Name: _____ Laboratory Section: _____

Date: _____ Score/Grade: _____

Video
Exercise 11
Pre-Lab Video
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LAB EXERCISE

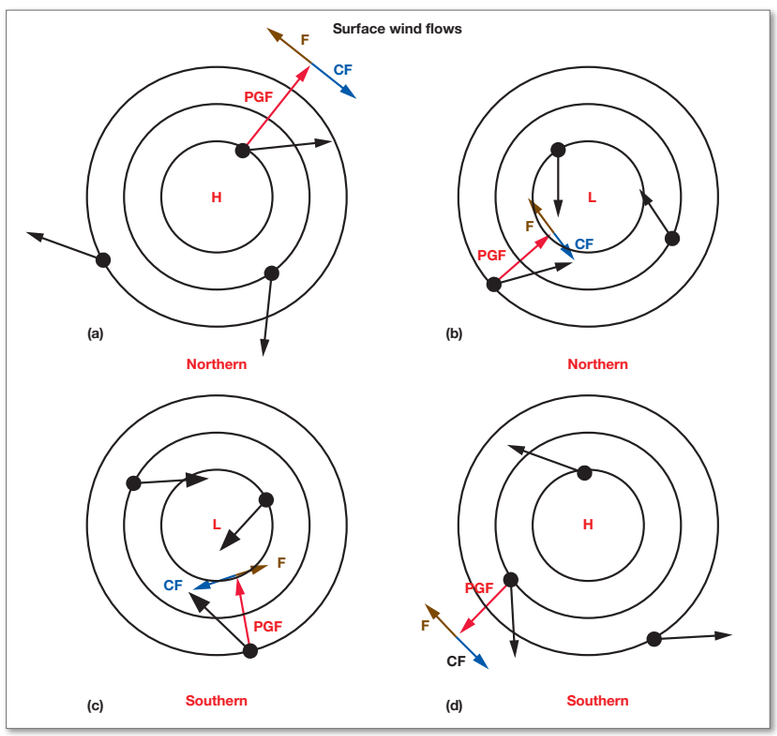
11 Earth's Atmosphere: Pressure and Wind Patterns

Lab Exercise and Activities

SECTION 1

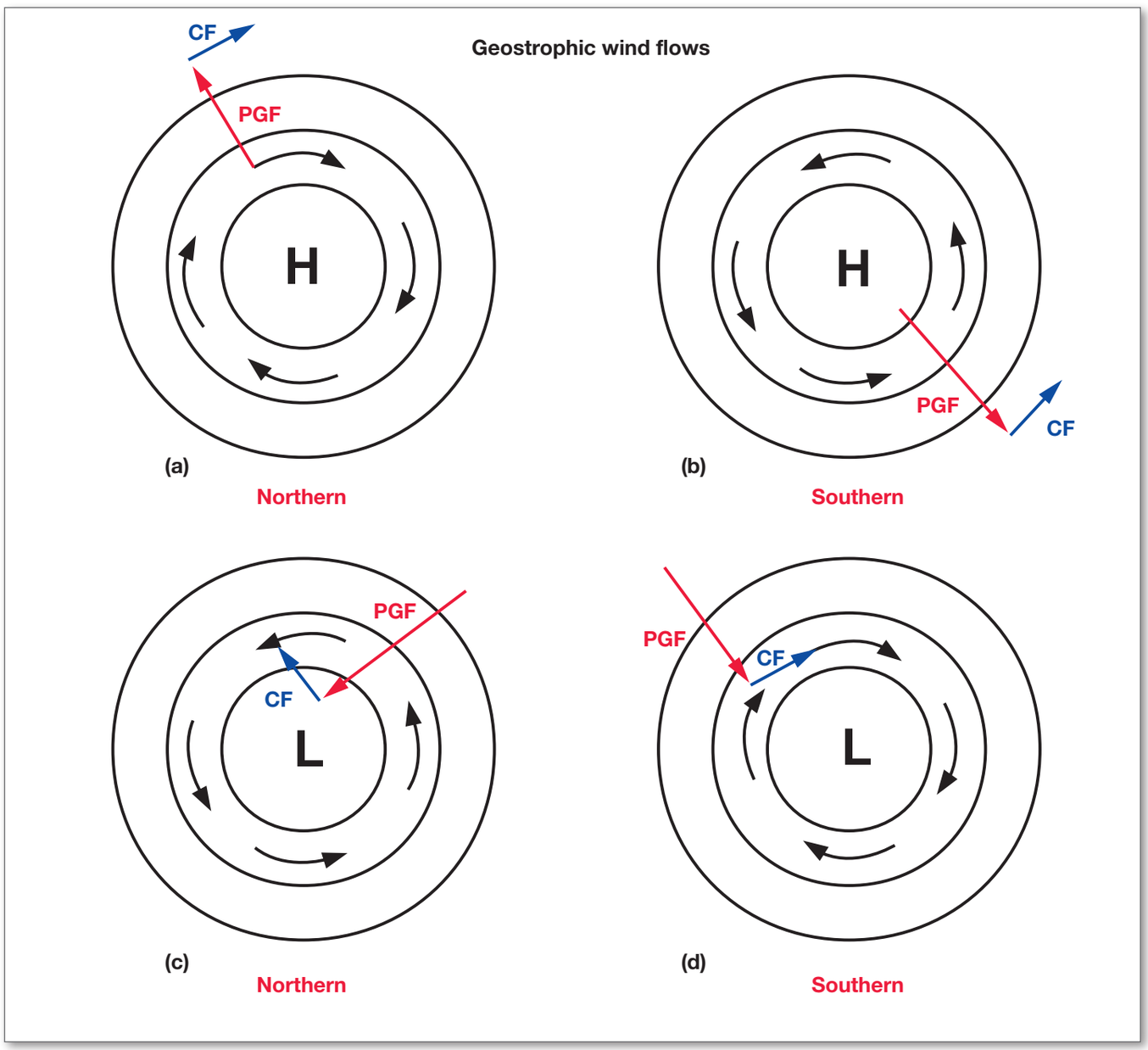
Driving Forces Within the Atmosphere and Wind Patterns

