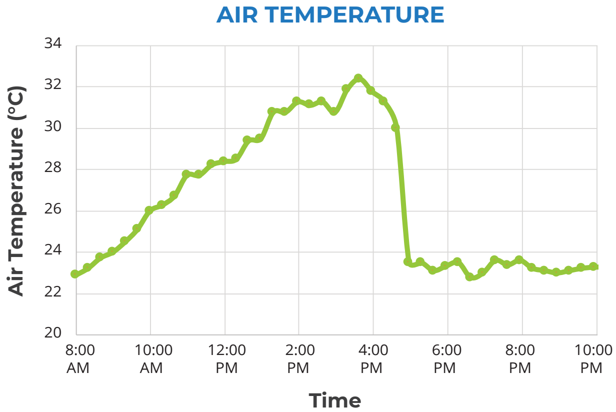
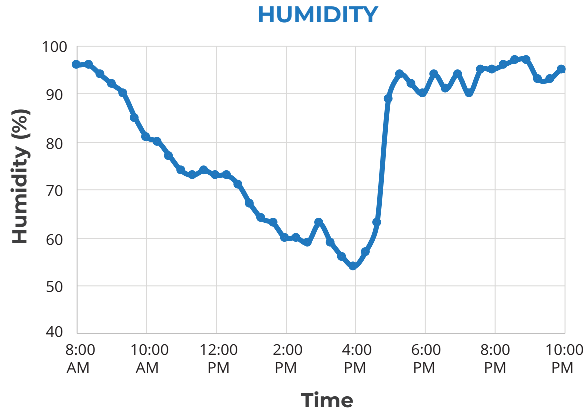
Name Period Date

Learning Sequence 1 Assessment: From Cloud to Storm

An isolated storm happened in Rockwall, Texas, on August 26, 2017. The graphs below show how humidity and air temperature changed during the day. Use the data in the graphs below to answer the following questions.





1. What time do you think the storm occurred? Explain your reasoning using the temperature and humidity data.

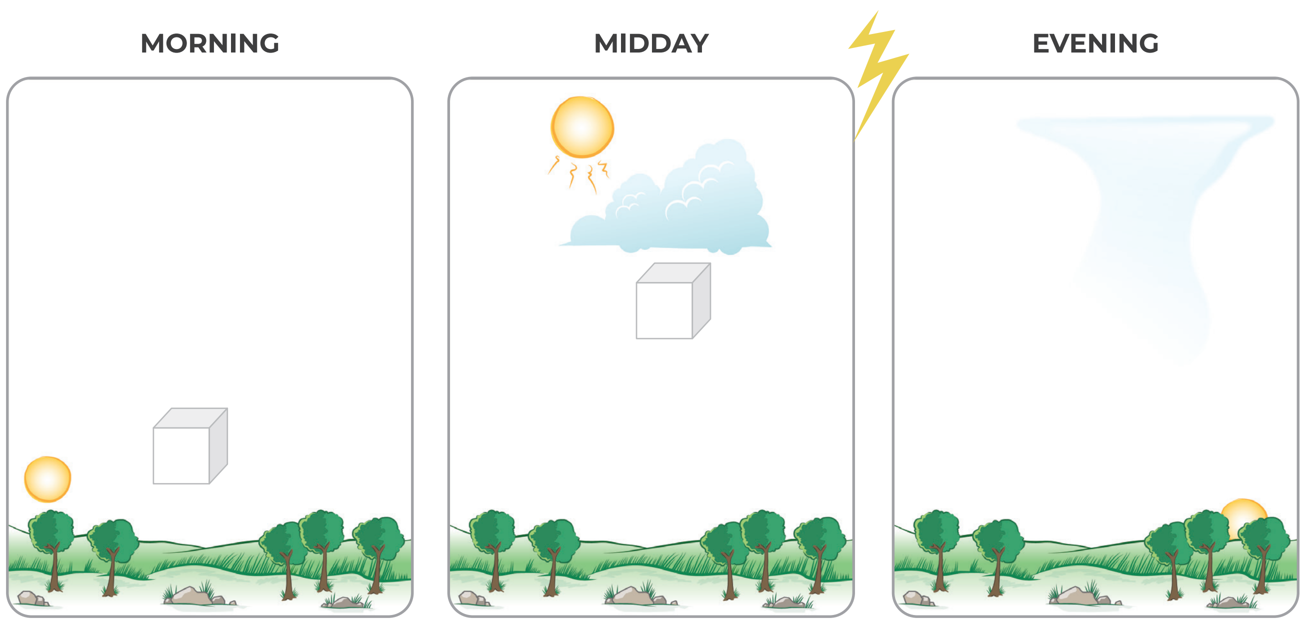
2. Sunrise in Rockwall, Texas, was at 6:57 a.m. on August 26. Explain why the air temperature changed the way it did from between 8:00 a.m. and 12:00 p.m.

