**Uneven Heating**

There are many reasons why cities at the same latitude might have different average monthly temperatures. Some cities are near large bodies of water, such as oceans, which influence temperature patterns over the course of the year. Other cities are located at higher elevations, which experience different temperatures than places at lower elevations. Do the following investigation and reading to find out how nearness to large bodies of water and elevation impact regional temperatures.

**OVERVIEW OF TEAM TASKS**

**Part 1. Investigating Temperatures of Land and Water**. This investigation will help us think about how does nearness to large bodies of water affects average temperature.

You will heat samples of soil and water. Observe and describe changes in the temperatures of the soil and water as they are heated and then allowed to cool. Graph your results.

**Part 2. Investigating Elevation**. This investigation will help us think about how elevation affects average temperatures. You will read *Climb to Cold* and plot elevation and temperature data on an elevation profile.

**SUPPLIES**:

1 Heat Lamp

1 Cup, about 2/3 filled with Soil

1 Cup, about 2/3 filled with Water

2 Thermometers

2 Pieces of Masking Tape

1 Watch or Clock with second hand

Colored Pencils

Reading: *Climb to Cold*

**Part 1. Investigating Temperatures of Land and Water:** This investigation will help us think about how does nearness to large bodies of water affects average temperature.

Before you begin:

1. How will you make sure that the heating and cooling are even for both water and soil?
2. How will you make sure the thermometers are measuring the same thing? Should they be at the same depth? How deep do they need to be so that the heat energy reaches them? How will you be sure they are both secure?
3. How will you track your measurements? How will you make sure they are accurate

**COLLECTING DATA: SOIL AND WATER**

What is the temperature of the soil and the water at the start? Record this Baseline measurement on the Data Table below. Now, turn on the heat lamp. Be sure that it is heating both the water and soil equally. One group member should watch the time closely. After 3 minutes, record the new temperature for the soil and water. Then wait another 3 minutes, and record the temperatures again. You will record temperatures every 3 minutes. At 9 minutes, turn the heat lamp off to begin the cooling phase. At least two people should read the thermometers to be sure an accurate measurement is recorded.

**DATA TABLE: SOIL AND WATER**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Baseline | Heating | Cooling |
| Material | 0:00 | 3:00 | 6:00 | 9:00 | 12:00 | 15:00 | 18:00 |
| Soil |  |  |  |  |  |  |  |
| Water |  |  |  |  |  |  |  |

**GRAPHING DATA: SOIL AND WATER**

Now, graph the data points on the blank line graph below. Use one colored pencil to represent the temperature line for soil and another colored pencil to represent the temperature line for water. Once the graph is completed, compare your data with your team members and answer the Interpreting Data questions.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Temperature** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Time** |

**INTERPRETING DATA: SOIL AND WATER**

1. What patterns do you notice between the temperatures of soil and water during the heating phase? What about during the cooling phase?
2. Water and land heat and cool the air above them. In the summer, the land and water heat up, and so does the air. In the winter, the land and water cool down, and so does the air. But they do not heat and cool at the same rate.

How would the does the data you collected support this statement?

**Part 2. Investigating Elevation:** This investigation will help us think about how elevation affects average temperatures.

**COLLECTING DATA:**

Read the story, *Climb to Cold*. Complete the data table below each time the team in the story takes an elevation and temperature measurement. When you complete the story, plot each city’s elevation and temperature on the elevation profile provided below. *Not all cities will have temperatures, but you can still plot their elevation.*

**DATA TABLE: ELEVATION**

|  |  |  |
| --- | --- | --- |
| Location | Elevation (in meters) | Temperature (in °F) |
| New Delhi, India |  |  |
| Kathmandu, Nepal |  |  |
| Lukla, Nepal |  |  |
| Everest Base Camp |  |  |
| Everest Camp I |  |  |
| Everest Camp II |  |  |
| Final Camp |  |  |
| Summit of Everest |  |  |

**GRAPHING DATA: ELEVATION PROFILE**

Now, graph the data points using the elevation profile below. An elevation profile is a cross-section view of the land as it changes elevation. For each city, plot a dot at the correct elevation level. Then, next to the data point, write the temperature (for the cities that have temperature data). Once you plot all data points for the cities, connect them with a line and shade in the area below the line. This shaded area below the line represents a cross-section of the land (what is would look like if you could take a “slice” out of Earth and see it from the side).

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Elevation (in Meters) | 9,000 |  |  |  |  |  |  |  |  |  |
| 8,000  |  |  |  |  |  |  |  |  |  |
| 7,000 |  |  |  |  |  |  |  |  |  |
| 6,000 |  |  |  |  |  |  |  |  |  |
| 5,000 |  |  |  |  |  |  |  |  |  |
| 4,000 |  |  |  |  |  |  |  |  |  |
| 3,000 |  |  |  |  |  |  |  |  |  |
| 2,000 |  |  |  |  |  |  |  |  |  |
| 1,000 |  |  |  |  |  |  |  |  |  |
| 0 |  | New Delhi | Kathmandu | Lukla | Base Camp | Camp I | Camp II | Final Camp | Summit |
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**INTERPRETING DATA: ELEVATION**

1. What pattern in temperature did you notice as the climbers traveled to Everest?
2. Why might the climbers have to wear oxygen masks on the final part of the climb?
3. How do you think air density relates to air temperatures?
4. Based on the story that you read and the data you collected, what reason might you have to explain the change in temperature as you travel to higher elevation?