



## Activity Description & Estimated Class Time

Over the course of three to five 50-minute class periods, students try to solve a water pollution mystery in an imaginary town. Use the Fruitvale teacher's guide to work through this activity. The Fruitvale kit contains many excellent activities not covered in this Hydrosphere Teachers Guide. We encourage teachers to explore the kit beyond what we present here. The whole Fruitvale kit is included in the Hydrosphere kit. The Fruitvale teachers guide **MUST BE RETURNED** with the other non-consumable materials.

## Correlations to NC Science Standards

ESS.8.3.1 Analyze and interpret data to predict the safety and potability of water supplies in North Carolina based on physical and biological factors, including: temperature dissolved oxygen, pH, nitrates and phosphates, turbidity, and bio-indicators.

ESS.8.3.2 Engage in argument from evidence to explain that the good healthy of humans and the environment requires: monitoring of the hydrosphere, water quality, standards, methods of water treatment, maintaining safe water quality, and stewardship.

## Learning Target

Students will demonstrate knowledge and understanding of reciprocal relationship between the hydrosphere and humans.

## Brief Science Background

Background is in the Fruitvale teacher's guide starting on page 1, Activity 1, The Fruitvale Story, Part I. We recommend using all 12 lessons in Fruitvale in 14-20 class periods, but recognize that few teachers devote that much time to this topic. CIBL suggests compressing many of the Fruitvale activities, even though all the activities are excellent and valuable. The procedure below explains CIBL's suggestions.

## Part 1 — The Fruitvale Story

### Materials

#### Materials for groups of 2 students

- *The Mystery of Fruitvale's Water* story (pg. 7-9)
- 2 *The Mystery of Fruitvale's Water* student activity sheet (SD 1)

### Procedure

1. Give materials to students.
2. Read *The Mystery of Fruitvale's Water*, aloud as a class, a paragraph at a time. Pause after each paragraph to give students time to put something in each column on their student activity sheet (SD 1).
3. Ask them to write a few paragraphs about the situation and what they would do to investigate it.
4. Afterward, discuss the story as a class for a few minutes.

**At this point, students do not know the nature of the pollutant, but they will find out later. If students do not mention groundwater movement and topography, try to direct their attention to these factors.**



## Part 2 — Understanding Groundwater

### Materials

#### Materials for groups of 2 students

- *The Original Super Soaker* (SD 2)
- *Comparing Sand, Gravel, and Clay* (pg. 32)
- *Groundwater Movement* (pg. 33)
- *Groundwater Contaminants* (pg. 34)
- *Earth's Groundwater Supply* (pg. 27)

### Procedure

1. Ask students, "Where does water go when it falls to the earth?"  
**The earth is not a solid. Point out that most soils and many types of rocks have lots of space within them that can hold water.**
2. Ask students, "How does water "disappear" into solid ground? Where does it go? Can we get it back once it has disappeared?" Compile a list of student suggestions on the board.
3. Distribute and read *The Original Super Soaker* (SD 2), aloud as a class. Point out the new vocabulary introduced: permeable, impermeable, aquifer, and aquitard. Tell students that they will learn about three earth materials: gravel, sand, and clay.
4. Distribute and display *Comparing Sand, Gravel, and Clay*. Ask students "What properties of sand, gravel, and clay do you think affect the ability of each material to hold water? What properties affect the ability of water to move through them?" Discuss answers as a class.  
**Answers can be found on pg. 19 under step 3, synthesizing, question 2.**
5. Ask students "Of the three earth materials - gravel, sand, and clay - which would make the best aquifer? Which makes the worst aquifer?" Probe students to give evidence for their choices.  
**Answers can be found on pg. 19 under step 3, synthesizing, question 4.**
6. Distribute and display *Groundwater Movement*. Discuss aquifers and their importance by following the instructions on pg. 19 step 4.
7. Distribute *Earth's Groundwater Supply* and complete the lesson using step 5, read about the earth's groundwater supply, on pg. 20. Answer the analysis questions as a class.

## Part 3 — Fruitvale Maps

### Materials

#### Materials for groups of 2 students

- *Street Map of Fruitvale* (pg. 11)
- *Topographic Map of Fruitvale* (pg. 55)
- *Geologic Cross Section of Fruitvale* (pg. 56)

### Procedure

1. Hand out materials to each pair.
2. With the whole class, examine the three maps for more clues about Fruitvale's water pollution problem. Depending upon your knowledge and other resources, this process could take a full class period or several class periods. You might use these maps one-at-a-time. These topics are covered for a class period or more each in the Fruitvale teachers guide. They are Activity 4, Interpreting Maps, and Activity 5, Modeling Groundwater Contamination



## Part 4 — Pesky Pesticide

### Materials Materials for groups of 2 students

- *Pesky Pesticides* (pg. 91-92)
- 2 *Pesky Pesticides* student activity sheet (SD 3)

### Procedure

1. Give materials to students.
2. Read *Pesky Pesticide*, aloud as a class, a paragraph at a time. Pause after each paragraph to give students time to put something in each column on their student activity sheet (SD 3).
3. Ask students "What information and evidence do we have that is relevant in solving the mystery of Fruitvale's water?"
4. Based on the information that was gathered from the reading and what students know about groundwater have them answer the following questions:
  - a. Which three locations on the map are the most likely sources of pesticide?
  - b. Why did you pick each one and how could it have contributed to the water contamination?
  - c. What more would you like to know about Fruitvale and its water supply?
5. Discuss students answers as a class.

Additional information and answers can be found on page 88 and 89.