3. The air temperature was measured about one meter above the ground. Draw a line on the air temperature graph to show how you think the temperature of the ground changed over the day. Then, explain why you think the surface temperature would change like this.

4. The air temperature near the surface is different from the air temperature higher in the atmosphere. Explain how they are different and why this difference is necessary for a storm to form.

The pictures below show one location at three different times during one day: morning, midday, and evening. The day was sunny in the morning and then a thunderstorm formed around 3:00 p.m., which lasted an hour.

The boxes in the pictures represent a "pocket" of air that moves over time. In the morning, the air is near the ground. At midday (12:00 p.m.), the pocket of air has moved higher in the atmosphere. Answer the questions below to complete the model and to explain what it shows about the thunderstorm.



5. Draw a box to show where you think the pocket of air might be on the "Evening" diagram.

6. Explain why you put the box where you did.

7. Do you think the temperature and humidity of the air in the box is increasing, decreasing, or staying the same during the morning and midday (just before storm)? Circle your answers for each time in the table to the right.

   Explain why you think the temperature and humidity would change like this during the morning and then midday, just before the isolated storm occurred.

	TEMPERATURE	HUMIDITY
MORNING	Increasing Decreasing Staying the same	Increasing Decreasing Staying the same
MIDDAY	Increasing Decreasing Staying the same	Increasing Decreasing Staying the same

8. One student claims that the box would get larger between morning and midday, assuming that the molecules can't escape from the box. Do you agree or disagree? Explain your reasoning.

9. Another student claims that if there was another box of air high in the atmosphere at midday, it would be colder than the air below so it would sink toward the ground. Do you agree or disagree? Explain your reasoning.

10. Use what you learned about temperature and humidity patterns on a stormy day to explain why the storm happened in the afternoon instead of the morning.

11. Describe how energy from the Sun helps to cause the storm.

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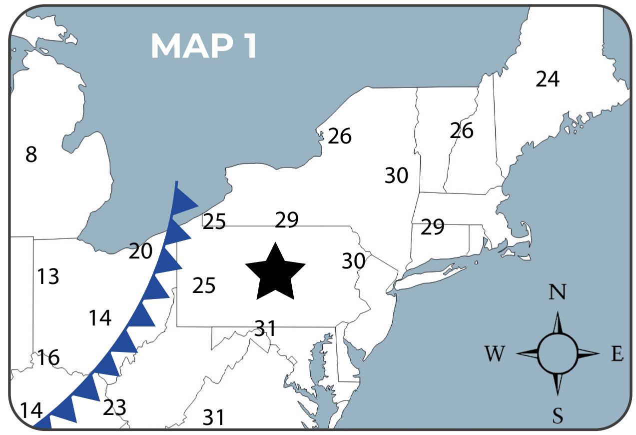
Learning Sequence 2 Assessment: A Front Headed Your Way

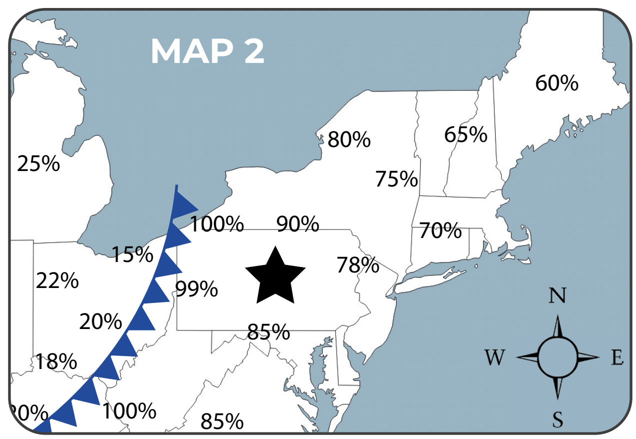
Map 1, to the right, shows maximum air temperatures (˚C) across the northeastern United States on June 28, and Map 2 shows humidity (%).



Weather forecasts **for the next day** (June 29) in central Pennsylvania (shown on the maps with a star ★) predict the following:

> Temperatures will drop to 15-20˚C, and storms are likely by the afternoon.

Answer the following questions to explain how weather forecasters used the data in these maps to decide that a storm is coming to central Pennsylvania.



1. The line with the triangles on each map shows the location of a cold front. Describe the temperature and humidity of the air on both sides of the front.

