

LESSON**Representing and Making Meaning from Data**

Students use data and graphs to draw conclusions about Baltimore's water supply and road salt.

What We Are Hoping For: Learning Goals

- Abiotic and Biotic Factors
- Water
- Runoff
- Human Impact
 - A, B, C
- Nature of Science
 - A-E
- Data Representation
 - A, B, C

Learning Goals:

- Using data to make conclusions
- Connecting Baltimore data to New York City's water supply

CHECKLIST

How Do You Investigate and Represent Data?

In this lesson, students will:

- Complete graphing their data **(20 min)**
- Discuss the importance of adding benchmarks and population densities to the graphs. **(5 min)**
- Use data to draw conclusions about Baltimore's water supply and road salt. **(8 min)**
- Make connections between Baltimore and your city's water supply. **(5 min)**
- Write their conclusions in the *Representing and Making Meaning from Data* section of the Investigation Booklet. **(7 min)**

(Times indicated are approximate.)

1. Students continue to graph data from the previous lesson. (20 minutes)

Setting Up Graphs

Getting a start on graphing the salt level data.

If they don't already have the datasets, distribute the complete datasets to the class, from the "How to Represent Data" activity.

Graphing Directions

A guide to group work on the graphs

- 1) Hand out the graphing template to each group of 4, which is prepared with a preset scale and a benchmark from the salt and ecosystems case study.
- 2) Assign each student one of the datasets: 1-forested, 2-suburban, 3-urban, and 4-annual data.
- 3) Before graphing ask students to use the salt and ecosystem case studies (see the "Salt and Ecosystems" activity) to add 2-3 more benchmarks onto their graphs. The students can use the sample benchmark as a guide for how to put the benchmarks onto the graphs.
- 4) Groups can choose a bar or line graph, but each person in the group must do the same type of graph for ease of comparison.
- 5) Ask students to fill in different population density levels for each area, which can be found on their datasets on the top of the graph next to the key.
- 6) Ask students to choose the appropriate check boxes in the title
 - Pick one checkbox for annual or seasonal
 - Pick all checkboxes that apply for forested, suburban, and urban streams
- 7) Remind students to individually label their lines or bars, if they are plotting data from more than one stream on their graphs (e.g. the annual dataset includes data from forested, suburban, and urban streams).
- 8) Check student work.
- 9) Ask students to begin graphing. If a student finishes early, they can begin to graph other datasets onto their graph. *Note: Make sure students delineate between the different datasets by using different colors or style of lines.*

Tips for Graphing

It is important for the students to complete the graphs correctly because their analysis hinges on the correct plotting of their data.

- When students plot the salt and freshwater benchmarks, they should use a straightedge to draw a straight line at the correct level of salt.
- When student groups choose to do a line or bar graph, make sure that everyone makes the same type of graph for ease of comparison.
- Ask students to complete the graph in pencil first and check their points before having them connect their lines or create their bars.

Scaffold — Rounding Numbers

Some students might need help determining how to round off numbers. For more instruction on rounding, try these websites:

[Math is Fun, Rounding Numbers](http://www.mathsisfun.com/rounding-numbers.html)

<http://www.mathsisfun.com/rounding-numbers.html>

[My Schoolhouse — Rounding Numbers](http://www.myschoolhouse.com/Teachers/Resources/rounding%20numbers.htm)

<http://www.myschoolhouse.com/Teachers/Resources/rounding%20numbers.htm>

2. Discuss the importance of adding benchmarks and population densities to the graphs. (5 minutes)

Contextualizing Data

Discuss the importance of adding benchmarks and population densities to the graphs.

Discussion

Key Idea: Dr. Sujay Kaushal chose to compare urban, suburban, and forested streams to gauge human impact on streams.

Question: Why was it important to incorporate the benchmarks and population densities of the different areas onto the graphs?

Answer: The benchmarks are a way to contextualize the salt levels in the Baltimore area with other salt levels. The population densities show how many people live and drive in the area, which has a direct relationship to how many roads there are and therefore how much salt enters area waterways.

Note: Remind students that NYC has a much higher population density (26.403 people/mile²) than Baltimore.

3. Compare graphs, and use the data to make conclusions about Baltimore's water supply and road salt. (8 minutes)

Comparing Graphs, Making Conclusions

Using data to make conclusions about Baltimore's water supply and road salt.

Reintroduce the guiding question, "How might snowy and icy roads affect Baltimore's water supply" before asking students to begin comparing their graphs.

Discussion

Key Idea: The amount of salt people added into freshwater ecosystems depends upon population density and number of roadways.

Recall that we began with the question, "How might snowy and icy roads affect the Baltimore area's water supply?" We thought that road salt would make its way into streams during winter months, and that we'd find more salt in streams near roads during snowier weather. We graphed the actual datasets that Dr. Kaushal analyzed. Now it is time to start drawing conclusions by looking for patterns in the data.

Question: What patterns do you see?

Answers: Seasonal pattern (more salt in water in the winter) Location pattern (more salt in urban areas than suburban or forested areas).

Question: What conclusions can you make from these patterns?

Answer: Salt put on roadways to melt snow and ice enters area streams making the water salty. The areas with the highest population density and the most roads have streams with the highest salt content.

Question: What are some consequences of salt entering the water supply of Baltimore on living things?

Answers: At 226 mg/L freshwater animals and plants will begin to die, at 400 mg/L some frogs will die, and at 1,000 mg/L freshwater fish like rainbow trout will die. Organisms that eat small plants and animals will also be affected because the food they eat will no longer be available.

Did you notice the increased levels of salt in the forested stream in the summer?

Dr. Kaushal thinks that salt levels increase in forested streams in the summer because there is less water in the stream causing the salt that is there to become more concentrated.

Misconception Alert**Individual salt footprint is lower in high-density urban areas than low-density rural areas**

Someone who lives in a rural area will contribute more to stream salt levels than someone who lives in an urban area. In rural areas, large areas of roadway are treated with salt to allow few people to travel. On a per person basis more roads exist.

Although, cities have many more roads than rural areas, they have fewer roads on a per person basis.

Stated another way - If all the people in New York City (over 8 million) moved to rural areas many more roads would need to be constructed, meaning a lot more salt would need to be added to roadways.

4. Generalize from the Baltimore data to apply conclusions to your city's water supply. (5 minutes)

Generalizing Conclusions to Your Water Supply

What do our conclusions about Baltimore mean for our local water supply?

Show the map of New York City's water supply or your water supply to help students make connections between the conclusions drawn about Baltimore's water supply to your water supply.

Discussion

Key Idea: Scientific findings can be generalized and applied to other similar situations.

Question: So you just used evidence to conclude that salt used to keep Baltimore's roadways clear is entering into its water supply. How can you apply what you just learned to your drinking water supply?

Answers: Our water supply may also have higher levels of salt because important parts of our water supply are near roads that are salted during the winter months.

5. Complete the *Representing and Making Meaning from Data* section of the Investigation Booklet. (7 minutes)