## FACTivity

### Time Needed

One class period

### Materials (for each student or group of students)

- Table on page 72
- Four blank pieces of graph paper (page 123)
- Pencils
- Rulers

The question you will answer in this FACTivity is: What is the relationship between the level of chemicals in a city's soils and level of the same chemicals in the city's riparian areas?

### Methods

Examine the table on page 72. This table contains actual data provided to you by the scientists in this study. The table presents the median and mean (average) levels of chemicals found in the Gwynns Falls watershed's riparian areas. The table also presents the median and mean level of chemicals in Baltimore city soils.

You will construct bar graphs based on the data in table 1 to help you understand the data. You can use the graph paper on page 123 to help you construct your bar graphs. You will have to understand the difference between the mean, or average, and the median. The mean is the value of all the values summed and divided by the number of values. The median is the middle value in a list of values, ordered from the smallest value to the largest value.

Your teacher may hold a class discussion about what these two values represent. Both values are summary values, intended to give you a feel for the entire list of values. The average, however, is sensitive to values that may be very different from most of the other values. The median, on the other hand, is not influenced by values that are very different from most of the other values.

- First, construct a bar graph for the mean value of the chemicals expressed as a percentage of a volume. Include both the Gwynns Falls Riparian Sediments and the Baltimore City Soils. Label the x-axis and y-axis.
- Next, construct a bar graph for the mean value of the chemicals expressed in ppm. Include both the Gwynns Falls Riparian Sediments and the Baltimore City Soils. Label the x-axis and y-axis.

#### How Much Is 1 PPM?

1 part per million (ppm) is roughly equal to:

1 inch in 16 miles
1 second in 11.5 days
1 minute in 2 years

- Now, observe your two bar graphs showing mean values. What do you notice about the amount of chemicals in Baltimore City Soils compared with the amount of chemicals in the riparian areas? What explanations do you have for your results?
- Now, construct a bar graph for the median value of the chemicals expressed as a percentage of a volume. Include both the Gwynns Falls Riparian Sediments and the Baltimore City Soils. Label the x-axis and y-axis.
- Next, construct a bar graph for the median value of the chemicals expressed in ppm. Include both the Gwynns Falls Riparian Sediments and the Baltimore City Soils. Label the x-axis and y-axis.

Blank graph paper is located on page 123.

- Now, observe your two bar graphs showing median values. What do you notice about the amount of chemicals in Baltimore city soils compared with the amount of chemicals in the riparian areas? What explanations do you have for your results? How do the two pairs of graphs compare? Did each statistical measure (mean and median) lead you to the same explanations?

What do you conclude about using different statistical measures? Your teacher will lead a class discussion about your class explanations and the effect of using different statistical measures to represent and summarize data.

| Chemical | Symbol | Gwynns Falls Riparian Sediments | | Baltimore City Soils | | Unit of Measurement (ppm = parts per million) |
|---|---|---|---|---|---|---|
| | | Median | Mean | Median | Mean | |
| Aluminum | Al | 1.9 | 1.8 | 1.4 | 1.4 | % |
| Calcium | Ca | 0.29 | 0.46 | 0.025 | 0.043 | % |
| Copper | Cu | 20 | 30 | 35 | 45 | ppm |
| Iron | Fe | 2.2 | 2.0 | 2.2 | 2.3 | % |
| Magnesium | Mg | 0.39 | 0.39 | 0.22 | 0.27 | % |
| Manganese | Mn | 450 | 440 | 420 | 470 | ppm |
| Lead | Pb | 35 | 76 | 89 | 231 | ppm |
| Zinc | Zn | 63 | 120 | 81 | 141 | ppm |
| Cadmium | Cd | 54 | 170 | 89 | 106 | ppm |
| Cobalt | Co | 11 | 12 | 12 | 15 | ppm |
| Chromium | Cr | 32 | 31 | 38 | 72 | ppm |
| Potassium | K | 0.12 | 0.14 | 0.076 | 0.090 | % |
| Molybdenum | Mo | 35 | 97 | 300 | 500 | ppm |
| Sodium | Na | 150 | 150 | 96 | 120 | ppm |
| Nickel | Ni | 26 | 40 | 18 | 27 | ppm |
| Phosphorus | P | 300 | 330 | 460 | 530 | ppm |
| Titanium | Ti | 110 | 110 | 197 | 282 | ppm |
| Vanadium | V | 31 | 33 | 31 | 37 | ppm |

**Table 1.** Chemicals Measured in Gwynns Falls Watershed Riparian Areas and Baltimore City Soils. Parts per million, or ppm, is a measure of how concentrated the chemical is in water. Percentage is a measure of the percent of a particular volume of liquid that contains the chemical.

## Natural Inquirer Connections

You may want to reference these *Natural Inquirer* articles for additional information and FACTivities:

- "Green Means Clean" on page 7 of this edition of *Natural Inquirer*. The FACTivity demonstrates the difference between runoff in vegetated, agricultural, and paved areas. You can modify this FACTivity by eliminating the agricultural option and assuming that the oil represents chemicals in the water.
- "Food for the Soil" *Natural Inquirer* monograph. The FACTivity simulates how water flows onto streambanks during a flood and deposits materials on the streambanks.

These resources can be found at: http://www.naturalinquirer.org/all-issues.html.

If you are a trained Project Learning Tree educator, you may use "Water Wonders," "Field, Forest, and Stream," and "Soil Stories" as additional resources.

## Web Resources

The U.S. Geological Survey (USGS) Water Science School: Runoff
http://water.usgs.gov/edu/runoff.html

The U.S. Geological Survey (USGS) Water Science School: Sediment
http://water.usgs.gov/edu/sediment.html

When It Rains It Runs Off: Runoff in Urbanized Areas in Arizona
http://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1542.pdf

How does this scene relate to what you learned in this article?