Experiment
2

PRELIMINARY ACTIVITY FOR A Local Weather Study

Weather is simply what is happening in the atmosphere at a particular place at a particular moment. *Climate*, on the other hand, is the average weather in an area over a long period of time. In this experiment, you will make weather measurements and investigate factors that influence weather and climate.

In the Preliminary Activity, you will gain experience measuring temperature, relative humidity, and UV radiation.

After completing the Preliminary Activity, you will first use reference sources to find out more about weather before you choose and investigate a researchable question. Some topics to consider in your reference search are:

- weather
- climate
- relative humidity
- rain shadows
- solar radiation
- hydrologic cycle

PROCEDURE

1. Go to a web site, suggested by your teacher, which gives the local weather for your school area. Note the displayed weather characteristics and their units.

2. Connect a Temperature Probe and a Relative Humidity Sensor to the data-collection interface.

3. Note and record the displayed values.

4. Disconnect the Temperature Probe and the Relative Humidity Sensor from the data-collection interface. Connect the UVB Sensor to the interface.

5. Use a ring stand and a utility clamp to suspend the UVB Sensor aiming directly at the sun. When it is aimed directly at the sun, its shadow is a small round circle. **CAUTION:** *Do not look directly at the sun*.

6. Note and record the displayed reading.

QUESTIONS

1. Describe the location where you recorded your measurements. Include observations such as:
   a. Is the spot open? Are there buildings, trees, or other objects that could have affected your measurements?
   b. What is the ground cover like—soil, vegetation, asphalt, concrete, or other?
   c. Are there any living organisms in the immediate area?
2. Did the measurements of other groups differ from yours? Why?
3. How did your weather observations of the local weather compare with those of the web site?
4. List at least one researchable question for this experiment.

Experiment
2

A Local Weather Study

OVERVIEW

In the Preliminary Activity, your students will learn data-collection techniques using Temperature Probes, Relative Humidity Sensors, and UVB Sensors. A student handout for the preliminary activity can be found at the end of the experiment.

During the subsequent Inquiry Process, your students will first learn more about weather using the course textbook, other available books, and the Internet. They will then generate and investigate researchable questions concerning local weather.

LEARNING OUTCOMES

In this inquiry experiment, students will

- Identify variables, design and perform the experiment, collect data, analyze data, draw a conclusion, and formulate a knowledge claim based on evidence from the experiment.
- Evaluate factors that affect weather and climate.

CORRELATIONS

AP Environmental Science Topic Outline Correlation

I. Earth Systems and Resources, B. The Atmosphere (Weather and climate)

IB Environmental Systems Syllabus Correlation

A.1 Measuring Physical Components of the System, 2 Describe and evaluate methods for measuring at least three abiotic factors within an ecosystem.

THE INQUIRY PROCESS

Suggested time to complete the experiment

See the section in the introduction, Doing Inquiry Experiments, for more information on carrying out each phase of an inquiry experiment.

I	Preliminary Activity	10 minutes
II	Generating Researchable Questions	10 minutes
III	Planning	15 minutes
IV	Carrying out the Plan	40 minutes or more (over several days)
V	Organizing the Data	15 minutes
VI	Communicating the Results	30 minutes
VII	Conclusion	15 minutes

MATERIALS

Make the following materials available for student use. Items in bold are needed for the preliminary activity.

data-collection interface
data-collection program
Vernier Temperature Probe
Vernier Relative Humidity Sensor
Vernier UVB Sensor
ring stand and utility clamp
Internet access
Vernier Barometer (optional)
anemometer (optional)
others as requested by students

I Preliminary Activity

This inquiry experiment begins with an activity that introduces the collection of temperature, relative humidity, and UV data. When auto-ID sensors are used, sensor readings are displayed once the Vernier data-collection program is started. If you are using non-auto-ID sensors, you will need to show your students how to set up the data-collection program to collect data.

Sample Results

Sensor	Measurement
Temperature	24.8°C
Relative Humidity	48.3%
UVB	287.2 mW/m^2

Answers to the Questions

1. Answers will vary.
2. Answers will vary.
3. Answers will vary.
4. Answers will vary. See the Researchable Questions list below for some possible answers.

