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Reproducible Student Pages

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Hands-On Activities
Mini Lab  Determining Dew Point

Procedure
1. Partially fill a metal can with room-temperature water. Dry the outer surface of the can.
2. Place a stirring rod in the water.
3. Slowly stir the water and add small amounts of ice.
4. With a thermometer, note the exact water temperature at which a thin film of moisture first begins to form on the outside of the metal can. Record in the table below.
5. Repeat steps 1 through 4 two more times.
6. The average of the three temperatures at which the moisture begins to appear is the dew point temperature of the air surrounding the metal container.

Data and Observations

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Dew Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Analysis
1. What determines the dew point temperature?

2. Will the dew point change with increasing temperature if the amount of moisture in the air doesn’t change? Explain.
Measuring Rain

Procedure
1. You will need a **straight-sided container**, such as a soup or coffee can, **duct tape**, and a **ruler**.
2. Tape the ruler to the inner wall of your container.
3. Place the container on a level surface outdoors, away from buildings or plants.
4. Measure the amount of water in your container after it rains. Record your data in the table below. Continue to take and record measurements for a week.

Data and Observations

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis
1. What was the average daily rainfall?

2. Why is it necessary to use containers with straight sides?
Lab Preview

Directions: Answer these questions before you begin the Lab.
1. For which cities will you find the barometric pressure?

2. What meaning is conveyed by the placement of the triangles or half-circles that are part of the weather symbol for a front?

Meteorologists use a series of symbols to provide a picture of local and national weather conditions. With what you know, can you interpret weather information from weather map symbols?

Real-World Question
How do you read a weather map?

Materials
- magnifying lens
- Weather Map Symbols Appendix
- Figure 19, Weather Map, in your textbook

Goals
- Learn how to read a weather map.
- Use information from a station model and a weather map to forecast weather.

Procedure
Use the information provided in the questions below and the Weather Map Symbols Appendix to learn how to read a weather map.

1. Find the station models on the map for Portland, Oregon, and Miami, Florida. Find the dew point, wind direction, barometric pressure, and temperature at each location. Record your findings in Table 1 in the Data and Observations section.

2. Looking at the placement of the isobars, determine whether the wind would be stronger at Springfield, Illinois, or at San Diego, California. Record your answer in Table 2 in the Data and Observations section. What is another way to determine the wind speed at these locations?

3. Determine the type of front near Dallas, Texas. Record your answer in Table 2.

4. The triangles or half-circles are on the side of the line toward the direction the front is moving. In which direction is the cold front located over Washington state moving?
Data and Observations

Table 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Dew Point</th>
<th>Wind Direction</th>
<th>Barometric Pressure</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Portland, Oregon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Miami, Florida</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Location</th>
<th>Wind Speed</th>
<th>Type of Front</th>
<th>Direction of Cold Front</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. San Diego, California</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Dallas, Texas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Washington</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conclude and Apply

1. Locate the pressure system over southeast Kansas. Predict what will happen to the weather of Nashville, Tennessee, if this pressure system moves there.

2. Prevailing westerlies are winds responsible for the movement of much of the weather across the United States. Based on this, would you expect Columbia, South Carolina, to continue to have clear skies? Explain.

3. The direction line on the station model indicates the direction from which the wind blows. The wind is named for that direction. Infer from this the name of the wind blowing at Little Rock, Arkansas.

Communicating Your Data

Pretend you are a meteorologist for a local TV news station. Make a poster of your weather data and present a weather forecast to your class.
Model and Invent
Measuring Wind Speed

Lab Preview
Directions: Answer these questions before you begin the Lab.
1. Who was Admiral Beaufort?
2. How could different sizes and shapes of paper be used to measure wind speed?

When you watch a gust of wind blow leaves down the street, do you wonder how fast the wind is moving? For centuries, people could only guess at wind speeds, but in 1805, Admiral Beaufort of the British navy invented a method for estimating wind speeds based on their effect on sails. Later, Beaufort’s system was modified for use on land. Meteorologists use a simple instrument called an anemometer to measure wind speeds, and they still use Beaufort’s system to estimate the speed of the wind. What type of instrument or system can you invent to measure wind speed?

Real-World Question
How could you use simple materials to invent an instrument or system for measuring wind speeds? What observations do you use to estimate the speed of the wind?

Goals
- Invent an instrument or devise a system for measuring wind speeds using common materials.
- Devise a method for using your invention or system to compare different wind speeds.

