6. Tracking Weather

Driving Questions

Analyze atmospheric data to determine how variations in temperature, humidity, barometric pressure, dew point, wind speed, and sky conditions relate to each other and produce specific weather conditions.

- How do changes in barometric pressure affect sky conditions?
- Is there a relationship between temperature and relative humidity?
- What types of clouds produce rain?

Background

Weather is a daily "snapshot" of the atmosphere at a specific place and time. Weather occurs in the troposphere, the atmospheric layer closest to the earth and is about 9 to 16 kilometers thick. This distance, in comparison to the rest of the planet, is as thin as the skin of an apple.

Four main constituents of weather include temperature, wind speed, humidity, and air pressure. Temperature is a measure of the average motion of molecules in the atmosphere. Wind is the air in horizontal motion across the earth. Wind is caused by differences in pressure. Air flows from areas of high pressure to areas of low pressure, in an attempt to balance the pressure. Greater differences in pressure result in faster winds. Humidity is a measure of the amount of water vapor in the air. Atmospheric pressure is the force that air molecules exert upon the Earth's surface. Atmospheric pressure is measured using a barometer, and is often referred to as barometric pressure.

Clouds form when moist air cools and water vapor condenses onto microscopic particles of dust, smoke, or salt in the troposphere. These tiny droplets of water are extremely small; indeed, it takes a million of them to form a single raindrop. Clouds are named according to their height and appearance.

Clouds are named according to their height and appearance. High-forming clouds are assigned the prefix 'cirro', whereas clouds formed at a middle altitude receive the prefix 'alto' (low-forming clouds do not receive a prefix). Rain-producing clouds usually receive the suffix 'nimbus'. Two main cloud types are cumulus or clumped clouds and stratus or layered clouds. Depending on their location, they may have the alto- or cirro- prefixes.

Cumulus clouds typically signal fair weather, but if they expand into the upper part of the atmosphere, they become cumulonimbus or rain clouds. These clouds are tall (can surpass 15 km) and dark. They are an indication of rapidly changing air masses capable of producing lightning, heavy rain, hail, high winds, and tornadoes.

Stratus clouds are layered and not as tall as cumulus types. Precipitation can occur as rain, freezing rain, sleet, hail, and snow with varying intensity. Water droplets with a diameter greater than 0.5 mm are classified as rain, but when smaller than this, as drizzle.

Materials and Equipment

For each student or group:

- Weather Sensor
- Brick or board (2)
- Weather shield[1]
- Weather data for comparisons[2]

Safety

Add this important safety precaution to your normal laboratory procedures:

- If students go outdoors to set up their data collection, be aware of hazards both from weather and traffic for students and also for the data collection systems.

Procedure

After you complete a step (or answer a question), place a check mark in the box (☐) next to that step.

Set Up

1. ☐ Select a location for your experiment according to your teacher's instructions.

2. ☐ Start a new experiment on the data collection system.

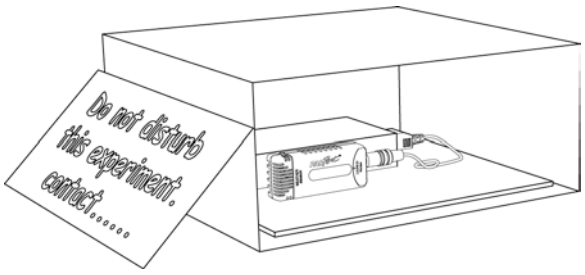
3. ☐ Attach the weather/anemometer sensor to the data collection system.

4. ☐ Display barometric pressure, temperature, relative humidity, wind speed, and dew point in a table.

5. ☐ Change the sample rate to once every 10 minutes.

6. ☐ Place the data collection system on a brick or on a couple of boards to keep it off the ground.

7. ☐ Keep the direct sun from shining on your system by placing a weather shield over it.



Collect Data

8. ☐ Start data recording.

9. ☐ Describe the location of the data collection system.

10. ☐ Make a careful description of the current sky conditions each hour as the data is being collected.