   East of the front (to the right of the front on the map):

   West of the front (to the left of the front on the map):

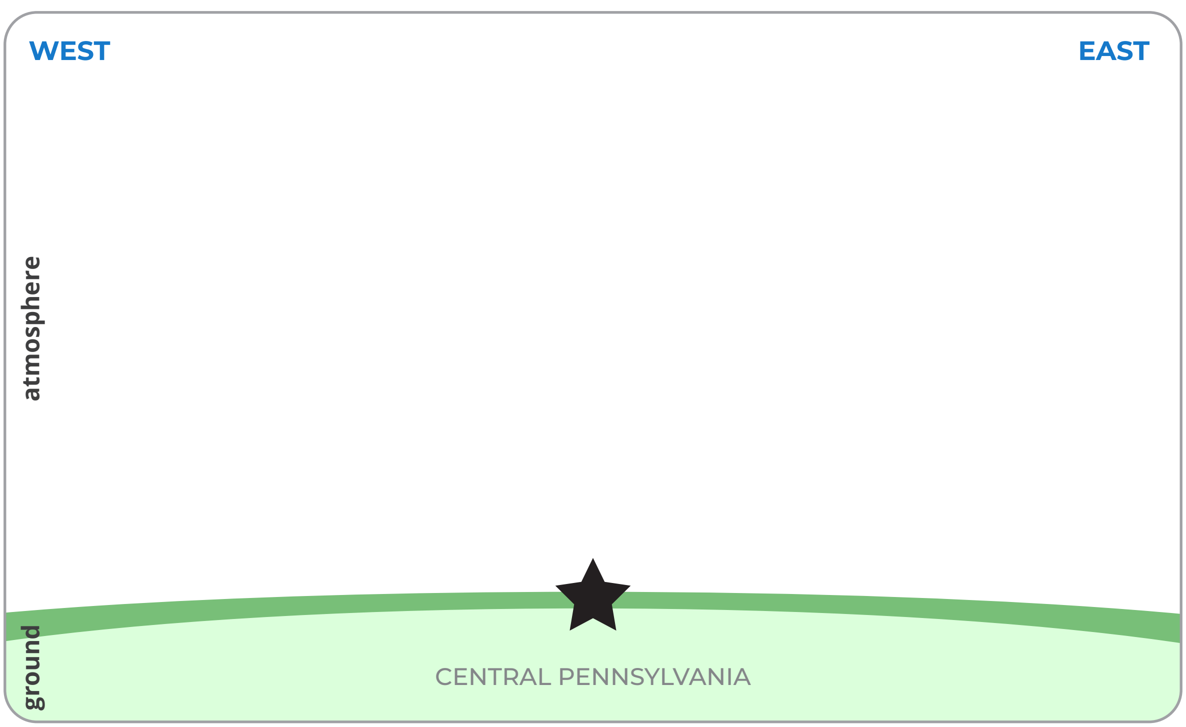
2. Using what you know about the air on both sides of the front, describe how air is moving at the front.

3. Draw an **L** to show where you would expect to find the lowest air pressure on a map on the previous page and an **H** to show where you would expect to find the highest air pressure. Explain why you put the H and the L where you put them.

4. Describe how you'd expect air pressure to change in central Pennsylvania (shown with a ★ on the maps on the previous page) from June 28 to June 29 as the cold front moves through. Explain your reasoning.

5. Draw a cross-sectional model below to show how the air masses will interact along the cold front as it moves through central Pennsylvania (shown with a ★) on June 29. Your model should:

- show the location of the cold front.
- show the location of air masses (and note the temperature, humidity, and air pressure).
- use arrows to show how air is moving.
- indicate where a storm is likely to form.



6. How can the movement of the air shown in your cross-sectional model cause a storm? Explain your reasoning.

7. Add an **H** to your cross-sectional model to show where air pressure would be highest and an **L** where air pressure would be lowest. How do these differences in air pressure cause the air to move?

8. Use your model and the temperature and humidity data on the maps to explain why it will likely rain in central Pennsylvania (★).

9. In the table below, describe two similarities and two differences in how isolated storms and cold front storms form.

	SIMILARITIES	DIFFERENCES
1		
2		

10. What are some reasons that could explain why one air mass would have a higher temperature than another air mass? Explain each reason.

11. Think about what you know about air temperature around the Earth. Some areas are usually warmer than others. What causes some areas to be warmer than others?