Possible Materials
- paper
- scissors
- confetti
- *measuring tape

Safety Precautions

Data Source
Refer to Section 1 in your text for more information about anemometers and other wind speed instruments. Consult the data table for information about Beaufort’s wind speed scale.

Make a Model
1. Scan the list of possible materials and choose the materials you will need to devise your system.
2. Devise a system to measure different wind speeds. Be certain the materials you use are light enough to be moved by slight breezes.

Check the Model Plans
1. Describe your plan to your teacher. Provide a sketch of your instrument or system and ask your teacher how you might improve its design.
2. Present your idea for measuring wind speed to the class in the form of a diagram or poster. Ask your classmates to suggest improvements in your design that will make your system more accurate or easier to use.
Test Your Model
1. Confetti or grass clippings that are all the same size can be used to measure wind speed by dropping them from a specific height. Measuring the distances they travel in different strength winds will provide data for devising a wind speed scale.

2. Different sizes and shapes of paper also could be dropped into the wind, and the strength of the wind would be determined by measuring the distances traveled by these different types of paper.

Analyze Your Data
1. Develop a scale for your method.

2. Compare your results with Beaufort’s wind speed scale.

3. Analyze what problems may exist in the design of your system and suggest steps you could take to improve your design.

Conclude and Apply
1. Explain why it is important for meteorologists to measure wind speeds.

2. Evaluate how well your system worked in gentle breezes and strong winds.

Communicating Your Data
Demonstrate your system for the class. Compare your results and measurements with the results of other classmates.

<table>
<thead>
<tr>
<th>Description</th>
<th>Wind speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calm—smoke drifts up</td>
<td>less than 1</td>
</tr>
<tr>
<td>Light air—smoke drifts with wind</td>
<td>1–5</td>
</tr>
<tr>
<td>Light breeze—leaves rustle</td>
<td>6–11</td>
</tr>
<tr>
<td>Gentle breeze—leaves move constantly</td>
<td>12–19</td>
</tr>
<tr>
<td>Moderate breeze—branches move</td>
<td>20–29</td>
</tr>
<tr>
<td>Fresh breeze—small trees sway</td>
<td>30–39</td>
</tr>
<tr>
<td>Strong breeze—large branches move</td>
<td>40–50</td>
</tr>
<tr>
<td>Moderate gale—whole trees move</td>
<td>51–61</td>
</tr>
<tr>
<td>Fresh gale—twigs break</td>
<td>62–74</td>
</tr>
<tr>
<td>Strong gale—slight damage to houses</td>
<td>75–87</td>
</tr>
<tr>
<td>Whole gale—much damage to houses</td>
<td>88–101</td>
</tr>
<tr>
<td>Storm—extensive damage</td>
<td>102–120</td>
</tr>
<tr>
<td>Hurricane—extreme damage</td>
<td>more than 120</td>
</tr>
</tbody>
</table>
Clouds are groups of tiny water droplets that are suspended in the air. They form when water condenses around particles in the air. The temperature of the air is one of the factors that affects the type of cloud that forms.

**Strategy**
You will simulate the formation of a “cloud” inside a soft drink bottle.
You will form a hypothesis that predicts which clouds are denser, those formed by hot air and hot water, or those formed by cold air and cold water.

**Materials**
- large clear plastic bottle with cap (2 L soft drink bottle)
- graduated cylinder
- thermometer
- water (cold)
- water (very hot, but not boiling)
- matches

**Procedure**
1. Use the graduated cylinder to measure 60 mL of very cold water. Measure the temperature of the water and record it in the Data and Observations section table. Pour the water into the plastic bottle.
2. Replace and secure the cap. Shake the bottle vigorously for about 10 s. Place the bottle on a firm flat surface.
3. Remove the cap and drop a lighted match into the mouth of the bottle. **WARNING:** Handle matches carefully.
4. Replace the cap. Now squeeze the bottle with both hands to increase the internal pressure and observe what happens. Stop squeezing and observe what happens. Squeeze and release the bottle one more time.
5. Record your observations in the Data and Observations section table.
6. Empty the plastic bottle. Measure 60 mL of very hot water. Measure the temperature of the water and record in the Data and Observations section table. Pour the water into the bottle.
7. Hypothesize how your observations will differ using hot water.
8. Repeat steps 3, 4, and 5.
Laboratory Activity 1 (continued)

Data and Observations

<table>
<thead>
<tr>
<th>Water Temperature</th>
<th>Observations When Pressure Increased</th>
<th>Observations When Pressure Decreased</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cold water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Hot water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions and Conclusions

1. What happened when the match was dropped into the bottle?

2. What happened when the bottle with cold water was squeezed?

3. What happened when the bottle with cold water was released?

4. How did the results obtained using cold and hot water compare? How can you explain these results?

5. Why did a “cloud” form when you stopped squeezing the bottle?

6. What was the purpose of dropping a lighted match into the bottle?
7. How did your hypothesis compare with the results of this activity?