Table 1: Sky conditions and cloud cover

Time	Sky conditions	Type of clouds present

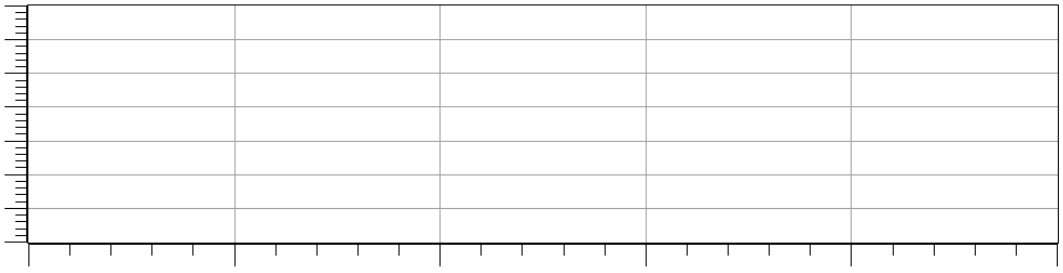
11. ☐ After the data has been collected for at least 6 hours, stop recording data.

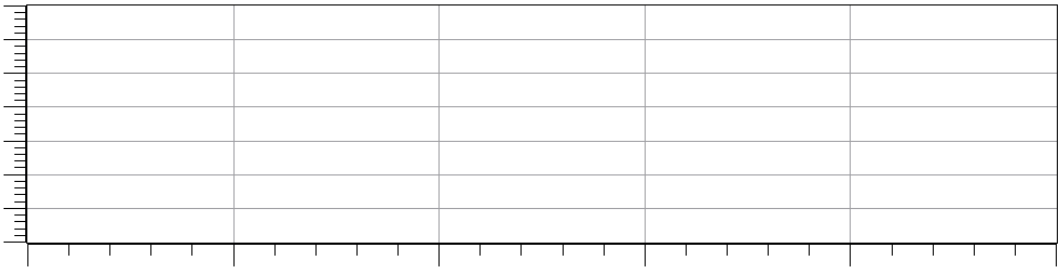
12 ☐ Save your experiment.

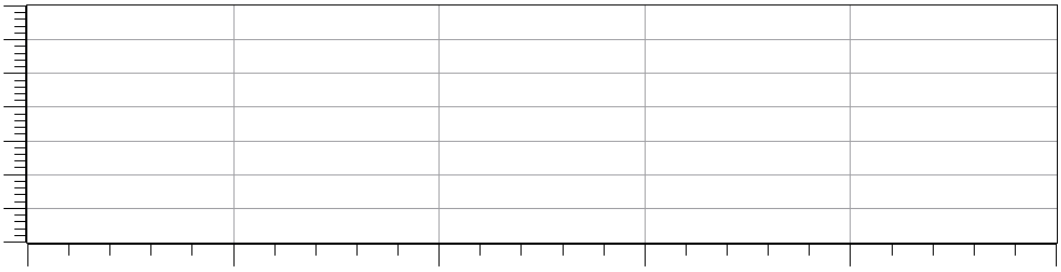
13 ☐ Return the equipment and the data collection system to the classroom.

