THE WEATHER
AIM 3: How can we predict the weather?

HW
- Read “How Can We Predict the Weather?” p169-172
- Do all questions on Part A&B-1 on p172-174
- Read “Can We Learn to Live with Natural Hazards?” p175-178
- Do all questions on Part A on p178&179

Review Unit
- Do all Chapter Review Questions p179-183

Fronts are the leading edges of moving air masses.

A **cold front** is produced when an advancing mass of cold air pushes warmer air above.
- The rising warm air forms clouds and intense but short precipitation occurs.
- A cold front moves quickly in a matter of an hour or two.

A **warm front** is produced when warm air flows in to replace a retreating cold air mass.
- The rising warm air forms clouds and long lasting precipitation occurs.
- A warm front moves slowly in a matter of several days.
A stationary front occurs where the winds blow in opposite directions along a boundary between warm and cold air masses.

- Stationary fronts bring unsettled weather.

![Stationary Front Diagram](image)

An occluded front is produced when an advancing cold air mass pushes a lighter warm air mass completely above the ground.

- Occluded fronts bring rainy weather.

![Occluded Front Diagram](image)

Meteorologists make extensive use of technology to observe and predict the weather.

- Thermometers
- Rain gauges
- Wind gauges
- Barometers
- Weather balloons
- Radars
- Satellite photographs
- Computers
The more information meteorologists have about recent weather conditions, the more reliable their forecasts become.

A high pressure system "H" brings cool and dry air with clear skies and stable conditions.
- Highs are zones of divergence where sinking air at the center causes the winds to blow outward.

A low pressure system "L" brings warm and moist air with cloudy skies, and precipitation.
- Lows are zones of convergence where rising air at the center causes winds to blow inwards.
Weather systems usually move across the United States from west to east. Ex: See weather maps below

Test your understanding

8/07

Base your answers to questions 36 and 37 on the graph below, which shows air temperature, dewpoint, and present weather conditions for a 23-hour period at Dallas, Texas.

36 The thunderstorm that occurred between 11 p.m. and 12 midnight was most likely the result of
   (1) the arrival of a warm front
   (2) the arrival of a cold front
   (3) an increase in the difference between air temperature and dewpoint
   (4) an increase in both air temperature and dewpoint

37 Which weather condition was reported at Dallas when the air temperature was equal to the dewpoint?
   (1) fog (2) rain (3) thunderstorm (4) drizzle

Base your answers to questions 68 and 69 on the barogram below, which shows air pressure recorded in millibars at Green Bay, Wisconsin, from April 2 through April 4, 1982.
68 Calculate the rate of change in air pressure from 10 a.m. to 8 p.m. on April 3. Label your answer with the correct units.

69 What most likely caused the changes in air pressure for the period of time shown on the graph?

6/07

Base your answers to questions 51 through 53 on the weather map below. The weather map shows a low pressure system in New York State during July. The L represents the center of the low-pressure system. Two fronts extend from the center of the low. Line XY on the map is a reference line.

51 The cross section below shows a side view of the area along line XY on the map. On lines 1 and 2 in the cross section, place the appropriate two-letter air-mass symbols to identify the most likely type of air mass at each of these locations.
The forecast for one city located on the map is given below: “In the next hour, skies will become cloud covered. Heavy rains are expected with possible lightning and thunder. Temperatures will become much cooler.” State the name of the city for which this forecast was given.

Identify one action that people should take to protect themselves from lightning.

The map below shows the boundary between two air masses. The arrows show the direction in which the boundary is moving.

Which weather map uses the correct weather front symbol to illustrate this information?

Base your answers to questions 13 and 14 on the weather map below, which shows a low-pressure system centered near Poughkeepsie, New York. Isobars shown are measured in millibars.

13 Which city is most likely experiencing winds of the greatest velocity? (1) New York City (2) Binghamton (3) Poughkeepsie (4) Scranton

14 Surface winds are most likely blowing from

(1) Danbury toward New York City (2) Poughkeepsie toward Scranton (3) Binghamton toward Danbury (4) Port Jervis toward Binghamton

Base your answers to questions 67 through 71 on the passage below, which describes a tornado produced from a thunderstorm that moved through a portion of New York State on May 31, 1998.