1. Figure 11.2 shows surface wind flow in the Northern and Southern Hemispheres. Place an H or an L in the center of each example to indicate what type of pressure is shown and write the name of the correct hemisphere below each of the examples. Pick one arrow from each example and draw your own arrows to indicate the pressure-gradient force in red, Coriolis force in blue, and friction in brown for that figure, or colors as indicated by your professor, as shown in Figure 11.2a. Label the pressure-gradient force arrow with PGF, the Coriolis force arrow with CF, and the friction with F.



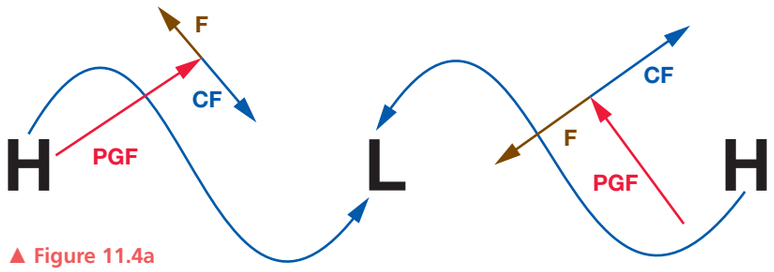
▲ Figure 11.2

2. Figure 11.3 shows geostrophic wind flows. Write the name of the correct hemisphere under each figure. Pick one arrow from each example and draw your own arrows to indicate the pressure-gradient force in red and the Coriolis force in blue for that figure, or colors as indicated by your professor, as shown in Figure 11.3a. Label the pressure-gradient force arrow with PGF and the Coriolis force arrow with CF.