## Part 5 — Testing Fruitvale's Wells

### Materials Materials for whole class

- set of 40 dropper bottles labeled: Fruitvale Water Sample (Wells 1-40)
- dropper bottles of universale indicator (1 per 4 students)
- paper towels (provided by teacher)
- colored pencils (provided by teacher)

### Materials for groups of 2 students

- 2 *Map of Fruitvale's Wells, Student Sheet* (pg. 95)
- 2 student Fruitvale testing plan (SD 4)
- chemplate

### Preparation

Allow for approx. 20 min.

1. Divide the 40 bottles of well water into four sets of 10 bottles each:
  - a. Set 1 consisting of Wells 1-10
  - b. Set 2 consisting of Wells 11-20
  - c. Set 3 consisting of Wells 21-30
  - d. Set 4 consisting of Wells 31-40
2. Clearly label each set with the well numbers in that set.
3. Place each set in a different, but easily accessible, part of the room.

More information can be found in the Fruitvale teachers guide from *Testing for Pesticide Concentrations, Activity 8*, pp. 97-100.

**Procedure**

1. Hand out materials to each team.
2. Inform students that they will work with their group to make a plan to test **12 wells** in Fruitvale. They should use what they learned from both readings and the maps (street map, topographic and geologic cross section, and wells) to help make their choices.
3. Ask students to test samples from test wells **3-at-a-time** and fill in their student Fruitvale testing plan (SD 4). They will complete the first two columns on the chart before doing any testing.
4. As they test each well, students will record the data in the last 3 columns and shade in the circles on the *Map of Fruitvale's Wells* to match the test color of the wells.  
**More information can be found in the Fruitvale teacher's guide from Testing for Pesticide Concentrations, Activity 8, pp. 97-100.**

## Part 6 — Plume of Contamination

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**Materials****Materials for groups of 2 students**

- completed *Map of Fruitvale's Wells, Student Sheet*
- completed student Fruitvale testing plan

**Procedure**

1. Explain to students that they will now use the results from their testing to draw the plume of the contamination in Fruitvale. Their plume should show the outline or shape of the spread of the contamination, and should be based on data. Using pencil, or colored pencil, students should outline the plume on their completed *Map of Fruitvale's Wells Student Sheet* that shows the colored circles reflecting the contamination level of the wells' tests.
2. To help with drawing the plume, students should use their well testing data, any information from the readings that gives information on the contamination, the topographic maps, and the geologic cross section map.
3. After students have drawn their plumes, have other groups share their plumes. Discuss why there are differences.  
**This is a good time to discuss how drawing conclusions from data can include uncertainty and how more data can improve the accuracy of conclusions.**
4. The “correct” answer is not particularly important here. If you would like to share the “answer” to the mystery, see pg. 116 in the Fruitvale teacher’s guide, right column for details.

**SD 1**      *The Mystery of Fruitvale's Water* Student Activity Sheet

Name:

As you read the *The Mystery of Fruitvale's Water* complete the chart below.

<b>Information you learned about Fruitvale's water</b>	<b>Questions you want to ask about Fruitvale's water, or Fruitvale</b>	<b>Ideas on how to get answers to your questions</b>

## SD 2

## The Original Super Soaker

**How does water disappear into the earth and how can we get it back?**

The residents of Fruitvale, both humans and other living organisms, use water that is found on and below the surface of the earth. How and where water flows on the surface may not be a big mystery to you, but do you know how water gets below the earth's surface and how we get it back?

In this investigation, you will learn how water flows through three earth materials - sand, gravel, and clay. This will help you better understand how water is stored and moves beneath Fruitvale. This information might be helpful in understanding and solving the town's water problem.

The ground beneath your feet looks solid, and it certainly feels solid when you jump up and down on it. But what happens when you pour water on the ground? Depending on what the ground is like, it might make a puddle or a little stream, or it might soak right in. Materials that liquids can flow through are called **permeable**, and permeable earth materials that collect water are called **aquifers**. Materials through which liquids cannot soak or flow are called **impermeable**, and impermeable earth materials are called **aquitards**.

SD 3

*Pesky Pesticides* Student Activity Sheet

Name:

As you read *Pesky Pesticides*, complete the chart below.

Important facts, details, and information you learned	Why I think it's important	How I think this information will help me solve the mystery

1. Which three locations on the map are the most likely sources of pesticide?
2. Why did you pick each one and how could it have contributed to the water contamination?
3. What more would you like to know about Fruitvale and its water supply?

SD 4 1 o 2

Fruitvale Testing Plan

Name:

1. Work with your group to make a plan to test 12 wells in Fruitvale. Be sure to use what you learned from both readings and the maps (street map, topographic and geologic cross section, and wells) to help you make your choices.
2. **You will test wells in groups of 3.** Complete the first 2 columns of the chart before doing any testing.
3. Record the data in the last 3 columns and shade in the circles on the *Map of Fruitvale's Wells* to match the test color of the wells as you test them. You will test a total of 12 wells.

Test 1-3

Well Number	Reason for selecting	Test Color	Pesticide Concentration	Hazard Level

What important information did you learn from these wells?



**SD 4 2 o 2**

**Test 4-6**

Well Number	Reason for selecting	Test Color	Pesticide Concentration	Hazard Level

What important information did you learn from these wells?

**Test 7-9**

Well Number	Reason for selecting	Test Color	Pesticide Concentration	Hazard Level

As you prepare to test your last 3 wells, summarize what you have learned so far about the source and spread of the contamination in Fruitvale. What important information did you learn from these wells?