum temperature data by constructing stem-and-leaf plots using the weekly observation sheets.

   - The Monthly Summary sheet provides the stem for maximum and minimum temperature.

   - The "leaves" are added by taking each day's observation and placing the least significant digit (the right-most one) to the right of the vertical line on the same row as the most significant digit(s).

   - All zeros are listed first, then all ones, and so on. For example, if the observations were 57, 59, 58, 60, 58, 66, 58, and 61, then the plot would look like this:

stem		*leaves*
6	0 1 6	
5	7 8 8 8 9	

   - The stem-and-leaf plot provides a quick way to locate the maximum (the last observation on the top line) and minimum (the first observation on the lowest line) values and the median (the value for which half of the observations are greater and half are less).

   - Once the maximum and minimum values are known, the range can be found by subtracting the minimum from the maximum.

6. Rainfall can be summarized by adding the daily values together to find the monthly rainfall and then determining the number of days with measurable precipitation. Present weather and sky cover can be summarized with vertical bar charts representing the number of occurrences of each type.

Closure

- Discuss the weather summary for the month and compare it with the weather summaries of previous months. In particular, look for more frequent cool days as fall moves into winter and then more frequent hot days as winter moves into spring.

- Also look for correlations like more days with rainfall when there are more cloudy days.

- You may notice that cool periods during the winter are associated with dry weather since high pressure, which generally limits precipitation, usually accompanies the cool weather. At the beginning and end of the school year, you may notice that very hot periods are often dry since the clear skies that accompany high pressure allow plenty of solar heating to increase temperatures.

- You should also look for signs of frontal passages in the graphs of daily observations. Generally, cold fronts will show up as dramatic changes in temperatures from one day to the next. Rainfall should correspond to this sudden change in temperature.

- The line graphs of maximum and minimum temperature, taped together so that you have a continuous record throughout the school year, will serve as a good means of discussing how temperature changes from season to season during the year.

- A good way of summarizing all of the data would be to create line graphs of monthly rainfall totals and the average monthly temperature over the school year. The latter value is calculated by averaging all of the average daily temperatures during the month.

Resources

(activities, data sheets, lab sheets)

Activity Sheet 1

Fill in the blank with the appropriate figure, word, or number.

Cow	Boy	Friend	Ship
Through	Out	Side	Walk
Back	Ground	Hog	_____
_____	_____	_____	_____

		
		_____

1

1 1

1 2 1

1 3 3 1

1 ____ ____ ____ 1

1 ____ ____ ____ ____ 1

1 ____ ____ ____ ____ ____ 1

1 ____ ____ ____ ____ ____ ____ 1

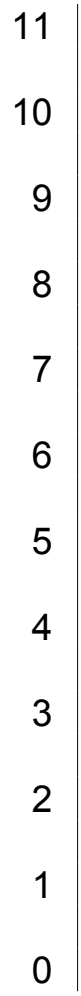
Month:_____ **WEATHER OBSERVATIONS** Week: _____

	Monday	Tuesday	Wednesday	Thursday	Friday
Minimum Temperature					
Maximum Temperature					
Average Temperature (Min + Max)/2					
Cloud amount					
Present weather					
Rainfall					

WEATHER SUMMARY

Month:_____ Variable:_____

Stem and Leaf Plot

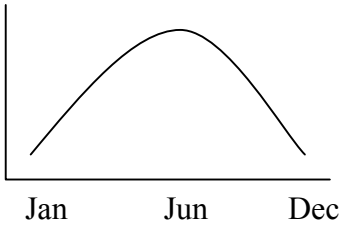


Maximum Value:	
Minimum Value:	
Range:	
Median:	
Average:	

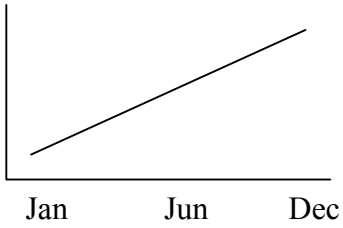
Assessment

1. If you lived south of the equator, say in Argentina, your seasons would be reversed. Thus, when it is winter in the United States, it is summer in Argentina and, when it is summer in the United States, it is winter in Argentina. Which of the following graphs would show how the average monthly temperature in Argentina might look?

