Chapter 18: Moisture, Clouds, and Precipitation

Section 18.1: Water in the Atmosphere

I. Water’s Changes of State  
   Group #_____  
   Main Idea:  

   A. Solid to Liquid  
      Group #_____  
      Main Idea:  

   B. Liquid to Gas  
      Group #_____  
      Main Idea:  

   C. Solid to Gas  
      Group #_____  
      Main Idea:  

II. Humidity  
   Group #_____  
   Main Idea:  

   A. Saturation  
      Group #_____  
      Main Idea:  

   B. Relative Humidity  
      Group #_____  
      Main Idea:  

   C. Dew Point  
      Group #_____  
      Main Idea:  

   D. Measuring Humidity  
      Group #_____  
      Main Idea:  

Section 18.2: Cloud Formation

I. Air Compression and Expansion  
   Group #_____  
   Main Idea:  

   A. Adiabatic Temperature Changes  
      Group #_____  
      Main Idea:  

   B. Expansion and Cooling  
      Group #_____  
      Main Idea:  

II. Processes That Lift Air
Main Idea:  

A. Orographic Lifting
Main Idea:  

B. Frontal Wedging
Main Idea:  

C. Convergence
Main Idea:  

E. Localized Convective Lifting
Main Idea:  

III. Stability
Main Idea:  

A. Density Differences
Main Idea:  

B. Stability Measurements
Main Idea:  

C. Degrees of Stability
Main Idea:  

D. Stability and Daily Weather
Main Idea:  

IV. Condensation
Main Idea:  

A. Types of Surfaces
Main Idea:  

Section 18.3: Cloud Types and Precipitation

I. Types of Clouds
Main Idea:

A. Cirrus  
Main Idea:  

B. Cumulus  
Main Idea:  

C. Stratus  
Main Idea:  

D. High Clouds  
Main Idea:  

E. Middle Clouds  
Main Idea:  

F. Low Clouds  
Main Idea:  

G. Clouds of Vertical Development  
Main Idea:  

II. Fog  
Main Idea:  

A. Fogs Caused by Cooling  
Main Idea:  

B. Fogs Caused by Evaporation  
Main Idea:  

III. How Precipitation Forms  
Main Idea:  

A. Cold Cloud Precipitation  
Main Idea:  
IV. Forms of Precipitation

Main Idea:

A. Rain and Snow

Main Idea:

B. Sleet, Glaze, and Hail

Main Idea:
Chapter 19: Air Pressure and Wind

Section 19.1: Understanding Air Pressure

I. Air Pressure Defined
   Group #_____  
   Main Idea:
   
II. Measuring Air Pressure
    Group #_____  
    Main Idea:
    
III. Factors Affecting Wind
     Group #_____  
     Main Idea:
     
      A. Pressure Differences
         Group #_____  
         Main Idea:
         
      B. Coriolis Effect
         Group #_____  
         Main Idea:
         
      C. Friction
         Group #_____  
         Main Idea:
         
Section 19.2: Pressure Centers and Winds

I. Highs and Lows
   Group #_____  
   Main Idea:
   
   A. Cyclonic and Anticyclonic Winds
      Group #_____  
      Main Idea:
      
   B. Weather and Air Pressure
      Group #_____  
      Main Idea:
      
   C. Weather Forecasting
      Group #_____  
      Main Idea:
      
II. Global Winds
    Group #_____  
    Main Idea:
    
    A. Non-Rotating Earth Model
       Group #_____  
       Main Idea:
       
       Drawing__________________

       Drawing__________________

       Drawing__________________

       Drawing__________________

       Drawing__________________

       Drawing__________________

       Drawing__________________
B. Rotating Earth Model
   Main Idea: Group #_____ Drawing_______________

C. Influence of Continents
   Main Idea: Group #_____ Drawing_______________

Section 19.3: Regional Winds
I. Local Winds Group #_____ Main Idea:
   A. Land and Sea Breezes Group #_____ Main Idea: Drawing_______________
   B. Valley and Mountain Breezes Group #_____ Main Idea: Drawing_______________

II. How Wind Is Measured Group #_____ Main Idea:
   B. Wind Direction Group #_____ Main Idea: Drawing_______________
   B. Wind Speed Group #_____ Main Idea: Drawing_______________

III. El Nino and La Nina Group #_____ Main Idea:
   A. El Nino Group #_____ Main Idea: Drawing_______________
   B. La Nina Group #_____ Main Idea: Drawing_______________

IV. Global Distribution of Precipitation Group #_____ Main Idea: Drawing_______________
Section 18.1 Water in the Atmosphere

This section describes how water changes from one state to another. It also explains humidity and relative humidity.