8. Summarize the process of cloud formation.

Strategy Check

Can you simulate the formation of a cloud inside a soft drink bottle?

Can you predict which clouds are denser, those formed by hot air and hot water, or those formed by cold air and cold water?
Wind Power

Wind is an important renewable energy source. Some of the solar radiation that strikes Earth’s atmosphere is changed to heat energy. The alternate heating and cooling of the atmosphere as Earth rotates causes air pressure differences. Air moves from regions of high pressure to regions of low pressure, causing wind. Wind energy can be used to drive generators to produce electricity. Any wind that blows at a constant speed above 12.8 km/h can be used to generate electricity. However, the efficiency of the wind as an energy source also depends on the generating system.

Strategy
You will construct the simple device to measure wind speed.
You will measure the wind speed at different times during the day for a week.
You will evaluate wind as a source of energy.

Materials
- cardboard (stiff)
- scissors
- nylon line (30-cm)
- table tennis ball
- glue or paste
- colored marker
- graph paper

Procedure
1. Cut out the protractor in Figure 2 and glue it to the cardboard.
2. Thread the nylon line through the needle and push the needle through to the center of the table tennis ball. **WARNING:** Use care when handling sharp objects.
3. Tie a knot in the nylon line just above the surface of the ball and glue it to the ball. Glue the free end of the nylon line to the spot marked Center on the protractor.
4. Color the nylon line with the colored marker.
5. Test the device by setting it on the edge of the desk. If it is level, the line should cover the 0˚ mark.
6. Select the windiest area of the school grounds. Block the wind and level the device. See Figure 1. Hold the device level and face the wind. Allow the wind to move the table tennis ball. See Figure 1. The angle made by the nylon line will be the wind speed in degrees. Measure the angle and record it in Table 1.
7. Measure and record the wind speed in degrees three times a day for a week. Use the same site each time. Record your measurements in Table 1.
Laboratory Activity 2 (continued)

Data and Observations
Using Table 2, convert your wind speed in degrees to wind speed in kilometers per hour. Fill in the column in Table 1.
Graph the wind speed in kilometers per hour on the vertical axis of the graph paper and graph date/time on the horizontal axis.

Table 1

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Wind Speed (degrees)</th>
<th>Wind Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Angle</th>
<th>km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>9.6</td>
</tr>
<tr>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>20</td>
<td>19.2</td>
</tr>
<tr>
<td>25</td>
<td>20.8</td>
</tr>
<tr>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>35</td>
<td>25.6</td>
</tr>
<tr>
<td>40</td>
<td>28.8</td>
</tr>
<tr>
<td>45</td>
<td>32</td>
</tr>
<tr>
<td>50</td>
<td>33.6</td>
</tr>
<tr>
<td>55</td>
<td>36.8</td>
</tr>
<tr>
<td>60</td>
<td>41.6</td>
</tr>
<tr>
<td>65</td>
<td>46.4</td>
</tr>
<tr>
<td>70</td>
<td>52.8</td>
</tr>
</tbody>
</table>

Questions and Conclusions
1. Is the wind constant in your area? What effect does this have on electricity generation?


2. Estimate how many hours a day you could generate electricity at your site.


3. What are some advantages to the use of wind power to generate electricity?

4. What are some drawbacks to using wind power?

**Strategy Check**

_____ Can you construct a device to measure wind speed?

_____ Can you measure wind speed?

_____ Can you evaluate wind as a source of energy?
Weather

What is Weather?

Weather Patterns

Forecasting Weather

determined by air masses, pressure systems, and fronts

meteorologists use many different instruments and computers

National Weather Service collects data.

the atmosphere at a specific time and place

the result of heat and Earth's air and water
Meeting Individual Needs
Directions: Complete the concept map using the terms in the list below.