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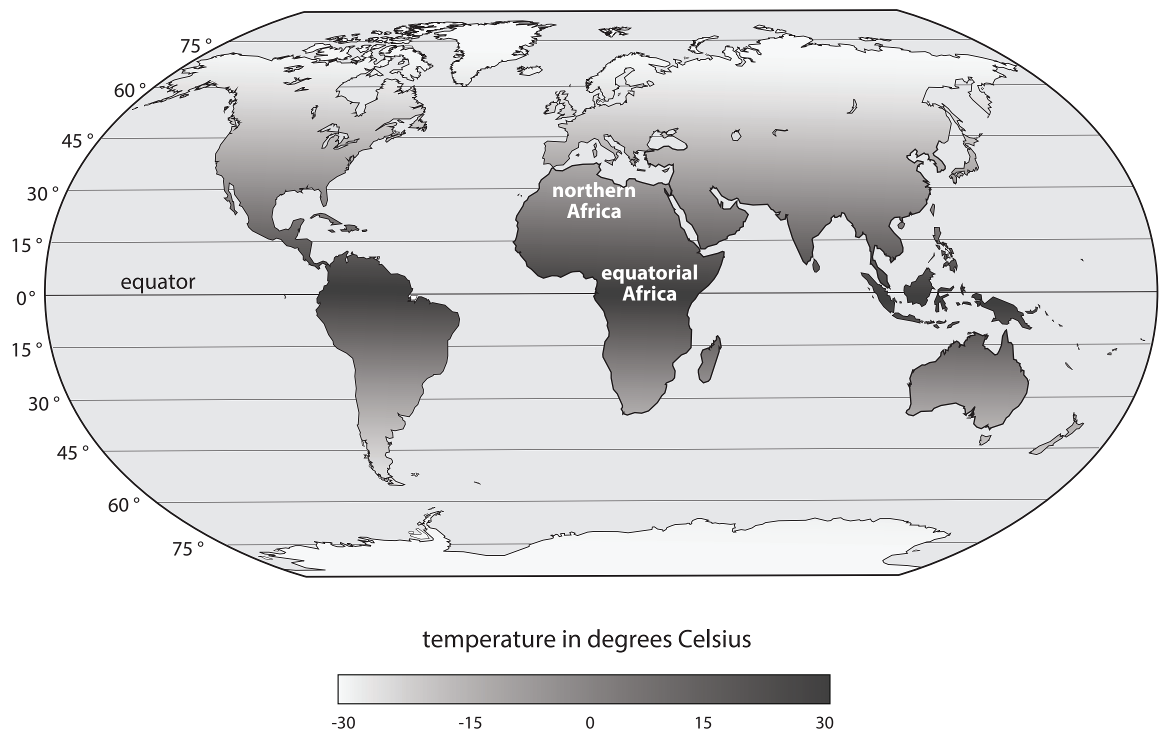
Learning Sequence 3 Assessment: Worldwide Weather

Northern Africa is very dry and receives very little rainfall throughout the year. However, equatorial Africa has many storms, meaning a lot of rainfall. Examine the map below.

MAP 1. AVERAGE ANNUAL TEMPERATURE AROUND THE GLOBE.



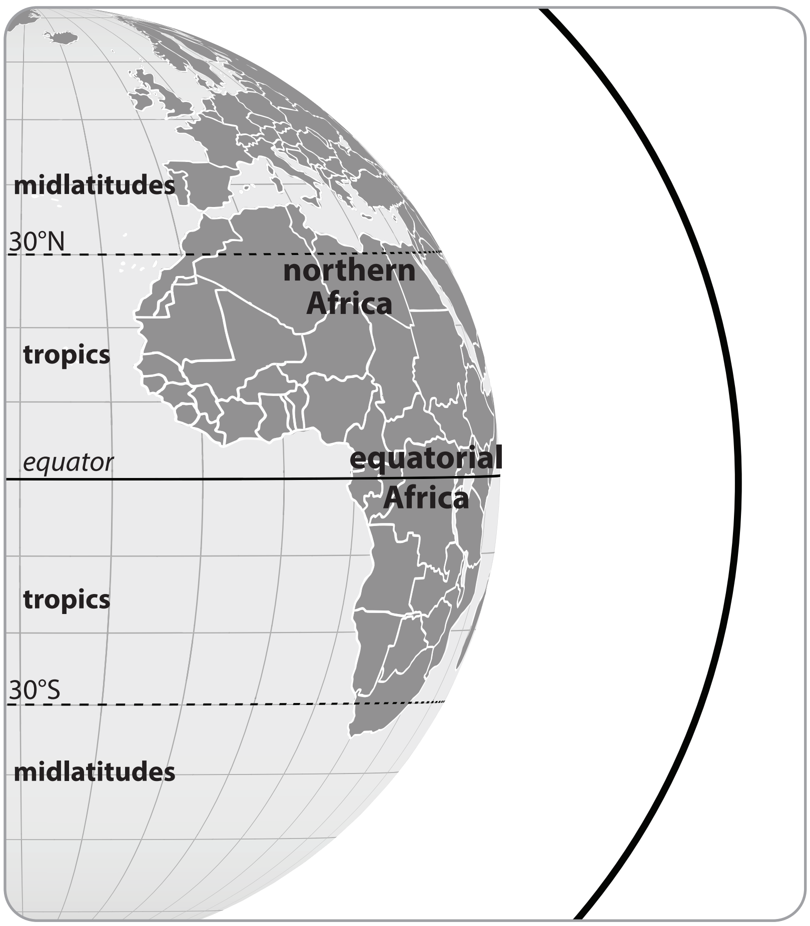
1. Answer the questions to explain what causes the different temperature patterns in the map above.
   a. Compare the average annual temperature in equatorial Africa to the average annual temperature in northern Africa.