New York Tornado

A small tornado formed and moved through the town of Apalachin, New York, at 5:30 p.m., producing winds between 40 and 72 miles per hour. The tops of trees were snapped off, and many large limbs fell to the ground. The path of the destruction measured up to 200 feet wide. At 5:45 p.m., the tornado next moved through the town of Vestal where winds ranged between 73 and 112 miles per hour. Many people experienced personal property damage as many homes were hit with flying material. At 6:10 p.m., the tornado moved close to Binghamton, producing winds between 113 and 157 miles per hour. A 1000-foot television tower was pushed over, and many heavy objects were tossed about by the strong winds. Then the tornado lifted off the ground for short periods of time and bounced along toward the town of Windsor. At 6:15 p.m., light damage was done to trees as limbs fell and small shallow-rooted trees were pushed over in Windsor. The tornado increased in strength again at 6:20 p.m. as it moved into Sanford. Some homes were damaged as their roof shingles and siding were ripped off. One mobile home was turned over on its side. The tornado moved through the town of Deposit at 6:30 p.m., creating a path of destruction 200 yards wide. The tornado skipped along hilltops, touching down occasionally on the valley floors. However, much damage was done to homes as the...
tornado’s winds reached their maximum speeds of 158 to 206 miles per hour. The tornado weakened and sporadically touched down after leaving Deposit. By 7:00 p.m., the tornado had finally ended its 1-hour rampage. 

67 On the map below, draw the path of the tornado and the direction the tornado moved, by following the directions below.

- Place an X through the point for each of the six towns mentioned in the passage.
- Connect the Xs with a line in the order that each town was mentioned in the passage.
- Place an arrow at one end of your line to show the direction of the tornado’s movement.

68 The tornado mentioned in this passage was produced by cold, dry air from Canada quickly advancing into warm, moist air already in place over the northeastern United States. List the two-letter air-mass symbols that would identify each of the two air masses responsible for producing this tornado.

69 Which type of front was located at the boundary between the advancing cold, dry air mass and the warm, moist air mass?

70 Using the Fujita Scale shown below and the information in the passage, complete the table below, by assigning an F-Scale number for the tornado as it passed through each town given in the table.

<table>
<thead>
<tr>
<th>Town</th>
<th>F-Scale Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vestal</td>
<td></td>
</tr>
<tr>
<td>Windsor</td>
<td></td>
</tr>
<tr>
<td>Sanford</td>
<td></td>
</tr>
<tr>
<td>Deposit</td>
<td></td>
</tr>
</tbody>
</table>

Fujita Scale

<table>
<thead>
<tr>
<th>F-Scale Number</th>
<th>Wind Speed (mph)</th>
<th>Type of Damage Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-0</td>
<td>40–72</td>
<td>some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards</td>
</tr>
<tr>
<td>F-1</td>
<td>73–112</td>
<td>peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed</td>
</tr>
<tr>
<td>F-2</td>
<td>113–157</td>
<td>considerable damage; roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated</td>
</tr>
<tr>
<td>F-3</td>
<td>158–206</td>
<td>roof and some walls torn off well-constructed homes; trains overturned; most trees in forest uprooted</td>
</tr>
<tr>
<td>F-4</td>
<td>207–260</td>
<td>well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated</td>
</tr>
<tr>
<td>F-5</td>
<td>261–318</td>
<td>strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100 meters; trees debarked; steel-reinforced concrete structures badly damaged</td>
</tr>
</tbody>
</table>

71 Calculate the tornado’s average rate of travel, in miles per minute, between Vestal and Windsor, by using the equation below. Express your answer to the nearest tenth.

tornado’s rate of travel = \frac{\text{distance between Vestal and Windsor (miles)}}{\text{time (minutes)}}

1/06

20 Which list correctly matches each instrument with the weather variable it measures?
Base your answers to questions 36 through 38 on the weather map below and on your knowledge of Earth science. The weather map shows a typical low-pressure system and associated weather fronts labeled A and B. The L indicates the center of the low-pressure system. A few New York State cities are shown. Symbols cP and mT represent different air masses. The wind direction at Utica and Rochester is shown on the station models.