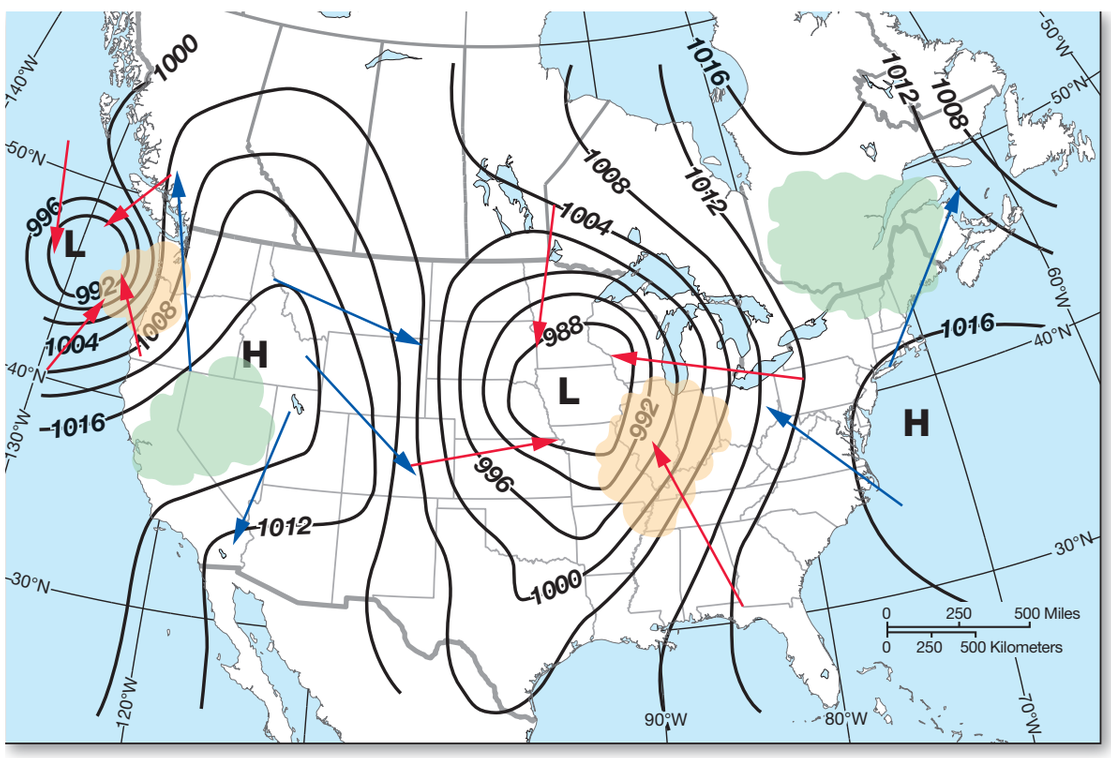
▲ Figure 11.3

3. Questions 3 and 4 involve patterns of wind at the surface, where wind moves at a 45-degree angle to the pressure gradient force. Draw the pressure-gradient force in red, Coriolis force in blue, friction in brown, and the resulting flow of wind in blue, from the two high-pressure cells toward the low-pressure cell in the center of **Figure 11.4a** below.



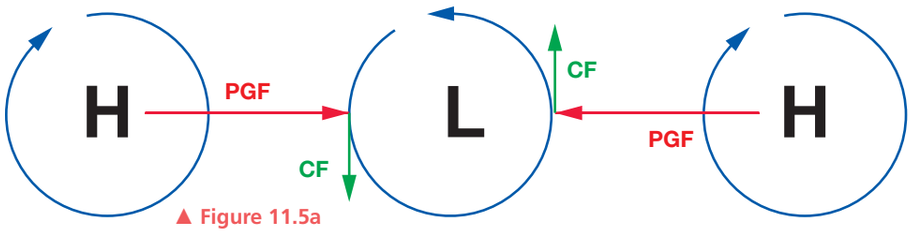
▲ Figure 11.4a

4. **Figure 11.4b** shows the surface pressure conditions on October 18, 2007. Using a red pencil, draw at least two arrows to show the directions of winds flowing from the high-pressure center over Idaho and Nevada into the low-pressure center off of the Pacific Northwest, and draw two more arrows showing the directions of winds flowing from the same high-pressure center into the low-pressure center over Iowa. Remember that surface winds flow at a 45° angle to the pressure gradient. Draw at least two red arrows to show wind flowing out of the high-pressure center off the east coast toward the low-pressure center over Iowa. Using an orange pencil, shade at least two regions with closely spaced isobars, indicating a steep pressure gradient. Using a green pencil, shade at least two regions with widely spaced isobars.