Reading Strategy

In the table below, list what you know about water in the atmosphere and what you would like to learn. After you read, list what you have learned. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>What I Know</th>
<th>What I Would Like to Learn</th>
<th>What I Have Learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>b.</td>
<td>c.</td>
</tr>
<tr>
<td>d.</td>
<td>e.</td>
<td>f.</td>
</tr>
</tbody>
</table>

1. Circle the letter of the most important gas in atmospheric processes.
   a. oxygen   b. nitrogen
   c. water vapor   d. carbon dioxide

Water's Changes of State

2. Select the appropriate letter in the figure that identifies each of the following changes of state.
   _____ sublimation   _____ freezing
   _____ deposition   _____ evaporation
   _____ condensation   _____ melting

![Diagram of water's changes of state with heat values and states of matter.]
3. For each change of state, write the opposite change of state.
   a. condensation: ________________
   b. freezing: ________________
   c. deposition: ________________

4. The heat absorbed or released during a change of state is called ________________.

**Humidity**

5. Is the following sentence true or false? Saturated warm air contains more water vapor than saturated cold air.

6. What is the difference between humidity and relative humidity?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

**Match each situation to its change in relative humidity.**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Change in Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ 7. Water vapor is added</td>
<td>a. increases</td>
</tr>
<tr>
<td>_____ 8. Air temperature decreases</td>
<td>b. no change</td>
</tr>
<tr>
<td>_____ 9. Water vapor is removed</td>
<td>c. decreases</td>
</tr>
<tr>
<td>_____ 10. Air temperature increases</td>
<td>d. increases</td>
</tr>
</tbody>
</table>

11. When a parcel of air is cooled to the temperature at which it is saturated, it has reached its ________________.

12. Circle the letter of the factor that a hygrometer is used to measure.
   a. humidity
   b. relative humidity
   c. temperature
   d. latent heat

13. A sling psychrometer works because the amount of cooling that occurs in the wet bulb is directly proportional to the ________________ of the air.

14. What happens when air that has reached its dew point is cooled further? ____________________________________________________________

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Chapter 18  Moisture, Clouds, and Precipitation

Section 18.2 Cloud Formation

This section explains what happens when air is compressed and expanded. It also describes processes that lift air, how stable and unstable air behaves, and how condensation occurs.

Reading Strategy

As you read, write the main idea for each topic in the table below. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Main idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic temperature changes</td>
<td>a.</td>
</tr>
<tr>
<td>Stability measurements</td>
<td>b.</td>
</tr>
<tr>
<td>Degrees of stability</td>
<td>c.</td>
</tr>
</tbody>
</table>

Air Compression and Expansion

1. ☐ When a parcel of air is allowed to expand, it ________________.
2. Why does a parcel of air expand as it rises upward through the atmosphere?

3. Is the following sentence true or false? The rate of heating or cooling of saturated air is the dry adiabatic rate.

4. When a parcel of air reaches its dew point, the process of ________________ begins.

5. After a parcel of air rises past the condensation level, the rate of cooling decreases because of the release of latent ________________.

Processes That Lift Air

6. ☐ List four mechanisms that can cause air to rise.
7. Complete the table below.

<table>
<thead>
<tr>
<th>Processes That Lift Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
</tr>
<tr>
<td>Orographic lifting</td>
</tr>
<tr>
<td>Frontal wedging</td>
</tr>
<tr>
<td>Convergence</td>
</tr>
<tr>
<td>Localized convective lifting</td>
</tr>
</tbody>
</table>

8. What causes a rain shadow desert? ____________________________

9. A(n) ________________ is produced when two air masses collide.

10. Is the following sentence true or false? Localized convective lifting produces thermals that lift birds to great heights.
    ________________

**Stability**

11. ☐ A parcel of air that is less dense than the surrounding air is ________________ and will tend to rise.

12. ☐ Is the following sentence true or false? Unstable air tends to remain in its original position. ________________

13. Circle the letter of the sentence that best describes a temperature inversion.
   a. Air temperature increases with height.
   b. Air temperature decreases with height.
   c. Low-altitude air is unstable.
   d. High-altitude air is unstable.

14. Clouds associated with lifting of ________________ air often produce thunderstorms.

**Condensation**

15. ☐ For condensation to occur, air must be ________________.

16. Is the following sentence true or false? Above the ground, tiny particles called condensation nuclei serve as surfaces for water-vapor condensation. ________________
Section 18.3 Cloud Types and Precipitation

This section describes different types of clouds, including fog. It also explains how precipitation forms and describes different types of precipitation.

