EXPLORATIONS

Activity 19

Sunrise, Sunset — Weather Match

Objectives

- To determine the relationship between temperature and light intensity
- To understand the effect of other atmospheric factors on weather

Materials

- TI-73
- Unit-to-unit cable
- CBL 2™
- Temperature sensor
- Light sensor
- Data Collection and Analysis pages (p. 180 - 184)

In this activity you will

- Use the CBL 2™ with a temperature sensor and light sensor to collect temperature and light intensity data for a 24-hour period.
- Graph the data collected to find any patterns in temperature and light intensity that occur.

Problem

Does the highest temperature occur when the light intensity is the greatest, and does the lowest temperature occur when the light intensity is the least?

Introduction

Earth rotates one full turn on its axis every 24 hours. Day occurs on Earth when locations face toward the sun, and night occurs when those locations face away from the sun. By reviewing light intensity and temperature data for a 24-hour period, you can analyze various weather changes, such as when sunrise and sunset occur, when the temperature is the highest and lowest, and more.

Hypothesis

Before testing, complete the **Hypothesis** section on the **Data Collection and Analysis** page to predict temperature and light intensity data for a 24-hour period.

Procedure: Collecting the Data

1. Put the CBL 2 in a place where you can leave it for 24 hours. The location can be outdoors, but the CBL 2 should be protected from rain or dew. Putting the CBL 2 on a covered patio or placing it in a plastic bag (leaving the sensors out) are two options.
2. Plug the temperature sensor into Channel 1 (**CH 1**) and the light sensor into Channel 2 (**CH 2**) on the CBL 2™.
3. Start the DATAMATE program.
4. The Main Screen is displayed. **CH 1:TEMP(C)** and **CH 2:LIGHT** are displayed at the top of the screen
5. Select **1:SETUP**. Select **MODE**, and then select **2:TIME GRAPH**.
6. The **TIME GRAPH SETTINGS** are displayed. If the screen shows **TIME INTERVAL: 1800**, **NUMBER OF SAMPLES: 48**, and **EXPERIMENT LENGTH: 86400**, go to step 8. If the settings are not correct, go to step 7.
7. Select **2:CHANGE TIME SETTINGS**. For **ENTER TIME BETWEEN SAMPLES IN SECONDS:**, enter **1800**. For **ENTER NUMBER OF SAMPLES:**, enter **48**. The **TIME GRAPH SETTINGS** screen reappears, showing the new settings.
8. Select **1:OK** twice to return to the Main Screen.
9. When the CBL 2 is in the testing location, press **2:START**. The CBL 2 beeps twice and displays a graph with the temperature in °C and the light intensity reading in the upper right-hand corner. When the experiment starts , press [ENTER] to quite DATAMATE but continue collecting data.
10. After 24 hours, the CBL 2 will be finished collecting data. The main graph screen is displayed. Select **3:RESCALE** and **1:AUTOSCALE** to display a graph showing the temperature data that was collected. Use [▶] and [◀] to move to each data point. On the **Data Collection and Analysis** page, record the temperature for each 30-minute interval in the table, and sketch the graph.
11. Press [ENTER] **4:RETURN 4:MORE 1:L3 VS L1** to display a graph showing the light intensity data that was collected. Use [▶] and [◀] to move to each data point. On the **Data Collection and Analysis** page, record the light reading for each 30-minute interval in the table, and sketch the graph.
12. Press [ENTER] **6:L2 AND L3 VS L1** to display the light and temperature graphs together. Sketch the graph on the **Data Collection and Analysis** page.
13. To exit from the DATAMATE program, press [ENTER] **8:RETURN TO GRAPH SCREEN 1:MAIN SCREEN**. Select **6:QUIT** and press [ENTER].
14. To display the lists showing the results, press [LIST]. The times are stored in **L1**, the temperatures are stored in **L2**, and the light readings are stored in **L3**.

Data Analysis

After testing, use your chart and graphs to complete the questions on the **Data Collection and Analysis** page to explore the temperature and light intensity patterns that occur in your data.

Application

On the **Data Collection and Analysis** page, sketch a reasonable temperature versus time graph for the following series of events. Remember to label and set a scale for the axes. Plot time in minutes on the *x*-axis and temperature in degrees Celsius on the *y*-axis.