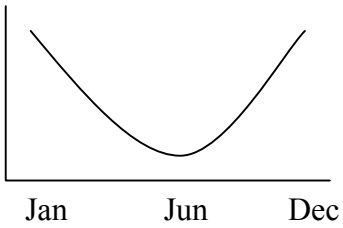
a.



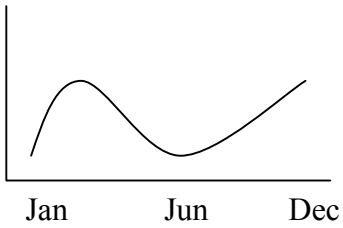
b.



c.



d.



2. Clouds are forecast to move into the area tonight. Therefore, the minimum temperature tomorrow should be _____ today. Also, the maximum temperature tomorrow should be _____ today.

   a. the same as, the same as
   b. less than, greater than
   c. less than, less than
   d. greater than, greater than
   e. greater than, less than

3. It is early November, and a cold front is expected to move through your area this afternoon. Write a weather forecast for today, being sure to mention if any precipitation will occur and describing what you expect will happen to the sky and the temperature. Explain why you believe your forecast will be correct.

Scoring:

1. c (Since January is cold in the northern hemisphere, it will be warm in the southern hemisphere. Since June is warm in the northern hemisphere, it will be cold in the southern hemisphere.)

2. e (Clouds will tend to increase minimum temperatures by absorbing energy emitted by the surface and radiating it back toward the ground. They will tend to decrease maximum temperatures by reflecting light from the sun back toward space, preventing it from being absorbed at the surface and warming the atmosphere.)

3. Scoring rubric

Answer	Score
Mentions warm conditions today and cooler conditions tonight, increasing cloudiness and rainfall in the afternoon.	5
Mentions warm conditions today and cooler conditions tonight, and increasing cloudiness or rainfall in the afternoon.	4
Mentions warm conditions today and cooler conditions tonight; does not mention increasing cloudiness or rainfall.	3
Mentions temperature change and cloudiness or rainfall during the day but does not provide specifics about timing or sense of temperature change.	2
Mentions temperatures changing today; does not mention increasing cloudiness or rainfall in the afternoon. Or mentions cloudiness and rainfall, but does not mention temperature change or specifies incorrect temperature change.	1
Does not mention temperature or mentions temperature remaining the same or increasing; does not mention clouds or rainfall.	0

Reference links

You can acquire the basic weather instruments needed for this unit from the following source.

Scientific Sales, Inc.
P.O. Box 6725
Lawrenceville, NJ 08648
Telephone: 800.788.5666
Fax: 609.844.0466
http://www.scientificsales.com

A good set of instruments would be similar to the following models from the above company. Each instrument has a 2001 price of $35, including shipping.

Model 4433 Minimum-Maximum Thermometer
Model 4330 Plastic Rain Gauge

Thermometers should be mounted on a non-conducting surface (like a white wooden board) on the north side of a building so that direct sunlight does not strike the instrument. The surface below the thermometer should be covered with grass. A rain gauge should be mounted on a stake driven into the ground or on a fence post so that its top is level with the ground and there is nothing taller than the top of the rain gauge within a distance equal to the potential obstruction's height. The top of the rain gauge should be within 1 meter of the surface and the surface should be covered with grass.

If you cannot purchase these instruments, you can generally find the necessary information in the local newspaper or on the nightly local news broadcast. A good site on the Internet for this information is provided by the National Weather Service at http://weather.gov. From the main site, go to the Louisiana state information and then look for climate data.