   b. Explain why the average annual temperatures are different in these two regions.

2. Draw on the cross-section below to show what is happening in the atmosphere above Africa. Focus on the tropics, which are between 30°N and 30°S latitude.

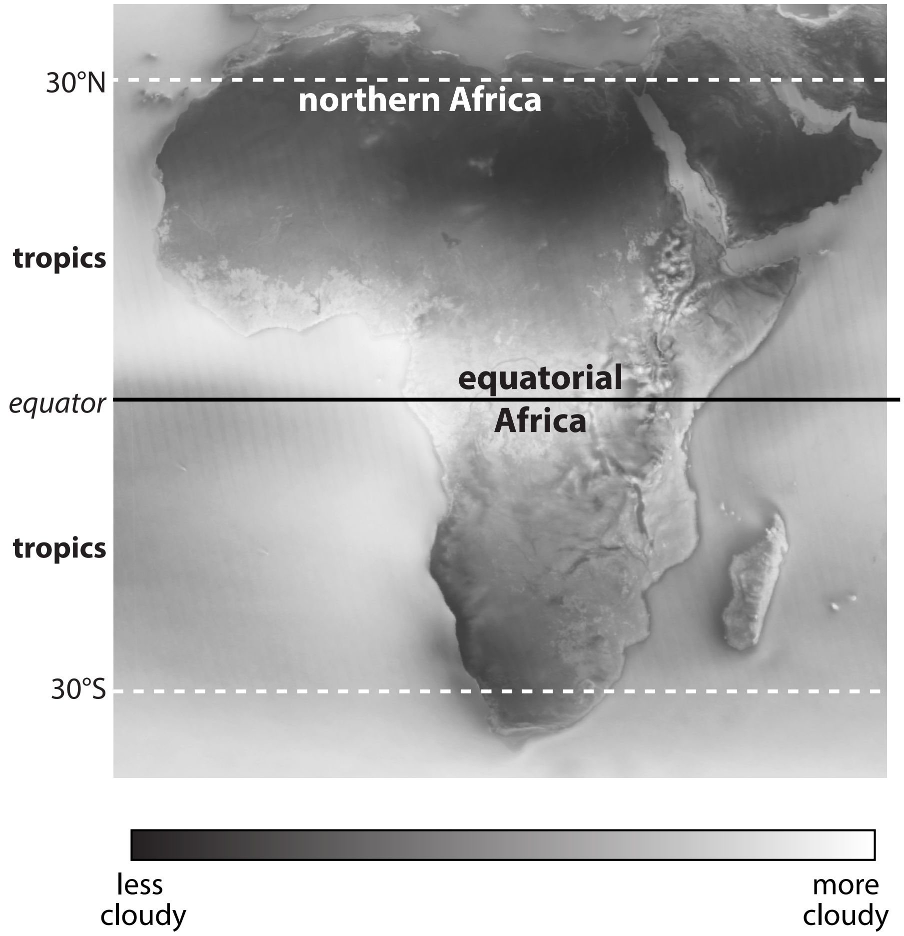
   a. Use arrows to show how air moves from the equator to the midlatitudes (from 0° to 30°N and also from 0° to 30°S).
   b. Draw clouds where you would expect to find the most cloud cover in the atmosphere above Africa.
   c. Add **H** for areas of high pressure and **L** for areas of low pressure.

AIR MOVEMENT IN THE ATMOSPHERE ABOVE AFRICA



3. Explain how different average annual temperatures in the tropics and midlatitudes help cause the different patterns in air circulation in the two regions you drew in the cross-section above.