II Generating Researchable Questions

See page xiii in the Doing Inquiry Experiments section for a list of suggestions for generating researchable questions. Some possible researchable questions for this experiment are:

- How does elevation affect air temperature?
- How does elevation affect relative humidity?
- How does temperature affect relative humidity?
- How would weather measurements made in an open area compare to those made in a nearby wooded area?
- How would measurements made in an open area (wooded area) compare with those posted on an Internet site for the locality?
- How would weather measurements made within a city compare to those made in the nearby countryside?
- How would measurements made in a city (countryside) compare with those posted on an Internet site for the locality?
- How would weather measurements made on an athletic field compare to those made in a nearby parking lot?
- How does proximity to a large body of water affect weather?

There are many, many more possible researchable questions. Students should choose a researchable question that addresses the learning outcomes of your specific standards.

III Planning

During this phase students formulate a hypothesis, determine the experimental design and setup, and write a method they will use to collect data. Circulate among the student groups asking questions and making helpful suggestions.

IV Carrying out the Plan

During this phase, students use their plan to carry out the experiment and collect data. Circulate among the student groups asking questions and making helpful suggestions.

V Organizing the Data

See page xiv in the Doing Inquiry Experiments section for suggestions concerning how students can organize their data for their inquiry presentations.

VI Communicating the Results

See page xv in the Doing Inquiry Experiments section for a list of inquiry-presentation strategies.

VII Conclusion

See page xv in the Doing Inquiry Experiments section for a list of suggestions concerning assessment and ways to utilize the results in subsequent instruction.

SAMPLE RESULTS

Student results will vary depending on experimental design.

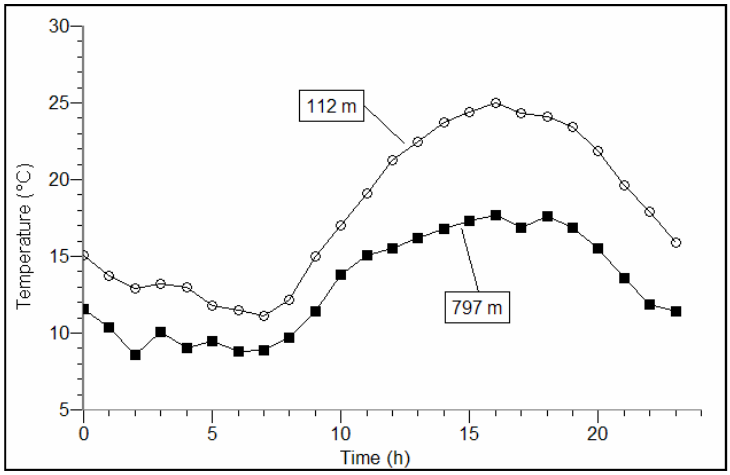

Figure 1 *The effect of elevation on air temperature*

This investigation addresses the question, "How does elevation affect air temperature?" The temperatures measured at an elevation of 797 m were lower than those measured in a nearby valley with an elevation of 112 m.

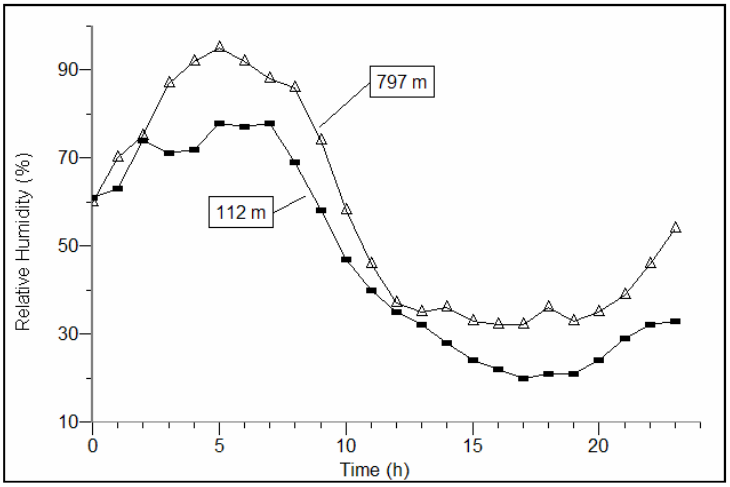

Figure 2 *The effect of elevation on relative humidity*

This investigation addresses the question, "How does elevation affect relative humidity?" The relative humidity values measured at an elevation of 797 m were higher than those measured in a nearby valley with an elevation of 112 m.