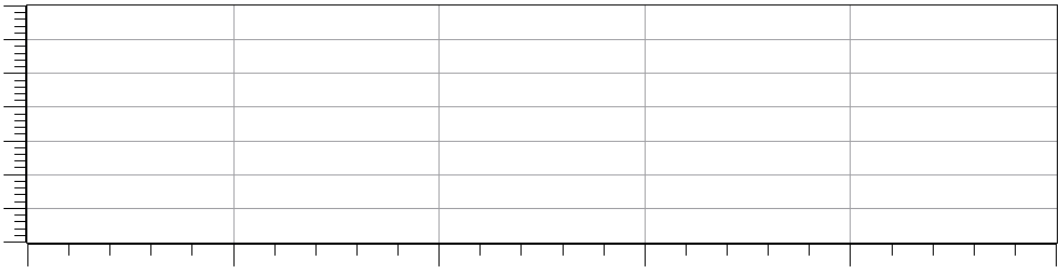
Data Analysis

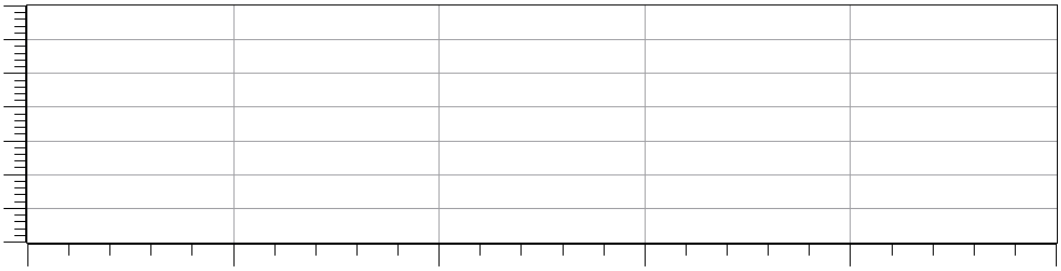
1. ☐ Using your collected data, create graphs for each of the following variables versus time: barometric pressure, temperature, relative humidity, wind speed, and dew point. Sketch or print each graph. Label the overall graph, the x-axis, the y-axis, and include units on the axes.











2. ☐ Describe the weather conditions in general over the test period. If clouds were present, what type were they?

3. ☐ How did the barometric pressure change during the data collection period? What weather conditions were related to this change in pressure?

4. ☐ How does the temperature vary as the relative humidity changes?

_____

5. ☐ How did the wind speed vary over the time you collected data? What conditions could explain this observation?

_____

_____

6. ☐ How would you classify the weather conditions during your data collection? Summarize the data you found for this type of weather.

Analysis Questions

1. **Compare weather data that was collected on days with different weather conditions. Fill in the first row of Table 2 with the data you collected and get weather data for four other weather conditions from your teacher. Summarize the general trends in the data from your teacher in the remaining four rows in Table 2.**

Table 2: Comparisons for weather data

Weather Conditions	Barometric Pressure	Temperature	Relative Humidity	Dew Point	Wind Speed

2. **Weather data recorded over several weeks may show trends. Would you be able to predict those trends based on the data you gathered?**

3. **In general, what is the relationship between temperature and relative humidity?**

4. **What correlations can you make between the barometric pressure and sky conditions?**

Synthesis Questions

Use available resources to help you answer the following questions.

1. **What type of weather would you expect if the atmospheric barometric pressure were dropping quickly and humidity was on the rise?**

2. **How can clouds form if the humidity is less than 100% at your measuring site?**

3. **What atmospheric condition would have to change the most for it to remain windy throughout the day?**

Multiple Choice Questions

Select the best answer or completion to each of the questions or incomplete statements below.

1. **_____ is the amount of water vapor in the air.**

   A. Barometer
   B. Dew point
   C. Troposphere
   D. Humidity
   E. Temperature

2. **If the temperature of an area is increasing what would you expect to happen to the humidity?**

   A. The humidity is probably increasing.
   B. The humidity is probably decreasing.
   C. The humidity will probably stay the same.
   D. The temperature will keep increasing until it is the same as the humidity.
   E. Both C and D are correct.

3. **Which of the following conditions will create the strongest winds?**

   A. An area of high pressure next to an area of low pressure.
   B. A vertical movement of air.
   C. An area in which the pressure is constant.
   D. Water vapor condensing in clouds.
   E. All of the above will create wind.

4. **Weather is best described as _____.**

   A. Conditions at a specific location measured over a period of at least 30 years.
   B. Temperature changes over a period of 24 hours.
   C. A daily "snap shot" of the atmosphere at a specific place and time.
   D. Changes in the atmospheric conditions as the seasons change.
   E. Both A and D together.

5. **What type of cloud would most likely cause rain?**

   A. Altostratus
   B. Cirrostratus
   C. Cirrus
   D. Cumulus
   E. Cumulonimbus