MAP 2. PERCENT OF AVERAGE ANNUAL CLOUD COVER OVER AFRICA FROM 2002 TO 2015.



4. Examine map 2 above, which shows cloud cover.

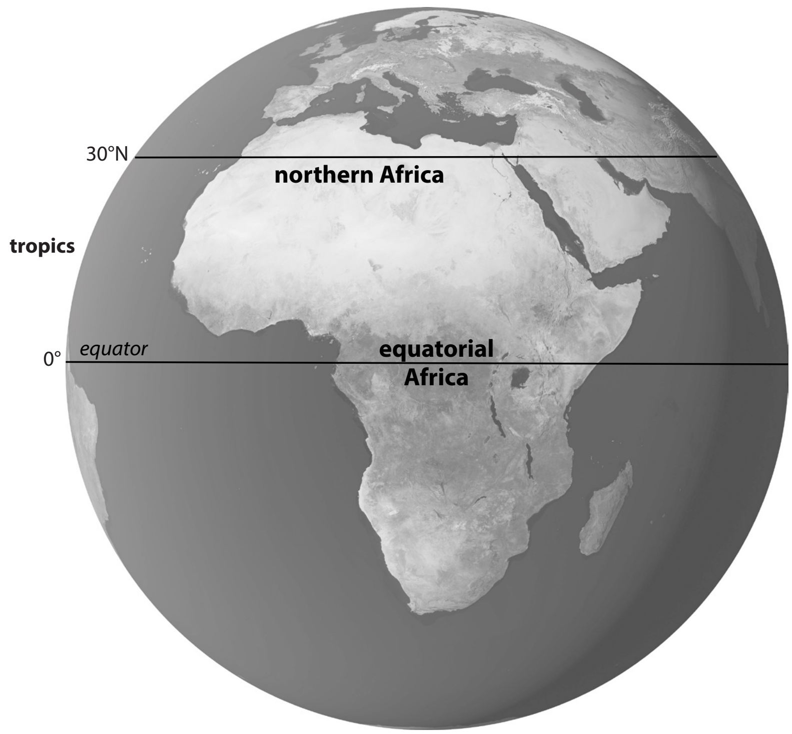
   Use what you know about how clouds form and the patterns in air circulation in the tropics to explain why there are fewer clouds in northern Africa.

5. Storms in tropical Africa generally do not move directly north from the equator toward northern Africa. Draw on the image below to explain the movement of storms in this part of the world.

   a. At 30°N, winds spread out across Earth's surface. Draw the direction that winds would travel north and south of 30°N if the Earth was not spinning.

   b. Use a different color to draw how winds actually curve north and south of 30°N due to the Coriolis effect.

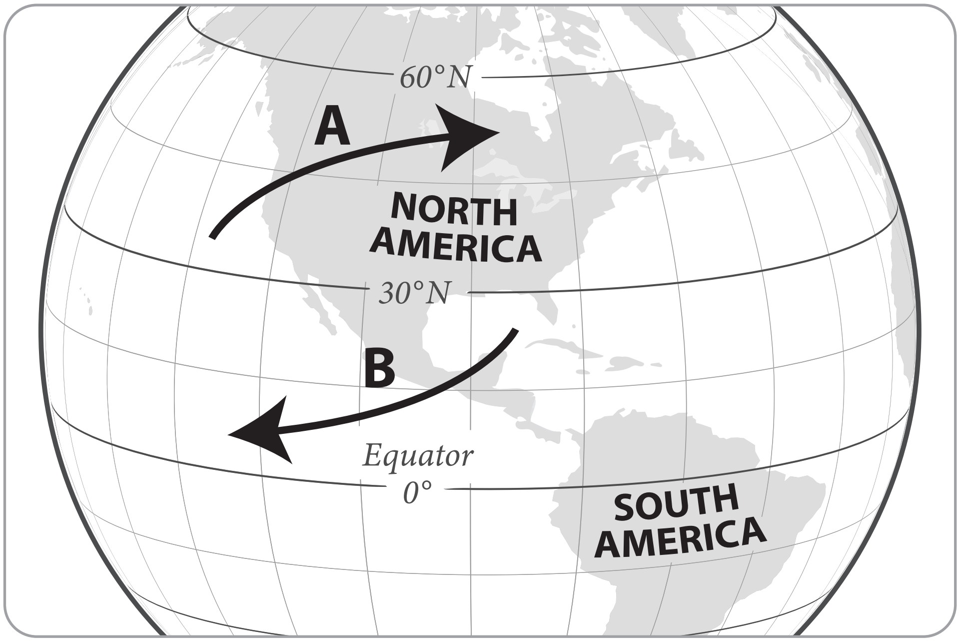
DIRECTION OF WIND IN NORTHERN AND EQUATORIAL AFRICA



   c. Use what you know about the direction of winds to explain why storms in tropical Africa do not move directly north from the equator toward northern Africa.