Sun fronts water air masses

low pressure high pressure air

Weather is caused by the interaction of

1. of

2. of

3. of

which form

4.

which can form

5.

where air moves from

6. _______ areas
to

7. _______ areas

Directions: Complete the following sentences using the correct terms.

8. Clouds form as moist air rises and ________________.

9. When dense, cold air meets less dense warmer air, the warm air is pushed ________________.

10. Winds form because air moves from an area of high pressure to an area of ________________ pressure.
Section 1  •  What is weather?

Directions: Write the letter of the correct question next to its answer below.

Questions
a. What is the dew point?
b. What is sleet?
c. What is fog?
d. What is humidity?
e. What is wind?
f. What is relative humidity?
g. What is weather?
h. What is temperature?
i. What are clouds?
j. What are types of precipitation?
k. What is caused by the interaction of air, water, and Sun?

Answers
1. a description of the current state of the atmosphere
2. the amount of water vapor in the air
3. objects that form as warm air rises, expands, and then cools
4. the temperature at which condensation forms from saturated air
5. the measurement of the amount of water vapor in the air compared to the amount needed for saturation at a specific temperature
6. rain, snow, sleet, and hail
7. a stratus cloud that forms near the ground
8. the weather
9. air moving in a specific direction
10. a measure of the average amount of motion of molecules
11. rain drops that pass through a layer of freezing air near Earth’s surface forming pellets
Directions: Unscramble the terms in italics to complete the sentences below. Write the terms on the lines provided.

1. A boundary between two different air masses is called a **norfi**.

2. Atmospheric **serpuser** is determined by the temperature and density of the air and the amount of water vapor in it.

3. Storms and **ipitrpitcone** occur at fronts.

4. Fronts usually bring a change in **etertermaup**.

5. Fronts always bring a change in wind **iridotnec**.

6. A(n) **ria sams** is a large body of air with the same properties as Earth’s surface under it.

7. A line connecting points of equal temperature is a(n) **timsrohe**.

8. A(n) **tiostan emdol** shows the weather conditions at one specific location.

Directions: Write the descriptive terms for air masses in their proper places on the map. Note that cool/moist and warm/moist appear twice.
**Key Terms**

**Weather**

**Directions:** Complete the following sentences using the correct terms. Then circle the terms in the word search puzzle.

1. ____________________ is the amount of water vapor in the air compared to the amount of water vapor needed for saturation at a certain temperature.

2. The temperature at which air is saturated and condensation begins is the ____________________.

3. When air is cooled to the dew point near the ground, it forms a stratus cloud called ____________________.

4. When you observe a change in the weather from one day to the next, it is due to the movement of ____________________.

5. A ____________________ is a large swirling low-pressure system that forms over tropical waters.

6. A ____________________ studies weather.

7. An ____________________ connects locations of equal temperature.

8. An ____________________ connects locations of equal pressure.

9. A ____________________ is a violent whirling wind that moves over land.

10. The boundary between cold and warm air masses is a ____________________.

---

**Meeting Individual Needs**

---

**Word Search Puzzle**

```plaintext
J M E T E O R O L O G I S T A S B
V I S O B A R Q U E X S L O I T F
A Z F R O N T J U S I S O F R H D
R R T N E D N U H T S N A W M T V
R W A A T H I R N U O M N Y A M P
M S O D E W P O I N T T Y P S M G
M W F O G H T A W M H A I L S D S
S N H U R R I C A N E C A U E I U
S W E A T H F O G E R A I N S T K
R E L A T I V E H U M I D I T Y X
```
Instrucciones: Completa el mapa de conceptos usando los siguientes términos.

Sol frentes agua masas de aire
baja presión alta presión aire

El tiempo lo causa la interacción

1. de
2. de
3. de

que forman

4. que pueden formar

5. en que el aire se mueve de

6. áreas de

7. áreas de

Instrucciones: Completa las siguientes oraciones usando los términos correctos.

8. Las nubes se forman a medida que el aire húmedo asciende y _____________.

9. Cuando el aire frío y denso se encuentra con aire cálido menos denso, el aire cálido es forzado a _______________.

10. Los vientos se forman debido a que el aire se mueve de una área de alta presión a un área de ____________ presión.
Sección 1 • ¿Qué es el tiempo?

Instrucciones: Escribe la letra de la respuesta correcta al lado de la pregunta.