Reading Strategy
As you read, add definitions for the vocabulary terms. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Vocabulary Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cirrus</td>
<td>a.</td>
</tr>
<tr>
<td>Cumulus</td>
<td>b.</td>
</tr>
<tr>
<td>Stratus</td>
<td>c.</td>
</tr>
<tr>
<td>Coalescence</td>
<td>d.</td>
</tr>
</tbody>
</table>

Types of Clouds
1. ☑ Is the following sentence true or false? Clouds are classified based on form and height. ________________
2. The three types of ________________ clouds are cirrus, cirrostratus, and cirrocumulus.
3. Which photograph shows cumulus clouds? ____
4. Which photograph shows cirrus clouds? ____

A.  
B.  

© Pearson Education, Inc., publishing as Pearson Prentice Hall. All rights reserved.
5. How can you tell from the name of a cloud if it is a middle-range cloud?

6. Circle the letter of each cloud type that is a low cloud.
   a. stratus
   b. altostratus
   c. stratocumulus
   d. nimbostratus

Fog

7. Define fog. __________________________________________

8. Is the following sentence true or false? Fogs can be formed by cooling or by evaporation. __________

How Precipitation Forms

9. What must happen for precipitation to form? __________________________

10. Formation of precipitation in cold clouds is called the _____________ process.

11. Is the following sentence true or false? In warm clouds, raindrops form by the Bergeron process. _____________

12. Circle the letter of the word that describes water in the liquid state below 0ºC.
   a. supersaturated
   b. coalesced
   c. saturated
   d. supercooled

Forms of Precipitation

Match each description with its form of precipitation.

<table>
<thead>
<tr>
<th>Description</th>
<th>Form of Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. small particles of ice</td>
<td>a. hail</td>
</tr>
<tr>
<td>14. drops of water that fall from a cloud and have a diameter of at least 0.5 mm</td>
<td>b. sleet</td>
</tr>
<tr>
<td>15. ice pellets with multiple layers</td>
<td>c. rain</td>
</tr>
</tbody>
</table>
Chapter 19  Air Pressure and Wind

Section 19.1 Atmosphere Characteristics

This section explains what air pressure is and how it is measured. It also describes the factors that cause and control wind.

Reading Strategy

As you read, write the main ideas for each topic in the table. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Main Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure Defined</td>
<td>Air pressure is the weight of air above. It is exerted in all directions.</td>
</tr>
<tr>
<td>Measuring Air Pressure</td>
<td>a.</td>
</tr>
<tr>
<td>Factors Affecting Wind</td>
<td>b.</td>
</tr>
</tbody>
</table>

Air Pressure Defined

1. Air pressure is the pressure exerted by the ________________ of air above a certain point.

2. ☞ Why doesn’t the weight of air above a table crush it? ________________

   ________________

   ________________

   ________________

3. Is the following sentence true or false? Average air pressure is about the same as that produced by a column of water 10 m high. ________________

Measuring Air Pressure

4. Circle the letter of the instrument used to measure air pressure.
   a. thermometer
   b. barometer
   c. anemometer
   d. aneroidometer
5. When air pressure increases, the mercury in the tube of a mercury barometer ________________.
6. Is the following sentence true or false? The mercury barometer was invented by Galileo. ________________
7. List two advantages of the aneroid barometer over the mercury barometer. ________________

Factors Affecting Wind
8. Wind is caused by horizontal differences in ________________.
9. Is the following sentence true or false? Pressure differences that cause wind are generated by unequal heating of Earth’s surface. ________________
10. What three factors combine to control wind? ________________

11. How are isobars related to pressure gradients? ________________

12. Due to the Coriolis effect, winds in the Northern Hemisphere are deflected to the ________________.
13. Is the following sentence true or false? The Coriolis effect occurs because Earth rotates underneath the path of moving objects. ________________

15. ________________ are high-altitude fast-moving rivers of air that travel from west to east.
16. Complete the table below.

<table>
<thead>
<tr>
<th>Factors That Affect Wind</th>
<th>Ultimate Cause</th>
<th>Effect on Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Differences</td>
<td>unequal heating of Earth’s surface by the sun</td>
<td></td>
</tr>
<tr>
<td>Coriolis Effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chapter 19  Air Pressure and Wind

Section 19.2 Pressure Centers and Winds

This section describes cyclones, anticyclones, and global wind patterns.