GLOBE Weather Final Assessment

Weather forecasters know there is a direction weather *usually* follows as air masses move in the midlatitudes and tropics. Answer the next two questions to explain why forecasters often predict that weather will move in the direction of the arrows shown on the globe below.



1. Why is the arrow curving to the east at point A? Why is the arrow curving to the west at point B?

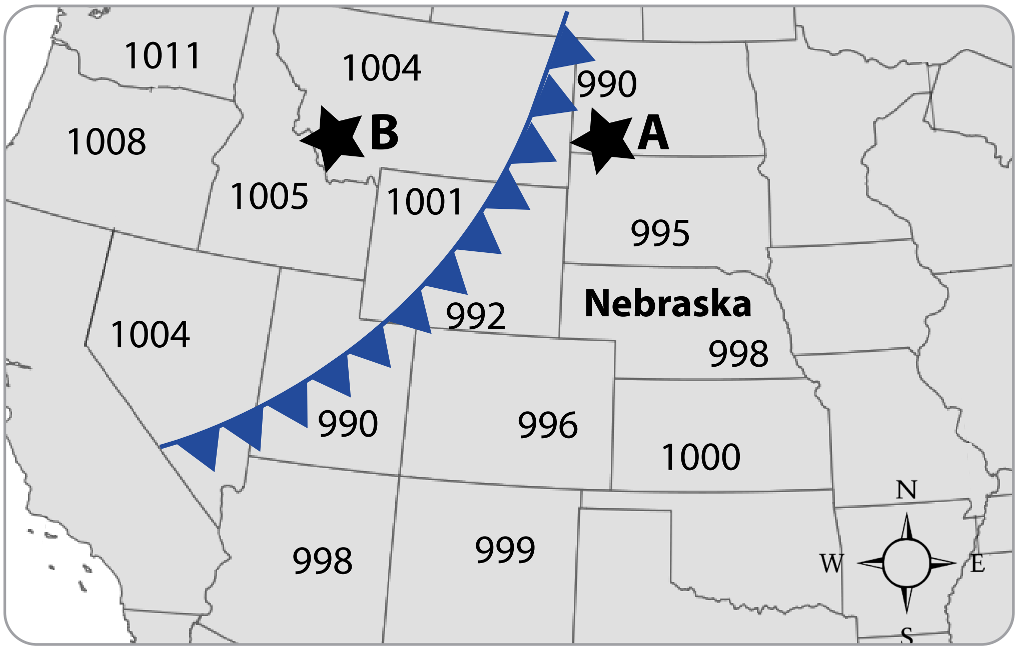
2. If the Earth didn't spin, what direction would the air in the region of A move? What direction would the air in the region of B move?

A school in Nebraska is planning a graduation party for a day in May. One day before the party, weather forecasters warned:

> Even though it is warm and sunny now, a cold front will soon move into Nebraska. Tomorrow the weather will become cool and rainy.

The weather forecasters used air pressure data (measured in millibars; shown on the map below) to predict more precisely how the front will move.

BAROMETRIC PRESSURE (MB)