Preguntas

a. ¿Qué es el punto de condensación?

b. ¿Qué es la aguanieve?

c. ¿Qué es la neblina?

d. ¿Qué es la humedad?

e. ¿Qué es el viento?

f. ¿Qué es la humedad relativa?

g. ¿Qué es el tiempo?

h. ¿Qué es la temperatura?

i. ¿Qué son las nubes?

j. ¿Cuáles son los tipos de precipitación?

k. ¿Qué causa la interacción del aire, del agua y del Sol?

Respuestas

1. una descripción del estado presente de la atmósfera

2. la cantidad de vapor de agua en el aire

3. lo que se forma a medida que el aire caliente se eleva, se expande y luego se enfria

4. la temperatura a la que se condensa el aire saturado

5. medida de la cantidad de vapor de agua en el aire comparada con la cantidad necesaria para la saturación, a una temperatura específica

6. lluvia, nieve, aguanieve y granizo

7. una nube estrato que se forma cerca del suelo

8. el tiempo

9. aire que se mueve en una dirección específica

10. medida de la cantidad promedio de movimiento de las moléculas

11. gotas de lluvia que pasan a través de una capa de aire congelado cerca de la superficie terrestre y que forman pellas
Instrucciones: Descifra los términos en bastardilla y completa las oraciones. Escribe el término en la línea dada.

1. El límite entre dos masas diferentes de aire se llama
   tenfre.

2. La temperatura, la densidad del aire y la cantidad de
   vapor de agua que éste contiene determinan el(la)
   sinpreó atmosférica(o).

3. Las tormentas y prenciócipita ocurren en los frentes.

4. Los frentes por lo general llevan un cambio en
   etartermaup.

5. Los frentes siempre llevan un cambio en la(el) iridóc-
   nec del viento.

6. Un(a) riae aams es una gran acumulación de aire con
   las mismas propiedades que la superficie terrestre
   debajo de él(ella).

7. Una línea que conecta puntos de igual temperatura es
   un(a) materosi.

8. Un(a) goidcó gicolómeteoro muestra las condiciones
   del tiempo en una ubicación específica.

Introducción: Escribe los términos descriptivos para las masas de aire en los lugares apropiados en el mapa. Observa que fresco/húmedo y cálido/húmedo aparecen dos veces.

---

9. ____________
10. ____________
11. ____________

---

12. ____________
13. ____________
14. ____________
Instrucciones: Completa correctamente las oraciones. Luego encuentra los términos en la sopa de letras.

1. El(La) ____________________ es la cantidad de vapor de agua en el aire comparada con la cantidad de vapor de agua necesaria para la saturación a cierta temperatura.

2. La temperatura a la que el aire se satura y comienza la condensación es el(la) ____________________.

3. Cuando se enfriá hasta el punto de condensación cerca de la tierra, el aire forma una nube estrato llamada ____________________.

4. Cuando observas un cambio en el tiempo de un día a otro, esto se debe al movimiento de ____________________.

5. Un(a) ____________________ es un sistema giratorio de baja presión que se forma sobre las aguas tropicales.

6. Un(a) ____________________ estudia las condiciones del tiempo.

7. Un(a) ____________________ conecta ubicaciones con la misma temperatura.

8. Un(a) ____________________ conecta ubicaciones con la misma presión.

9. Un(a) ____________________ es un viento arremolinado violento que se mueve sobre la tierra.

10. La frontera entre masas de aire frío y cálido es un(a) ____________________.
What is weather?

Directions: Answer the following questions on the lines provided.

1. How does temperature affect humidity?

2. Why can’t cold air hold much water vapor?

3. How do clouds form?

4. Complete the chart below about the types of clouds in Figures 1 through 4.

<table>
<thead>
<tr>
<th>Figure 1</th>
<th>Figure 2</th>
<th>Figure 3</th>
<th>Figure 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Directions: Match the terms in Column I with their descriptions in Column II. Write the letter of the correct description in the blank at the left.

Column I

5. snow
6. rain
7. sleet
8. hail

Column II

a. water drops that fall when the temperature is above freezing
b. water drops that fall and become solid when the temperature is below freezing
c. water drops that freeze in layers around small nuclei of ice during thunderstorms
d. water drops that pass through a layer of freezing air near the surface, forming ice pellets
Weather Patterns

Directions: Use the diagrams to answer the following questions.