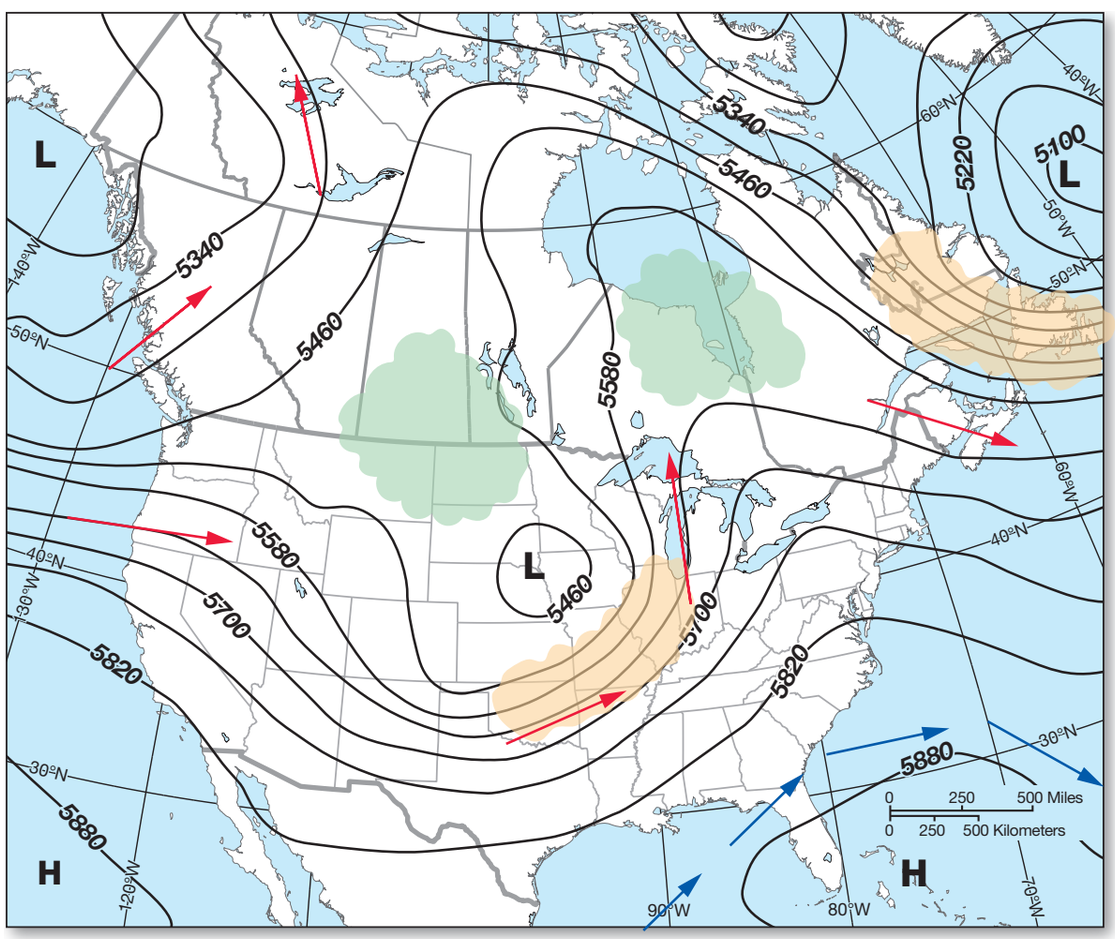
▲ Figure 11.4b

5. Questions 5 and 6 involve upper-level or geostrophic winds, which occur higher than 500 m (1600 ft). Because of the absence of friction, winds here flow parallel to the isobars, rather than at a 45-degree angle like surface winds. Draw the pressure-gradient force in red, Coriolis force in green, and the resulting flow of wind in blue, from the two high-pressure cells toward the low-pressure cell in the center of Figure 11.5a below.



▲ Figure 11.5a

6. Figure 11.5b shows the 500-mb chart for the same day. The 500-mb chart shows the position of high- and low-pressure regions and the pressure gradient. The 500-mb chart shows how many meters above sea level the 500-mb surface is rather than showing actual pressures, as the surface chart does. Draw two red arrows to show the direction of wind between the 5340 m and 5460 m height contours, and another two red arrows between the 5580 m and 5640 m height contours. Remember that wind flows parallel to the isobars in the upper atmosphere. Draw three blue arrows between the 5820 m and 5880 m contours to show the direction of wind flowing around the centers of high pressure. Using an orange pencil, shade at least two regions with closely spaced isobars, indicating a steep pressure gradient. Using a green pencil, shade at least two regions with widely spaced isobars.