> *At 4:00 P.M. on May 15, a CBL 2™ started collecting temperature data in the air-conditioned science lab at a middle school. At 4:30 P.M. Mrs. Brady, the teacher, took the CBL 2 to her car for the ride home. The car was very hot after being in the sun all day. Mrs. Brady turned the air conditioner on full blast. On her way home, she stopped at the grocery store and left the CBL 2 in the car with the windows rolled up. She arrived at home at 5:30 P.M. She parked her car in the garage and put the CBL 2 on the kitchen counter. The thermostat in the house read 76°F. At 6:00 P.M. Mrs. Brady placed the CBL 2 next to the air conditioning vent in her study. Then she placed it on the patio table outside from 7:00 to 10:00 P.M., where the outdoor thermometer read 78°F during the first two hours and 74°F for the last hour. At 10:00 P.M. Mrs. Brady remembered the CBL 2 and turned it off for the night.*

Extension

- Divide the class into groups. Each group will think of a scenario for CBL 2 temperature and light data collection. Groups will collect data for at least three hours. A group member will keep a diary of where the CBL 2 has been for the collection time. Compile the descriptions and label with numbers. Pass out all the descriptions to each group. Each group will present their temperature and light graphs on the overhead pointing out critical attributes of each graph. The class will match each graph to the printed description.
- Find temperature data on the Internet for a location of your choice. Graph this data as an xyLine plot on your calculator by entering time in **L1** and temperature in **L2**.

Data Collection and Analysis

Name _____

Date _____

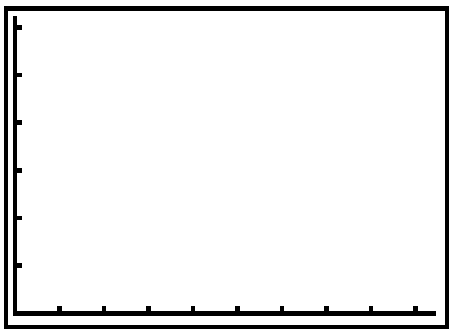
Activity 19: Sunrise, Sunset — Weather Match

Problem

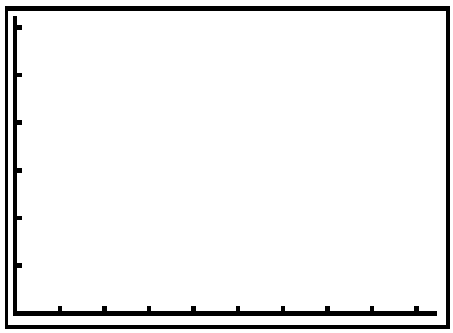
Does the highest temperature occur when the light intensity is the greatest, and does the lowest temperature occur when the light intensity is the least?

Hypothesis

1. Sketch predicted graphs of temperature and light intensity plotted over a 24-hour period. Mark starting times and reference time points on the *x*-axis. Plot temperature in degrees Celsius and light intensity on the *y*-axis. Share your prediction with the class.



Temperature versus Time



Light Intensity versus Time

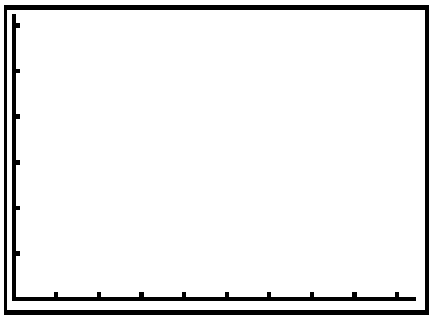
2. The highest temperature _____ occurs when the light intensity is the greatest, and the lowest temperature _____ occurs when the light intensity is the least.

Data Collection

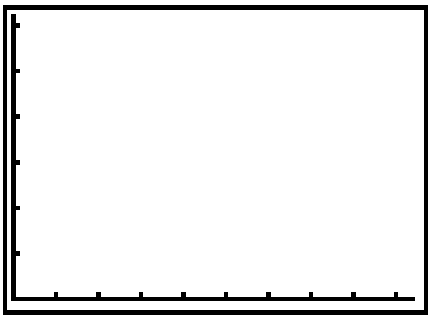
1. At the end of the 24-hour period, use the data stored in the lists on the TI-73 to complete the following table. (Make additional copies of the table if necessary.)

Time (hours : minutes)	Temperature (°C)	Light Intensity (milliwatts/cm^2)

2. Sketch and label the line graphs of the temperature and light intensity data over time, or print them on the computer and attach them to this page.

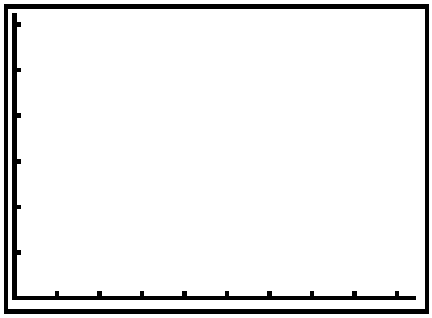


Temperature



Light Intensity

3. Sketch and label the double line graph showing the temperature and light intensity data over time together, or print it on the computer and attach it to this page.