1. What kinds of clouds form along the front in Figure 1? _______________________________

2. What kind of precipitation might come from these clouds? _____________________________

3. What kind of clouds form along the front in Figure 2? ________________________________

4. What kind of precipitation might come from these clouds? _____________________________

5. Figure 1 represents a ____________________________________________________________

6. Figure 2 represents a ____________________________________________________________

7. What will happen to the temperature in Columbus, Ohio, when the front passes?
   ____________________________________________________________

8. Compare the temperatures in Topeka and Kansas City, Kansas. ________________________

9. Fill in the chart about the elements of thunderstorms.

<table>
<thead>
<tr>
<th>Element of Thunderstorms</th>
<th>Caused by</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. heavy rain</td>
<td></td>
</tr>
<tr>
<td>b. strong winds</td>
<td></td>
</tr>
<tr>
<td>c. lightning</td>
<td></td>
</tr>
<tr>
<td>d. thunder</td>
<td></td>
</tr>
<tr>
<td>e. tornado</td>
<td></td>
</tr>
</tbody>
</table>
Directions: Use the weather map and Weather Map Symbols Reference Handbook to answer the following questions.

1. Which station has the lowest pressure?

2. How would you describe the wind at Station B?

3. Which station is recording the highest wind speed?

4. Which station has the highest pressure?

5. What kind of front is south of Station A?

6. Which station has the most cloud cover?

7. How might the temperature change at station C over the next few hours? Why?

Directions: Answer the following questions on the lines provided.

8. What is the difference between an isobar and an isotherm?

9. On a weather map for county A, the isobars are far apart. On a map for county B, about 100 miles away, the isobars are close together. Which map shows high winds? How can you tell?
Relating Clouds to Weather

Clouds are one indicator of weather. How well can you predict weather by observing the sky?

Materials
- camera
- roll of film
- poster board
- markers

WARNING: Do not aim the camera directly at the Sun. Damage could occur to the eyes if direct sunlight is observed.
(Hint: Catch the same tree or top of a building in the beginning photo each day so you know when each day begins in your information.)

Procedure
1. Take photographs of the sky during the day for seven days. Photograph from west to east each day. Record the weather conditions, time of day when each photograph is taken, and number of photos taken each day.
2. Watch or listen to a nightly weather report and briefly record what weather conditions existed that day.
3. Use your textbook and cloud charts to identify the type or types of clouds in each photograph.
4. Look up the weather conditions normally associated with each cloud type in your photographs. Compare this information with your observations.

Data and Observations
Make a poster organizing your observations and information. Attach your photographs and include which type of cloud each photograph contains, the type of weather associated with that cloud type, and the weather you actually observed with that cloud type.

Conclude and Apply
1. Do you notice any pattern to the clouds observed and the weather experienced? Explain.

2. What do you conclude about using clouds to predict weather?
Reading Weather Maps

The symbols on the weather map below show the locations of fronts, high- and low-pressure areas, and different kinds of precipitation across the United States in the afternoon on a particular day in March. The key below the map tells what the symbols mean.

Directions: Answer the questions below based on information in the weather map.

1. Would you expect to find clear weather or clouds near Fargo, North Dakota?

2. Where would you expect to find a storm?

3. How is the weather in Salt Lake City, west of the stationary front, different from the weather in Denver, east of the front?

4. What is happening to the air masses at the cold front?
Making Forecasts

Materials
Celsius thermometer
aneroid barometer
magnetic compass

Procedure
1. Make a chart like the one shown below to record your weather observations each day for 7 days. Be sure to make observations at the same time and place each day.
2. Determine the temperature by placing the thermometer in a shaded location.
3. Determine the air pressure using the aneroid barometer.
4. Estimate the amount of sky covered by clouds as clear, overcast, or somewhere in between.
5. Determine the types of clouds using the Cloud Field Guide in the back of your textbook.
6. Use a magnetic compass to determine the direction from which the wind is blowing.
7. Describe the precipitation. Use the terms rain, snow, sleet, hail, fog, or clear.
8. Use the data you collect each day to forecast weather conditions for the following day. Note any trends you see in your observations, such as high cirrus clouds preceding rainy weather.

<table>
<thead>
<tr>
<th>Date</th>
<th>Temp. (°C)</th>
<th>Atmospheric Pressure</th>
<th>% Cloud Cover</th>
<th>Cloud Types</th>
<th>Wind Direction</th>
<th>Precipitation</th>
<th>Forecast</th>
</tr>
</thead>
</table>

Conclude and Apply
1. Was there a relationship between low barometric pressure and the presence of clouds and precipitation? Explain.

2. How accurate were your forecasts for the next day? Give an explanation for any errors that may have occurred in your forecasting.