▲ Figure 11.5b

SECTION 2

Air Pressure Map Analysis

1. Use the four graphs in **Figures 11.8a**, **11.8b**, **11.9a**, and **11.9b** to plot pressure data along two parallels and two meridians as noted; then complete the pressure profile with a line graph connecting the plotted data points every 20°:

   a) January (Figure 11.6), along 50°N parallel (already done for you)

   b) January (Figure 11.6), along 90°W meridian

   c) July (Figure 11.7), along 40°N parallel

   d) July (Figure 11.7), along 60°E meridian

   After completing the plotting of pressure data on graphs in Figures 11.8a, 11.8b, 11.9a, and 11.9b, complete the following.

2. Using these maps and your textbook, explain the patterns of average atmospheric pressure over the landmasses. Are the patterns of high and low pressure caused by thermal or dynamic forces?

   a) January: ***Anticyclonic high-pressure systems dominate Northern Hemisphere landmasses.***

   b) July: ***Pressures are generally lower than in January as cyclonic systems dominate Northern Hemisphere landmasses.***

3. Using Figures 11.6 and 11.7, label the primary subtropical high-pressure and low-pressure cells in the Northern Hemisphere. Draw and label the primary wind systems in the midlatitudes and tropics.

   For Figure 11.7, draw arrows indicating the monsoonal flow of air from the Indian Ocean northward into India and the Tibetan Plateau.

4. During the Southern Hemisphere summer, describe the pressure gradient over the Southern Ocean (South Pacific and South Atlantic Oceans). What kind of wind speeds do you think this gradient produces?

   The extreme pressure gradient from 984 mb to 1024 mb produces strong winds from subpolar to midlatitudes—known as the "roaring forties."

5. Refer to the global air temperature profiles you plotted in Section 2 of Lab Exercise 9 (temperature maps in **Figure 9.2a** (January) and **9.2b** (July), and your graphs in **Figures 9.3a** and **9.3b** and **Figures 9.4a** and **9.4b**). Those temperature profiles in Lab Exercise 9 and these pressure profiles you just completed for this exercise are along the same parallels and meridians.

Comparing the two sets of graphs (**Figures 9.3** and **9.4** with Figures 11.8 and 11.9), what correlation can be seen between global temperature and pressure patterns? Select a few areas that seem to illustrate a link between your graphs.

Where temperatures are high, pressures may be relatively low and where temperatures are low, pressures may be relatively high.