36 Which front symbols are drawn correctly, based on the air masses shown?

37 If this weather system is following a normal storm track, the center of this low is most likely moving toward which city?
(1) Buffalo (2) Ithaca (3) Utica (4) Plattsburgh

38 Which map shows the regions that are most likely experiencing the precipitation associated with this weather system?
Base your answers to questions 46 through 50 on the two cross sections below, which represent the Pacific Ocean and the atmosphere near the Equator during normal weather (cross section A) and during El Niño conditions (cross section B). Sea surface temperatures (SST) are labeled and trade-wind directions are shown with arrows. Cloud buildup indicates regions of frequent thunderstorm activity. The change from normal sea level is shown at the side of each diagram.

46 Which statement correctly describes sea surface temperatures along the South American coast and Pacific trade winds during El Niño conditions?

(1) The sea surface temperatures are warmer than normal, and Pacific trade winds are from the west.
(2) The sea surface temperatures are warmer than normal, and Pacific trade winds are from the east.
(3) The sea surface temperatures are cooler than normal, and Pacific trade winds are from the west.
(4) The sea surface temperatures are cooler than normal, and Pacific trade winds are from the east.

47 Compared to normal weather conditions, the shift of the trade winds caused sea levels during El Niño conditions to

(1) decrease at both Australia and South America
(2) decrease at Australia and increase at South America
(3) increase at Australia and decrease at South America
(4) increase at both Australia and South America

48 During El Niño conditions, thunderstorms increase in the eastern Pacific Ocean region because the warm, moist air is

(1) less dense, sinking, compressing, and warming
(2) less dense, rising, expanding, and cooling
(3) more dense, sinking, compressing, and warming
(4) more dense, rising, expanding, and cooling
49 The development of El Niño conditions over this region of the Pacific Ocean has caused
   (1) changes in worldwide precipitation patterns  (2) the reversal of Earth's seasons
   (3) increased worldwide volcanic activity  (4) decreased ozone levels in the atmosphere

50 Earth's entire equatorial climate zone is generally a belt around Earth that has
   (1) high air pressure and wet weather  (2) high air pressure and dry weather
   (3) low air pressure and wet weather  (4) low air pressure and dry weather

51 The atmospheric conditions at a given location are represented by the weather station model below.

Fill in the correct information for each variable listed, based on this weather station model.
   Air pressure:  Air temperature:  Amount of precipitation during last six hours:
   Cloud cover:  Present weather:

Base your answers to questions 72 and 73 on the weather map provided in your answer booklet, which shows a large white band of clouds moving toward the southeast. The line shown in the middle of the white cloud band is the frontal boundary between a cP air mass and an mT air mass. Two large arrows show the direction the front is moving.

72 On the frontal boundary line on the weather map below, draw the weather front symbol to represent the front moving toward the southeast.

73 On the same weather map, place an X centered on the geographic region that was most likely the source of the warm, moist (mT) air mass.

11 Weather-station measurements indicate that the dew point temperature and air temperature are getting farther apart and that air pressure is rising. Which type of weather is most likely arriving at the station?
   (1) a snowstorm  (2) a warm front  (3) cool, dry air  (4) maritime tropical air

Base your answers to questions 57 through 58 on the weather map below, which shows a weather system over the northeastern United States and weather data for several locations. Isobars show a low-pressure (L) center. Point X is a location in Canada.
57 Describe the five specific weather conditions for Charleston indicated by the station model on the weather map. Complete the chart below and include appropriate units where necessary.