3. What weather observations can you make yourself?
Section 1  What is weather?

A. Weather is the state of the ________________ at a specific time and place.

1. Includes such conditions as air pressure, wind, ________________ , and moisture in the air.
   a. The ________________ evaporates water into the atmosphere forming clouds; water returns to Earth as rain or snow; the Sun also ________________ air.

2. Temperature is a measure of ________________ movement.
   a. The Sun’s energy causes air molecules to move rapidly; temperatures are ________________ and it feels ________________.
   b. When less of the Sun’s energy reaches air molecules, they move less rapidly and it feels ________________.

3. Wind—air moving in a ________________
   a. As the Sun heats air, it expands, becomes less ________________, rises, and has ________________ atmospheric pressure.
   b. Cooler air is ________________ and sinks, causing ________________ atmospheric pressure.
   c. Air moves from ________________ pressure areas to ________________ pressure areas, causing wind.

4. Humidity—the amount of ________________ in the air
   a. Warmer air can hold ________________ water vapor, tending to make it more humid.

5. Relative humidity—the amount of water vapor in the air compared to what it can hold at a ________________ temperature
   a. When air cools, it can’t hold as much water vapor, so the water vapor ________________ to a liquid or forms ice crystals.

B. ________________—the temperature at which air is saturated and condensation forms

C. Clouds form as ________________ air is forced upward and cools. Then the water vapor condenses in tiny droplets that remain suspended in the air.
D. The shape and height of clouds vary with temperature, pressure and the
________________________ in the atmosphere.

1. Shape
   a. ________________—smooth, even sheets or layers at low altitudes
   b. ________________—puffy, white clouds, often with flat bases
   c. ________________—high, thin, white, feathery clouds made of ice crystals

2. Height
   a. ________________—high clouds
   b. ________________—middle-elevation clouds
   c. ________________—low clouds

3. ________________ clouds are dark and so full of water that sunlight can’t penetrate them.

E. Precipitation—__________ falling from clouds

1. When ________________ in clouds combine and grow large enough, precipitation
   falls to Earth.

2. Air ________________ determines whether the droplets form rain, snow, sleet, or hail.

Section 2 Weather Patterns

A. Because ______________ and ______________ move in the atmosphere, weather constantly
   changes.

1. Air mass—a large body of air with properties like the part of ________________
   over which it formed

2. Highs and lows
   a. Stormy weather is associated with ______________ pressure areas.
   b. Fair weather is associated with ______________ pressure areas.
   c. Air pressure is measured by a ________________.

B. Front—a ______________ between two different air masses

1. Clouds, precipitation, and ______________ occur at frontal boundaries.
   a. Cold front—where ______________ air advances under ______________ air
   b. Warm front—where ______________ air advances over ______________ air

2. ________________ front—involves three air masses of different temperatures

3. ________________ front—air masses and their boundaries stop advancing
C. Severe weather

1. Thunderstorms occur along warm, moist air masses and at _________________.
   a. Warm, moist air is forced rapidly upward, where it cools and _________________.
   b. Strong updrafts of warm air and sinking, rain-cooled air cause strong _________________.

2. Lightning
   a. Movement of air inside a storm cloud causes parts of the cloud to 
      become _________________.
   b. Current flows between the regions of opposite electrical charge, forming a 
      _________________.

3. Thunder—lightning ________________ the air, causing it to expand rapidly and then 
   contract, forming sound waves

4. ________________—a violent, whirling wind that moves in a narrow path over land

5. ________________—a large, swirling, low-pressure system that forms over tropical oceans

6. Blizzard—a winter storm with strong winds, cold temperatures, and low visibility, that lasts 
   more than _______________ hours.

7. Severe weather safety
   a. A National Weather Service ________________ means conditions are favorable for severe 
      weather to develop.
   b. A ________________ means that severe weather conditions already exist.

Section 3  Weather Forecasts

A. ________________ study and predict the weather.

B. The National Weather Service makes _________________.

1. ________________ show weather conditions at a specific location.

2. Temperature and pressure
   a. Isotherms are lines on a weather map connecting points of equal 
      _________________.
   b. Isobars are lines on a weather map that connect points of equal atmospheric 
      _________________.