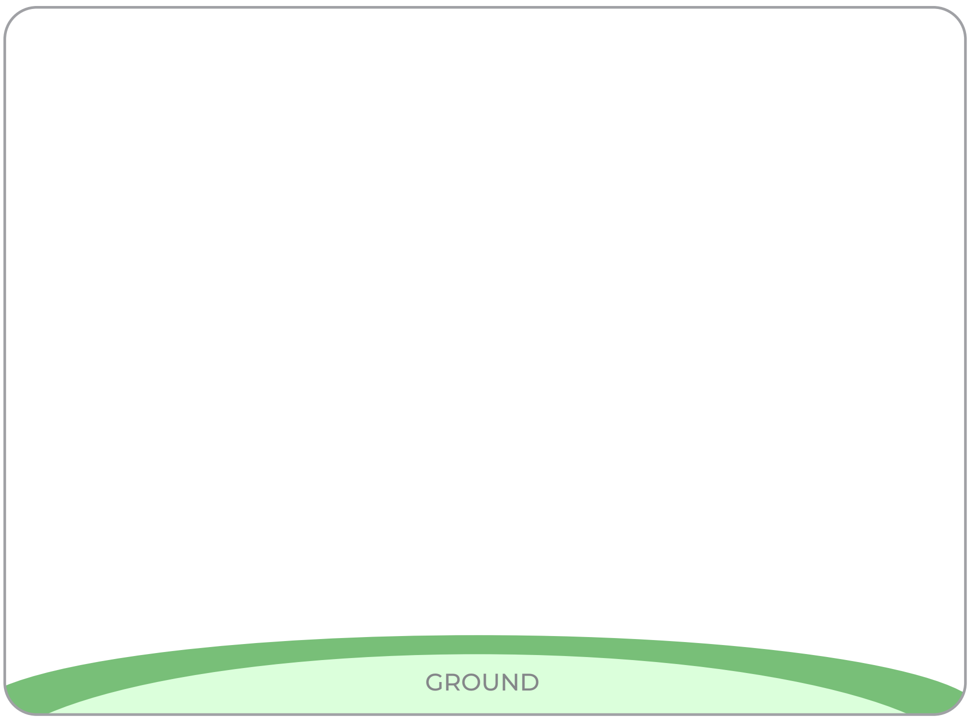
3. Use the air pressure data and cold front shown in the map to describe how air is moving at location A. Explain why it moves this way. Now describe how the air is moving at location B. Explain why it is moving this way.

4. Use the air pressure data and your knowledge about how air is moving at locations A and B to explain *why* weather forecasters predict that the front will *likely* move to Nebraska.

5. Think about the temperature of the air masses that make up a cold front and the air pressure data from the map on the previous page. When the cold front arrives in Nebraska, what will happen to the warm air that is there now? **Draw and label a cross-sectional model in the box below** to show how the air masses will interact.

Your model should show:

- the warm air mass
- the cold air mass
- the location of the cold front
- the direction that the cold front is moving
- what causes the cold front to move this way



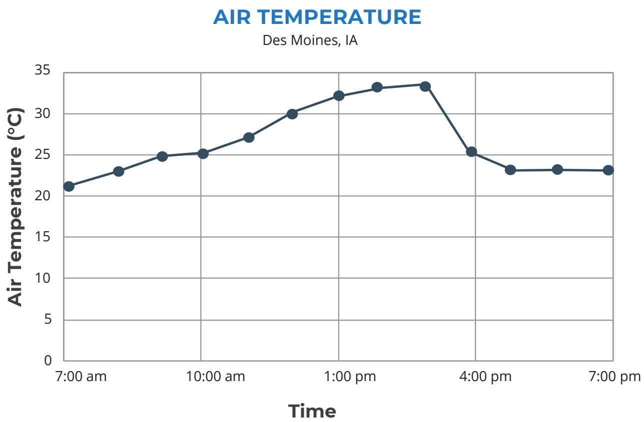
Add arrows, labels, and use color to help you explain what happens to the two air masses in your model.

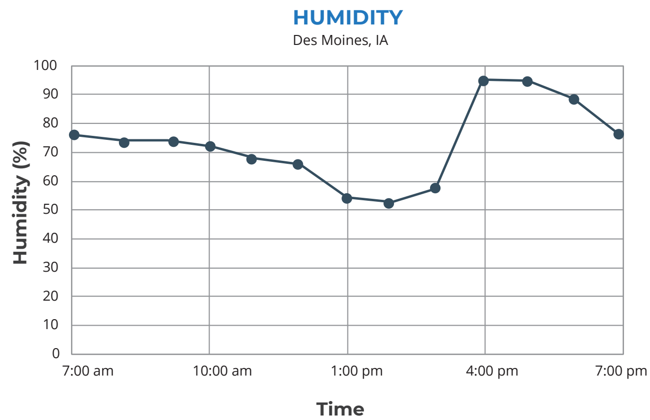
6. Explain *why* the warm air and cold air will move the way you showed in your model.

7. Before the cold front moved into Nebraska, students noticed it felt very muggy or humid. Use your model to explain *why* it will probably rain in Nebraska during the graduation party.

8. A school in Des Moines, Iowa has a similar problem. On graduation day, there was a thunderstorm around 4:00 p.m. that ended about an hour later.

   Use the air temperature and humidity data in the graphs below to analyze the storm.





   a. Think about how air temperature and surface temperature are different. Scientists reported that ground surface temperature at 7:00 a.m. was 23°C. **Draw a new line on the air temperature graph above** to show how the surface temperature changes during the day.

   b. Explain why ground surface temperature would follow the line that you drew.

9. Use the temperature and humidity data in the graphs above to explain why it rained in the afternoon.