<table>
<thead>
<tr>
<th>Weather Conditions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Air temperature</td>
<td></td>
</tr>
<tr>
<td>(2) Present weather</td>
<td></td>
</tr>
<tr>
<td>(3) Wind speed</td>
<td></td>
</tr>
<tr>
<td>(4) Wind direction</td>
<td>From</td>
</tr>
<tr>
<td>(5) Cloud cover</td>
<td></td>
</tr>
</tbody>
</table>

58 Describe how clouds form when warm, humid air rises along the cold front.
   a Include the terms dewpoint and either expansion or expands in your answer.
   b State the phase change that occurs at the dewpoint.

8/03

Base your answers to questions 37 through 39 on the weather map below, which shows air temperature and winds for a few locations in the eastern half of the United States. A large low-pressure system is shown on the map.

37 Surface winds within this low-pressure system generally flow
   (1) clockwise and toward the center of the system                        (2) clockwise and away from the center of the system
   (3) counterclockwise and toward the center of the system           (4) counterclockwise and away from the center of the system

38 Which type of front extends eastward from the low-pressure center? (1) cold (2) warm (3) occluded (4) stationary

39 If the low-pressure center follows a typical storm track, it will move toward the (1) southwest (2) southeast (3) northwest (4) northeast

6/03

Base your answers to questions 19 and 20 on the satellite image below, which shows cloud patterns associated with weather fronts over the United States on a certain day. The states of Nebraska (NE) and New York (NY) have been labeled.
19 At the time this satellite image was taken, what were the weather conditions in New York State?
   (1) clear skies with no precipitation  (2) mostly cloudy in the northern part of the State and clear in the southern part
   (3) cloudy with heavy precipitation  (4) very cloudy with no precipitation

20 Which type of front was producing the weather in Nebraska when this image was taken?
   (1) cold front  (2) warm front  (3) stationary front  (4) occluded front

Base your answers to questions 70 through 73 on the atmospheric cross section below, which represents a winter storm system. Zones A, B, C, and D are located on a west to east line at approximately 43’ N latitude across New York State. This cross section shows how solid and liquid forms of precipitation depend on the air temperature above Earth’s surface. The storm is moving from west to east.

70 Explain why sleet is occurring in Zone B

71 At the time of the events represented by the cross section, Syracuse, New York, is experiencing the following weather conditions:

<table>
<thead>
<tr>
<th>Cloud cover</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind speed</td>
<td>15 knots</td>
</tr>
<tr>
<td>Present weather</td>
<td>Freezing rain</td>
</tr>
<tr>
<td>Precipitation</td>
<td>1.23 inches past 6 hours</td>
</tr>
<tr>
<td>Visibility</td>
<td>1 mile</td>
</tr>
</tbody>
</table>
The temperature, dewpoint, and wind direction are shown on the weather station model below. Using proper format, add the information shown in the table to the model.

72 As the storm moves eastward, the type of precipitation received in Syracuse changes. State the type of precipitation that will immediately follow freezing rain.
73 Describe the general air movement and temperature change that caused the clouds associated with this storm to form.
8/02
56 The weather map below shows a typical mid-latitude low-pressure system centered in Illinois.

On the weather map below:
   a) indicate which boxed area has the highest surface air temperatures by marking an X in one of the four boxes on the map.
   b) draw an arrow to predict the normal storm track that this low-pressure center would be expected to follow.

Base your answers to questions 26 through 28 on the weather map of North America below. The map shows the location of a front and the air mass influencing its movement.
26 Which region is the probable source of the air mass labeled cP on the map?
   (1) central Canada (2) southwestern United States (3) North Atlantic Ocean (4) Gulf of Mexico
27 Which type of front and frontal movement is shown on the weather map?
   (1) cold front moving northwestward  (2) cold front moving southeastward
   (3) warm front moving northwestward  (4) warm front moving southeastward
28 The cP air mass is identified on the basis of its temperature and (1) wind direction  (2) cloud cover
   (3) moisture content (4) windspeed
29 Which type of front extends southward from the center of the low?
   (1) occluded  (2) stationary  (3) warm  (4) cold