3. Weather fronts move from _______________ to _______________.

Meeting Individual Needs

Note-taking Worksheet (continued)
Assessment
Part A. Vocabulary Review

Directions: Write the term that matches each description below on the spaces provided. Write one letter in each space. Use the letters in the boxes to find the answer to question 17.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________

1. Violent, whirling wind associated with thunderstorms
2. Line connecting points of equal temperature
3. Person who studies weather
4. Line connecting points of equal atmospheric pressure
5. Boundary formed between two colliding air masses
6. Large body of air with the same properties as the surface over which it develops
7. Present state of the atmosphere
8. Amount of moisture in air compared to amount needed for saturation at a given temperature
9. Weather information collected by meteorologists at specific locations
10. Temperature at which air is saturated and condensation begins
11. Severe storm that forms over tropical oceans
12. Great masses of air molecules pushing down from above
13. Includes rain, snow, sleet, and hail
14. Millions of drops of water suspended in the sky
15. Stratus cloud that forms near the ground
16. Air holding all the moisture it can at a particular temperature
17. What type of cloud brings long, steady rain?
### Part B. Concept Review

**Directions:** In the following table, write the description and weather associated with each type of cloud.

<table>
<thead>
<tr>
<th>Cloud type</th>
<th>Description</th>
<th>Weather Associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cirrus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Cumulus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Stratus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Nimbus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. What atmospheric conditions cause the following?
   a. cold front: ____________________________
   b. thunderstorm: ____________________________
   c. tornado: ____________________________
   d. hurricane: ____________________________

**Directions:** Answer the following questions on the lines provided.

6. What is the difference between isobars and isotherms?

   ______________________________________

7. Explain the relationship between fronts and low pressure systems.

   ______________________________________

8. List four forms of precipitation.

   ______________________________________

9. Describe how low pressure systems form at cold, warm, and stationary fronts.

   ______________________________________
Transparency Activities
Valley Mist

This Chinese painting depicts a mountain and valley scene. Mountains with fog hanging in the valleys are common elements in this style of painting.

1. What do you think the weather in this picture is like?
2. Describe how fog or mist feels.
3. How are fog and clouds similar?
Cloud Walking

If you’ve ever hiked up a mountain, you may have noticed that it is often cooler at higher elevations. Sometimes, however, the air at the top of a mountain is noticeably warmer than the air at the bottom. The warm air traps the colder surface air.

1. How can you tell that there is not a lot of air movement in this picture?
2. What will happen when the Sun warms the lower air?
3. What would happen if there were pollutants near the ground?
Whither wanders the weather?

For many people, knowing what the weather will be like is important. Farmers schedule planting, irrigation, or harvesting based on weather conditions. Weather can change travel schedules or even make travel unsafe. Many people like to know whether they should carry an umbrella.

1. Which of these items would you use if you wanted to know how much snow fell last night? Which item displays the path of a storm?
2. How has weather prediction changed in the last century?
1. What causes the weather to change?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

2. What three fronts are on the transparency?

__________________________________________________________________________

3. How can you tell how hard the wind is blowing on a weather map? Explain your answer.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

4. What are the two types of pressure areas on the transparency?

__________________________________________________________________________

5. What is a person who forecasts the weather called?

__________________________________________________________________________

6. What type of pressure area is located over the four corners region of the United States?

__________________________________________________________________________
Directions: Carefully review the table and answer the following questions.

### Three Main Cloud Shapes

<table>
<thead>
<tr>
<th>Name</th>
<th>Height</th>
<th>Shape</th>
<th>Type of Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratus</td>
<td>low</td>
<td>smooth layers</td>
<td>fair weather or precipitation</td>
</tr>
<tr>
<td>Cumulus</td>
<td>mid-high</td>
<td>puffy masses</td>
<td>fair weather or thunderstorms</td>
</tr>
<tr>
<td>Cirrus</td>
<td>high</td>
<td>feathery or curly</td>
<td>fair weather</td>
</tr>
</tbody>
</table>

1. The table provides information about the ___.
   - A discovery of clouds
   - B shape of clouds
   - C color of clouds
   - D approximate weight of clouds

2. According to the table, which types of clouds occur when it is raining?
   - F Cirrus and Cumulus
   - H Stratus and Cirrus
   - G Stratus and Cumulus
   - J Cirrus only

3. Tony and Brian noticed that there seemed to be more cumulus clouds in the afternoon than in the morning. Which of the following information should they add to the table above to BEST test this hypothesis?
   - A time of day when clouds are seen
   - B how many clouds appear in the sky
   - C the direction the clouds moved
   - D which season generally has the most clouds