Temperature and Light Intensity

Data Analysis

1. Refer to the table and graphs. How do day/night affect the temperature patterns and light intensity patterns?

_____

_____

_____

2. Identify any weather situations causing the peaks and valleys on the graphs.

_____

_____

_____

3. Compare the actual graphs to your predicted graphs in your hypothesis. Were your predictions reasonable? What surprised you about the actual graphs?

_____

_____

_____

4. From the home screen, use the 2nd [STAT] **MATH** menu to calculate statistical analyses with the temperature (**L2**) and light intensity (**L3**) lists. Enter the values in the table below. Use ranges for periods of time that had the same temperature or light readings.

Description	Actual Readings	Time of Reading
Maximum temperature		
Minimum temperature		
Temperature range (put in Time column)		
Mean temperature over 24 hours		
Median temperature		
Maximum light intensity		
Minimum light intensity		
Light intensity range (put in Time column)		
Mean light intensity		
Median light intensity		
When was sunrise (based on the light intensity)?		
When was sunset (based on the light intensity)?		

5. Compare the median temperature to the mean. Which one appears to be more stable? Which reflects the data best?

_____

_____

_____

6. Write a weather report based on your data for the 24-hour period.

_____

_____

Conclusion

1. Refer to the graph that shows the temperature and light intensity together. What patterns do you notice between the two graphs?

   _____

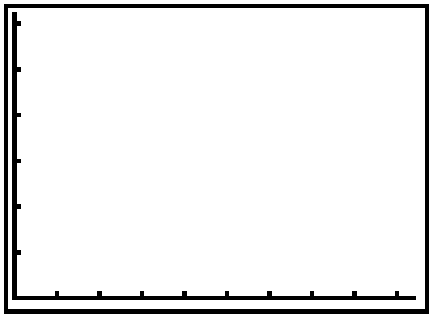
   _____

   _____

2. The highest temperature _____ occurs when the light intensity is the greatest, and the lowest temperature _____ occurs when the light intensity is the least.

Application

Sketch your temperature versus time graph here for the hypothetical series of events. Plot time on the *x*-axis and temperature in °C on the *y*-axis.



Temperature versus Time

Teacher Notes

Activity 19

Sunrise, Sunset — Weather Match

Objectives

- To determine the relationship between temperature and light intensity
- To understand the effect of other atmospheric factors on weather

NSES Standards

- Earth and Space Science: Structure of the earth system
- Earth and Space Science: Earth in the solar system
- Physical Science: Transfer of energy

Preparation

- If you want to collect you data outside, plan to do this activity when it is unlikely to rain. However, you should still set up the CBL 2™ and sensors where they will be protected from getting wet.
- To explore additional temperature and light intensity patterns, repeat this activity on several consecutive days. Also consider collecting the temperature and light intensity data on various days throughout the year.

Management

- Assign these student jobs for this lab:
  - Materials/setup person (sets up samples, sensor)
  - Tech person (operates CBL 2 and TI-73)
  - Data recorder (reads temperatures from the TI-73 at each collection interval)
  - Runner (brings CBL 2 and TI-73 to the computer to print graphs with TI-GRAPH LINK™ or TI™ Connect and brings **Data Collection and Analysis** pages to the teacher)
- Clear covered plastic shoeboxes will hold the CBL 2, temperature sensors, and other equipment neatly at each station.

- Students can record data points in their lab journals as they are displayed on the TI-73. This keeps them engaged throughout the data collection period and if they lose the data/graph later, they can still write up their lab reports. Students can also access the data in the TI-73 lists after data collection. You can send lists to all students' calculators using APPS **1:Link**.

  a. Press APPS.

  b. Press ENTER to select **1:Link.**

  c. Select **4:List** and press ENTER.

  d. Press ▼ to move the ▶ beside the list you wish to send. Press ENTER.

  e. Repeat step **d** for each list you wish to send.

  f. Set the receiving unit by pressing APPS ENTER ▶ to select **RECEIVE**. Press ENTER. **Waiting…** displays on the TI-73 screen.

  g. On the sending unit, press ▶ to select **TRANSMIT** and press ENTER.

  For more permanent storage of data, use TI-GRAPH LINK™ or TI™ Connect to save the lists in a computer folder. However, students may inadvertently lose their data or overwrite it in the next trial, so recording data in journals is a good option.

- Students can assess each other using a teamwork rubric after the lab. Provide a checklist of positive and negative behaviors. Copy these on quarter sheets of paper.