Reading Strategy

As you read about pressure centers and winds, complete the table indicating to which hemisphere the concept applies. Use N for Northern Hemisphere, S for Southern Hemisphere, or B for both. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

| Cyclones rotate counterclockwise. | a. |
| Net flow of air is inward around a cyclone. | b. |
| Anticyclones rotate counterclockwise. | c. |
| Coriolis effect deflects winds to the right. | d. |

Highs and Lows

1. Cyclones are centers of ______________ pressure associated with clouds and precipitation.

2. ☐ Is the following sentence true or false? In an anticyclone, the value of the isobars increases from the center to the outside.

   ☐

3. ☐ List the factors that cause winds in the Northern Hemisphere to blow inwards and counterclockwise around lows.

   ☐

4. ☐ Is the following sentence true or false? In the Southern Hemisphere, winds around a cyclone flow outward.

   ☐

5. These figures show side views of the air movement in a high and low. Select the letter of the figure that identifies each of the following air movements.

   ☐ surface low
   ☐ divergence aloft
   ☐ surface high
   ☐ surface divergence
   ☐ calm, clear weather

A.

B.
6. Why do weather reports always emphasize cyclones and anticyclones?

Global Winds

7. How does the atmosphere balance the amounts of energy received at different parts of Earth’s surface?

8. Is the following sentence true or false? Earth’s rotation causes the two-cell convection system to break down into smaller cells.

9. Select the appropriate letter in the figure that identifies each part of the global circulation model.
   - NE trade winds
   - polar easterlies
   - equatorial low
   - westerlies
   - subtropical high
   - SE trade winds
   - subpolar low

10. In which zone in the figure does sinking dry air produce deserts in some areas?

11. Circle the letter of the winds near the equator that blow from easterly directions.
   - a. jet streams
   - b. westerlies
   - c. trade winds
   - d. polar easterlies

12. The interaction of westerlies and polar easterlies produces the _____________.

13. Is the following sentence true or false? Inward and upward airflow at the equatorial zone is associated with clouds and precipitation.


15. What causes monsoons?

Name ___________________________ Class ___________________ Date _____________

Chapter 19  Air Pressure and Wind

Earth Science Guided Reading and Study Workbook  •  142
Section 19.3 Regional Wind Systems

This section discusses local winds and how wind is measured. It also explains El Niño and La Niña.

Reading Strategy

Before you read, use Figure 17 on page 547 to locate examples of the driest and wettest regions of Earth. After you read, identify the dominant wind system for each location. For more information on this Reading Strategy, see the Reading and Study Skills in the Skills and Reference Handbook at the end of your textbook.

<table>
<thead>
<tr>
<th>Precipitation</th>
<th>Location</th>
<th>Dominant Wind System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely low</td>
<td>a.</td>
<td>b.</td>
</tr>
<tr>
<td>Extremely high</td>
<td>c.</td>
<td>d.</td>
</tr>
</tbody>
</table>

Local Winds

1. ______________ are small-scale winds produced by a locally generated pressure gradient.

2. ☐ List two causes of local winds. ________________________________________________________________

Match each description with its local wind.

<table>
<thead>
<tr>
<th>Description</th>
<th>Local Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. During the day, heated air along mountain slopes rises.</td>
<td>a. land breeze</td>
</tr>
<tr>
<td>4. During the day, heated air over land rises, allowing cooler air to move in from over water.</td>
<td>b. sea breeze</td>
</tr>
<tr>
<td>5. At night, air over land cools and moves out over water.</td>
<td>c. valley breeze</td>
</tr>
<tr>
<td>6. At night, cooled air along mountain slopes moves downward.</td>
<td>d. mountain breeze</td>
</tr>
</tbody>
</table>

7. Circle the letter of the locations where the coldest air pockets usually can be found.
   a. valley floors
   b. mountain peaks
   c. mountainsides
   d. plains
8. Does the figure show a land breeze or a sea breeze? Explain your answer.

   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

   How Wind Is Measured
9. What is a prevailing wind? _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

10. In the United States, the __________ move weather from west to east.

11. Circle the letter of the instrument used to measure wind speed.
   a. thermometer  b. barometer  c. anemometer  d. wind vane

El Niño and La Niña
12. An episode of ocean warming that affects the eastern tropical Pacific is called __________.

13. Is the following sentence true or false? El Niño episodes occur at irregular intervals of 3 to 7 years. ______________

14. What conditions trigger a La Niña episode? _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

Global Distribution of Precipitation
15. How are rain forests related to wind patterns? _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________

16. Is the following sentence true or false? Areas dominated by subtropical low-pressure cells are often deserts. ______________