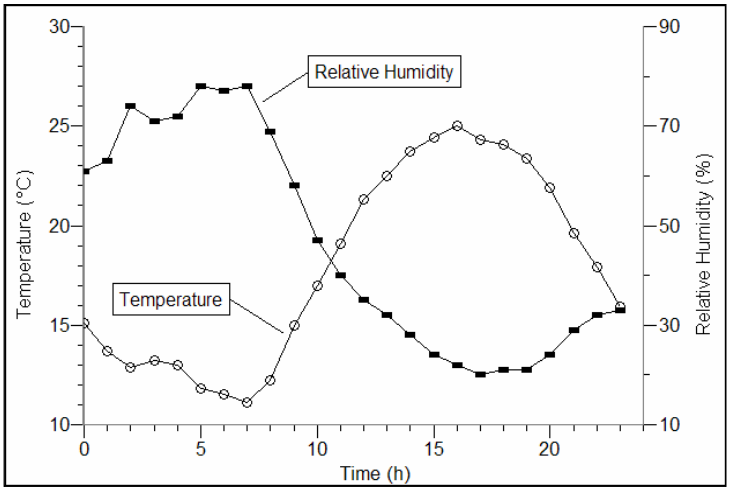

Figure 3 *The effect of temperature on relative humidity*

This investigation addresses the question, "How does temperature affect relative humidity?" As temperature increased, relative humidity decreased.

The Deutscher Wetterdienst is the data source of the information shown in Figures 1–3.

TIPS

Experiment Information

1. Many variations of this experiment are possible. Your students may design either short-term or long-term studies. Researchable questions may or may not utilize a web site that gives the local weather for your area. **Note:** This experiment presents a good opportunity for your students to **conduct a long-term study** and to **analyze a real data set** as described in the Laboratory and Field Investigation section of the booklet entitled *AP Environmental Science Course Description*.

2. The data-collection part of the Preliminary Activity should be done outdoors.

3. The Preliminary Activity suggests the use of three Vernier sensors: Temperature Probes, Relative Humidity Sensors, and UVB Sensors. Since Internet weather sites such as weather.com, accuweather.com, Yahoo Weather, and others also commonly provide current wind speed, wind direction, and pressure information, you could also use anemometers and Vernier Barometers in this experiment, if you have them available.

4. There are several methods your students can use for collecting data outside the classroom.
   - Use a Vernier LabQuest.
   - Use a laptop computer with a battery-powered Vernier interface.
   - Use a TI graphing calculator with a battery-powered Vernier interface (along with a calculator cradle and a link cable.)
   - Use a Palm® handheld with a battery-powered Vernier interface (along with a cradle and a link cable.)
   - Use a TI 84 Plus graphing calculator and an EasyLink. You will only be able to collect data from one sensor at a time.

- Use a Vernier LabPro as a remote, stand-alone unit. This method has students take a battery-powered Vernier interface outdoors without a computer, make measurements while outdoors, then return to computer in the classroom to download data. See *Appendix D* for more information.

5. Graphs can be copied and pasted into a Microsoft Word document. If your students collect data on a TI graphing calculator, have them import the data to Logger *Pro* or do a screen capture using TI Connect. If you students collect data on LabQuest or a Palm® handheld, have them import the data in to Logger *Pro*.

Sensor Information

1. Since the Vernier UV sensors allow the separate measurement of UVA and UVB irradiance, instead of an erythemally (or sunburning) weighted average, the individual readings of the Vernier sensors cannot strictly be converted to UV Index units. The erythemal action spectrum is predominately UVB, however, so an *estimate* of the UV index can be calculated by multiplying the UVB sensor reading by a factor of 0.004 index-m^2/mW—but this is only an estimate. The UVA sensor readings cannot be used to estimate UV index values.

2. The calibrations loaded with auto-ID Temperature Probes, auto-ID Relative Humidity Sensors, and auto-ID UVB Sensors are ideal for this experiment.

Sensor Check

To tell if your Temperature Probe is working correctly, hold the tip of the sensor in your hand and check for the temperature readings to change.

To tell if your UV Sensor is working correctly, take readings outdoors in the sunlight with and without a barrier, such as a sunglasses lens. Confirm that the readings are in the normal range for your area.

To tell if your Relative Humidity Sensor is working correctly, try the following.

1. Start the data-collection program. Check the readings on the default screen. Move the sensor to two places (one can be a container with a small amount of calcium chloride for low humidity; the other can be a container with a small amount of warm water for higher humidity).

2. Confirm that the relative humidity readings change in a logical manner.