What is the source of Fruitvale’s pesticide contamination?

Lesson Overview: In this lesson students will explore a pesticide spill in the fictional town of Fruitvale. The materials and worksheets for this lesson are included in the experimental setup provided by SEPUP Inc. (http://sepuplhs.org/). Information presented in this lesson is meant to supplement the existing teaching materials contained in the Fruitvale Investigation experiment.

Lesson Core

The Guiding Question: What is the source of the pesticide spill in Fruitvale?

Safety precautions: None.

Advanced Preparation: Prepare all worksheet packages for each student using the worksheets provided in Sepup materials including the Fruitvale background story, data sheets, and Fruitvale maps. Prepare a short presentation to describe and define the important terms outlined below.

Background Information for Teachers: Prior to instruction teachers should review all materials of interest in the SEPUP experiment materials.

Engage: How can we determine the source of a pesticide spill in groundwater?

Building on prior knowledge:

- What does a pesticide plume in groundwater look like?
- How fast does groundwater move?
- What concentration is a pesticide dangerous to humans?
- How can we measure the concentration of a pesticide in groundwater?
- Who should be tasked with cleaning up a pesticide spill in a public drinking water source?
Pre-teaching: Students should have a good understanding of water quality and the relationship between land use and water quality prior to this lesson. See previous lessons in the Watershed Connections and Groundwater and Biogeochemical Connections Units.

Explore:
Review with students the PowerPoint presentation ‘Groundwater’. Use this presentation as a guideline to direct students into thinking about how groundwater moves. Students should understand the relationship between groundwater and potential contaminants prior to completing the Fruitvale experiment.

Have students complete the activities in the Fruitvale investigation regarding the understanding of concentration (serial dilution). Pair students together into small lab groups. Read as a class the background information detailing the current knowledge of the pesticide spill in Fruitvale. Have students highlight or discuss the major clues in each section of the story. For example, what can we conclude from speaking with our friend’s family? How may Randy’s filling station play a role in the pesticide spill. Remind students that they will be using this information as a base for their upcoming investigation.

Explain to students that they will act as hydrologists tasked with modeling and determining the source of the pesticide pollution in Fruitvale’s drinking water. Each group will test 12 wells in Fruitvale and use their results to model the pesticide plume in Fruitvale’s groundwater. Each group will then use this information to decide the origin of the pesticide spill by examining different land uses in Fruitvale that may impact the quality of their drinking water.

Explain:
Each student will prepare a scientific lab report to explain their results. Review as needed the organization and vital components of a scientific report. Review the ‘Trouble in Fruitvale: Report Guidelines’. Because the student’s estimated pesticide plumes will vary based on the wells they chose to test, have each pair share their plume map with the class. Use this time to discuss why the plumes may look different and the potential sources of the pollution in Fruitvale. Ask students to explain where they think the pesticide spill originated. How might this look 8 years later given groundwater movement? Does your map reflect this? Ask students why their maps may look different from the maps of other groups.

Elaboration: A mock debate may be used to further examine the pesticide plume in Fruitvale. Students will be given a particular role to play in the community and will participate in a mock debate to A) determine the source of the pesticide spill in Fruitvale and B) decide who will be tasked with cleaning up the town’s groundwater. The materials for this debate are available in the Fruitvale investigation materials from SEPUP. Additional roles may be used to increase the breadth of the community members involved in the debate. This should encompass 2 additional class periods. In the first class period students will be assigned to a community role and given time to prepare their arguments. On the second day, each group will be given time to address their viewpoints and the city council will decide who should clean up the groundwater.

Evaluate: Students will be evaluated based on their participation in the experiment as well as on their individual lab reports. Use the attached ‘Trouble in Fruitvale: Lab Report Evaluation’ to grade student lab reports.
Lesson Closure:

- What is the most useful thing you learned in doing this experiment?
- Could something like this happen in your town?
- How could you tell if your groundwater supply was contaminated?
- In what ways do community members contribute to groundwater quality?
- Who should monitor groundwater quality in our area?
- Can you think of ways that we could modify present land use activities in our area to limit the amount of potential pollutants reaching our drinking water?

Lesson Extension

Additional Resources:

- United States Geological Survey (USGS) and Michigan State University (MSU) map viewer gives geographic data on water sources and contamination sites in Michigan (http://gwmap.rsgis.msu.edu/viewer.htm).

- Michigan Technological University's Tech Alive web modules provide information and animation to describe the concept of groundwater http://techalive.mtu.edu/meec_index.htm
Trouble In Fruitvale: Report Guidelines

Your lab report should include the following:

A. Title:
   - Descriptive title of your experiment.
   - Names of all group members.

A. Introduction:
   - Background information on the Trouble in Fruitvale.
   - The objective(s) or purpose of your research.
   - Clear statement of your hypothesis using an if/then statement.
   - Brief explanation of why you chose your hypothesis.

B. Methods:
   - Detailed step by step methods in paragraph form describing how you completed your experiment.

A. Results:
   - Explanation of your results in paragraph form. Describe the differences in the data you collected (e.g., highest and lowest value, trends).
   - One data table containing the data from your 12 test wells with a descriptive caption.
   - Reference the table in the text.
     - Example: “We observed the highest concentration of pesticide in well 29 (Table 1). Using this data, we estimated the area of the pesticide spill in Fruitvale (Figure 1).”

A. Discussion:
   - Interpret your data and the conclusions you can draw from it.
   - Provide evidence to accept or reject your hypothesis.
   - One figure containing a map of Fruitvale with the pesticide plume colored by concentration according to the class results from all of the wells tested with a descriptive caption.
   - Explain what you think the pesticide plume in Fruitvale’s groundwater supply looks like and why.
   - Reference the figure in your text (see table example above).

B. Conclusions:
   - Briefly summarize the experiment and your conclusions.
   - Provide one suggestion for how to improve the experiment or what you would do differently if you repeat the experiment.

Notes:
   - Your report must be typed using MS Word and free of grammar mistakes.
   - All information must be in your own words. Any plagiarism in the report earns a score of 0 for both group members.
   - Each group member must contribute equally to the report.
### Trouble In Fruitvale: Lab Report Evaluation

**Grading Standard:**

- **0 points** *None*- the student has not met any of the requirements for this criterion.
- **1 point** *Fair*- the student has only minimally met the requirements for this criterion and it is incomplete or incorrect.
- **2 points** *Good*- the student has met most of the requirements or it contains minor mistakes.
- **3 points** *Excellent*- the student has met all of the requirements; it is complete and correct.

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<tr>
<th>Requirement</th>
<th>3pts</th>
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<tr>
<td>The report is free of grammar and spelling mistakes.</td>
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<td>The report contains a title, student names, and the five sections of a scientific report.</td>
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<td>The hypothesis and justification is clearly stated in the Introduction.</td>
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<td>An explanation of the hypothesis is explained in the Introduction.</td>
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<td>The Introduction contains sufficient background information.</td>
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<td>The Methods are clearly explained and logically organized.</td>
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<td>Results are easy to interpret and summarize data collected.</td>
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<td>A table of data is included with proper format and labels with a reference in the text.</td>
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<td>The Discussion contains interpretation of the results and contains a properly labeled figure.</td>
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<td>A statement of acceptance or rejection of the hypothesis is explained in the Discussion.</td>
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<td>A colored map of the pesticide plume is included and referenced in the text.</td>
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<td>The Fruitvale pesticide plume map is explained clearly in the Discussion.</td>
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<td>The Conclusion section contains a summary of the experiment and suggestions for improvement.</td>
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<td>Each group member participated equally in preparing the report.</td>
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Total Score __________ of 45 points