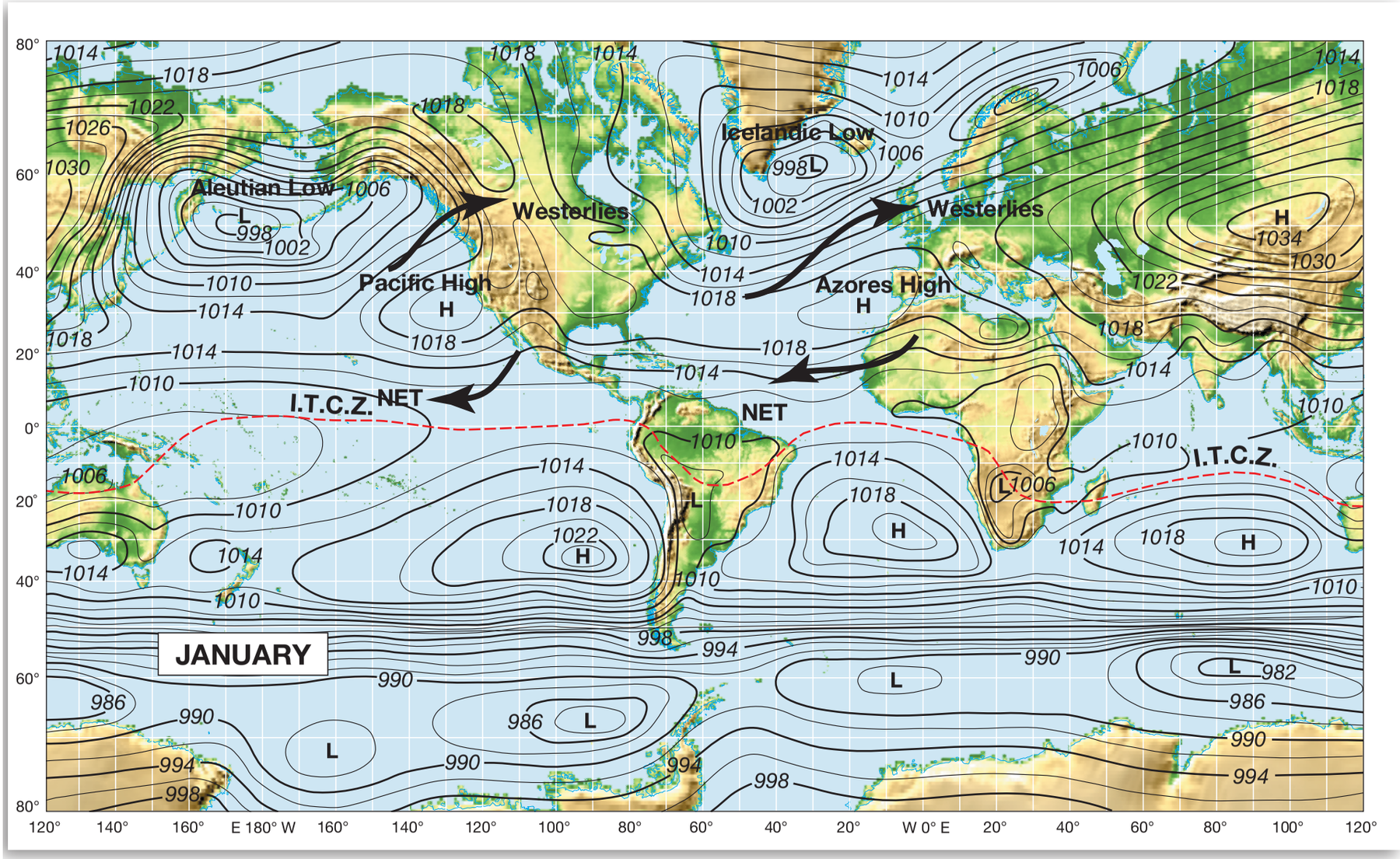
The following pages contain:

Figure 11.6: January world pressure map

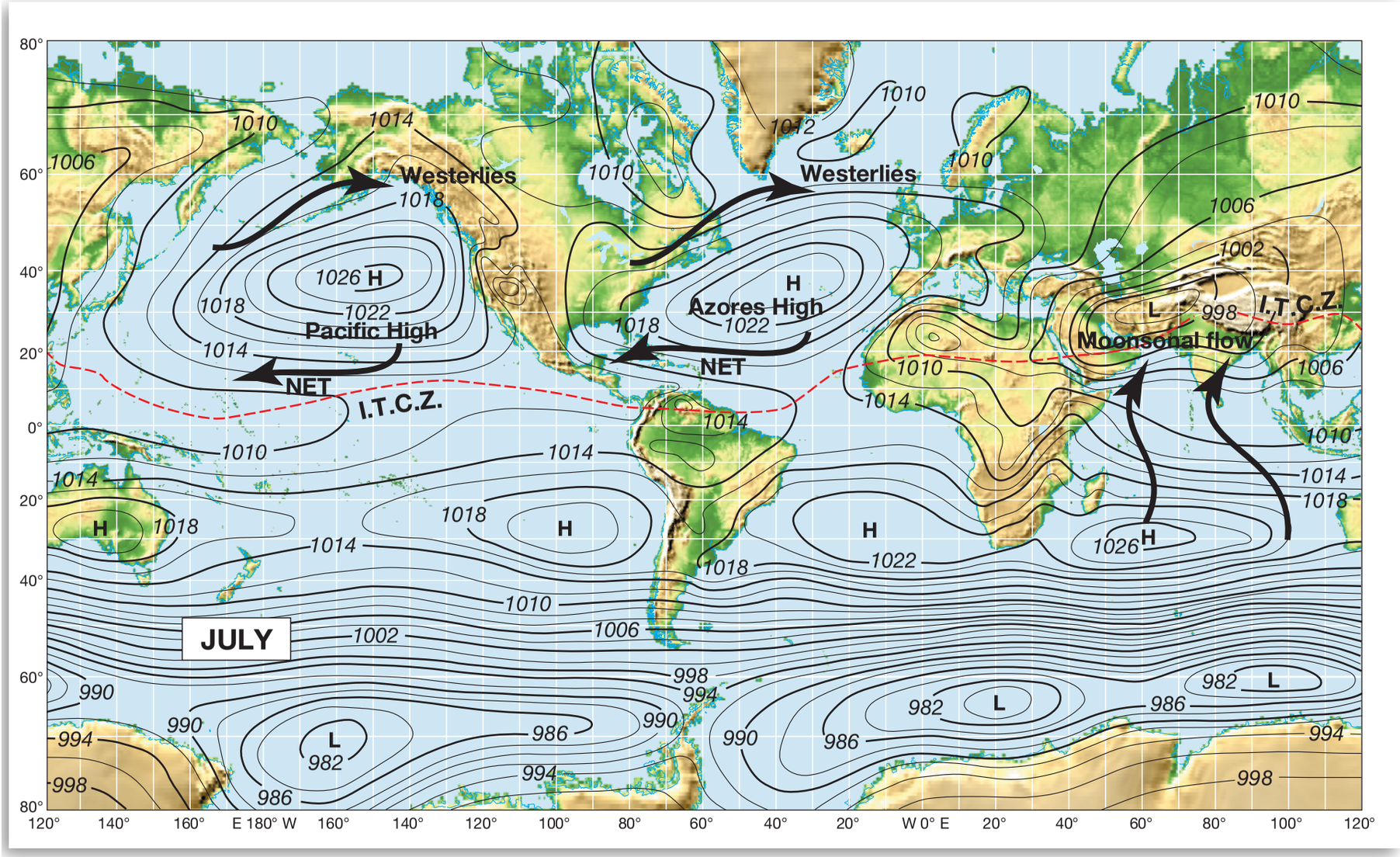
Figure 11.7: July world pressure map

Figures 11.8a and 11.8b: plots for 50°N and for 90°W (11.8a and 11.8b are completed for you)

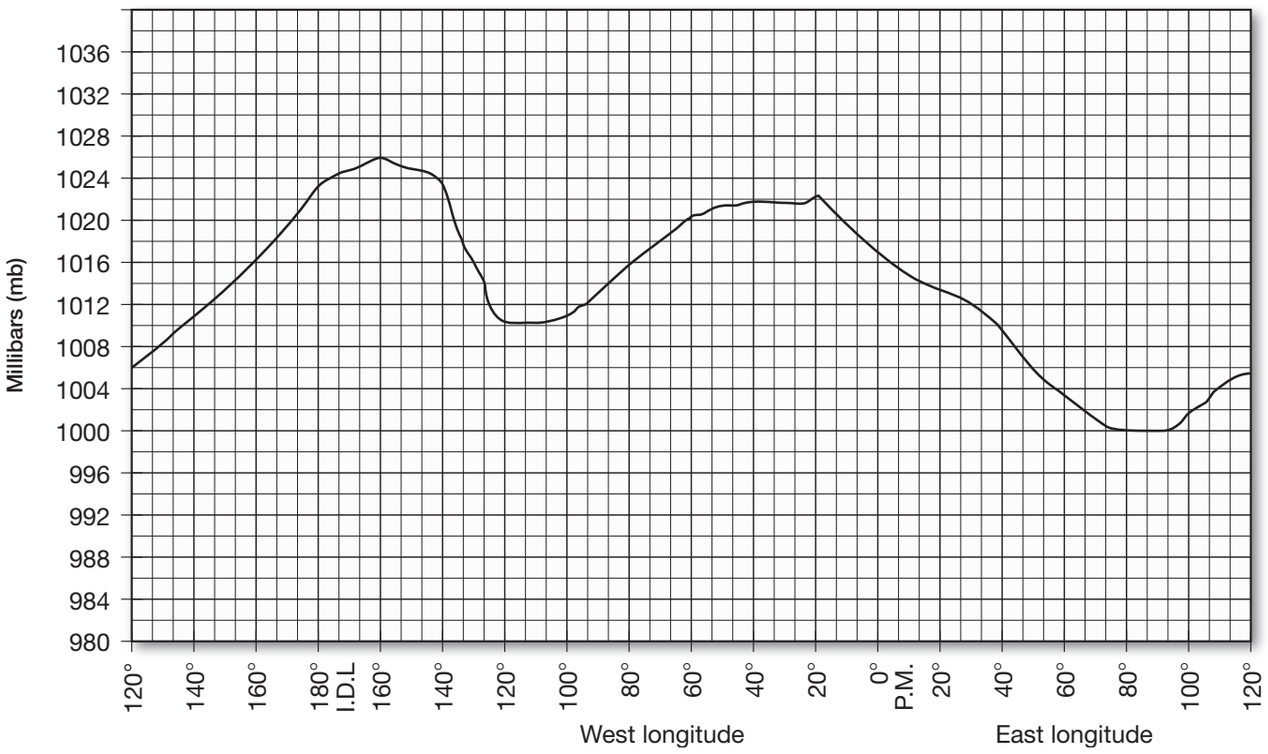
Figures 11.9a and 11.9b: plots for 40°N and 60°E



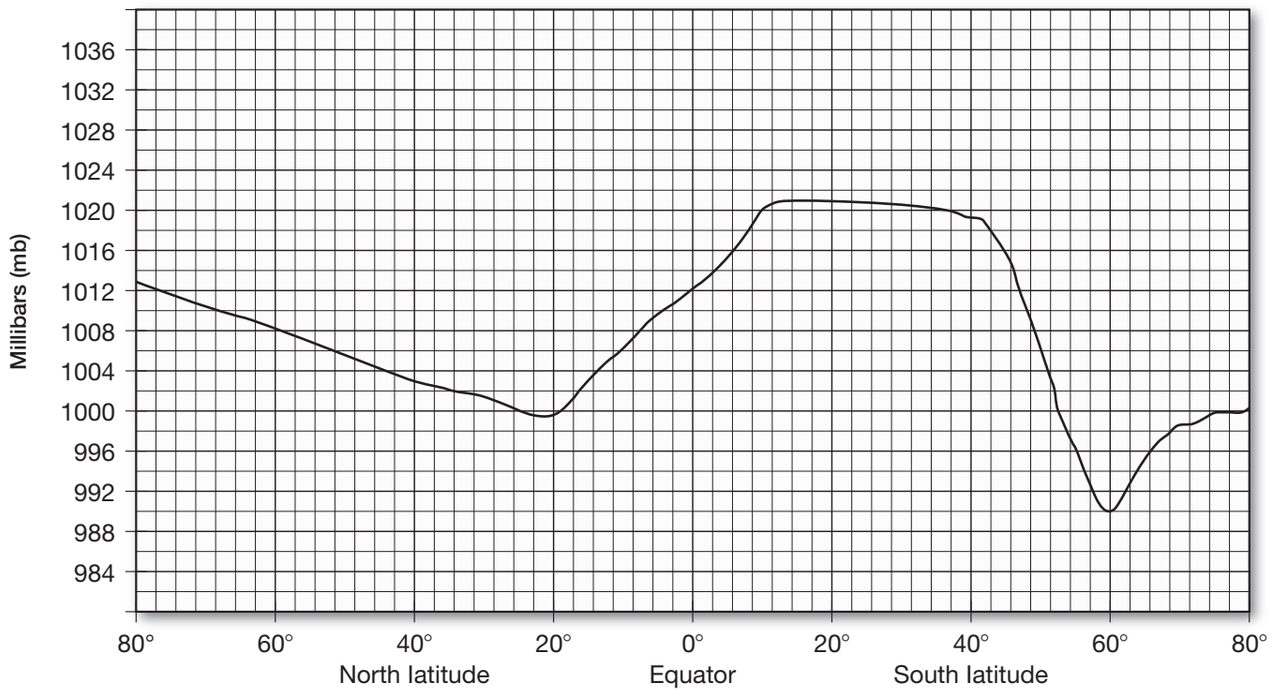
▲ **Figure 11.6** Global barometric pressure for January



▲ **Figure 11.7** Global barometric pressure for July



▲ **Figure 11.9a** Plot of average air pressure along 40°N latitude for July



▲ **Figure 11.9b** Plot of average air pressure along 60°E longitude for July