

Reading the River

Summer 2001

**A Study of The Water
General Science Grade 9
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Overall Unit Goal

The overall goal is to develop a series of lessons on watershed and water analysis to be taught in the Earth Science component of the General Science freshman course.

Unit Goals and Objectives

Kentucky State Learner Goals

- Goal 2 – Students develop their abilities to apply core concepts and principles from science to what they encounter throughout their lives.
- Goal 4 – Students develop their abilities to become responsible members of a work group and community.
- Goal 6 – Students develop their abilities to connect and integrate experiences and new knowledge from what they have previously learned and build on past learning experiences to acquire new information.

Kentucky State Academic Expectations / Objectives

- 1.3 – Students will be able to interpret various things observed by participating in class discussion and hands on laboratory water testing and using enviroscape model.
- 2.1 – Students will be able to use scientific ways of thinking and working and use those methods to solve real life problem by learning about water quality and watersheds and how they could apply to their lives.
- 2.3 – Students identify and analyze systems and their ability to affect each other.
- 2.4 – Students will be able to use scientific models such as the Enviroscope model to explain the organization and functions of watersheds and predict other characteristics that might be observed.
- 6.2 – Students will be able to use what is already know to interpret new experiences by understanding the watershed and water analysis.
- 6.3 – Students will be able to expand the understanding of existing knowledge by making connections with new knowledge, skills and experiences.

Program of Studies for Unit

Scientific Inquiry and Scientific ways of Thinking and Working

Students will

- Identify and refine questions and scientific concepts to guide the design of scientific investigation.
- Conduct different kinds of scientific investigations for a wide variety of reasons.
- Use equipment (water chemistry kits), tools, techniques (measuring), technology (calculators, CBL's, LabProbes) and mathematics to improve scientific investigations and communications.

Chemical Reactions

Students will:

- Investigate chemical reactions. (Ph, dissolved oxygen)
- Investigate factors (temperature) affecting reaction rates.

Motions and Forces

Students will:

- Investigate forces and the effects of forces on the motion of objects. (Rate of stream flow)

The Interdependence of Organisms

Students will:

- Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms.

Applications/Connections

Students will:

- Investigate how science can be used to solve environmental quality problems.
- Use science to investigate natural hazards and human induced hazards.
- Analyze the role science plays in everyday life.

Core Content for Unit

Physical Science

- SC-H-1.3.1 Chemical reactions occur all around us.
- SC-H-1.3.2 Reaction rates depend on concentration, temperature, and properties of reactants.

Motions and Forces

- SC-H-1.4.1 Objects change their motion only when a net force is applied.
- SC-H-1.4.3 The electric force is a universal force that exists between any two charged objects.

Life Science: The interdependence of Organisms

- SC-H-3.5.5 Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems.
- SC-H-3.5.1 Atoms and molecules cycle among the living and non-living components of the biosphere.

Lesson 1

Title: The Water Cycle

Objectives:

- 2.3 – Students identify and analyze systems and their ability to affect each other.
- 2.4 – Students will be able to use scientific models to explain the water cycle.

Program of Studies:

Scientific Inquiry and Scientific ways of Thinking and Working

Students will

- Identify and refine questions and scientific concepts about the water cycle to guide the design of scientific investigation.

The interdependence of Organisms

Students will:

- Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms. (Water Cycle)

Applications/Connections

Students will:

- Investigate how science can be used to solve environmental quality problems within the water cycle.
- Use science to investigate natural hazards and human induced hazards.
- Analyze the role science plays in everyday life.

Core Content:

Life Science: The interdependence of Organisms

- SC-H-3.5.5 Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems.
- SC-H-3.5.1 Atoms and molecules cycle among the living and non-living components of the biosphere.

Student Objectives

- Students will be able to identify and refine questions and scientific concepts about the water cycle to guide the design of scientific investigation.
- Students will be able to examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms. (Water Cycle)
- Students will be able to investigate how science can be used to solve environmental quality problems within the water cycle.
- Students will be able to use science to investigate natural hazards and human induced hazards.
- Students will be able to analyze the role science plays in everyday life.

Materials:

Water cycle transparency (picture of water cycle with parts of cycle labeled), water cycle study guide worksheet (describes how pollution can enter water cycle), water distribution information from "Splashing in Kentucky", The Hydrologic or Water Cycle activity and lab from "Splashing in Kentucky", What come around goes around activity from "Splashing in Kentucky", Watch Water Cycle activity from "Splashing in Kentucky", Watersheds from "Splashing in Kentucky".

Activity Procedure:

Day One

1. Introduce with water distribution handout.
2. Discuss the Hydrologic or Water Cycle using handout.
3. Set up the Watch Water Cycle activity.
4. Do water Cycle study guide worksheet.

Day Two

1. Review with water cycle transparency and interpretive questions.

2. Do What comes around goes around activity.
3. Make observations about Watch Water Cycle activity.
4. Introduce watersheds using watershed handout.

Assessment:

Grade What Comes Around, Goes Around and Interpretive Questions

References:

Neeley, C. L. (1998). Splashing in Kentucky. Kentucky Waterways Alliance. Kentucky Division of Water.

Lesson Two

Title: What Happens to the Water?

Objectives:

- Goal 2 – Students develop their abilities to apply core concepts and principles from science to what they encounter throughout their lives by learning about the watershed.
- Goal 4 – Students develop their abilities to become responsible members of a work group and community by learning what they can do to improve the watershed.
- Goal 6 – Students develop their abilities to connect and integrate experiences and new knowledge from what they have previously learned and build on past learning experiences to acquire new information.

Academic expectations/objectives.

- 1.3 – Students will be able to interpret various things observed by participating in class discussion and hands on use of enviroscape.
- 2.1 – Students will be able to use scientific ways of thinking and working and use those methods to solve real life problem by learning about watersheds and how they could apply to their lives.
- 2.4 – Students will be able to use scientific models such as the Enviroscope model to explain the organization and functions of watersheds and predict other characteristics that might be observed.
- 6.2 – Students will be able to use what is already know to interpret new experiences by understanding the watershed.
- 6.3 – Students will be able to expand the understanding of existing knowledge by making connections with new knowledge, skills and experiences.

Program of Studies:

The interdependence of Organisms

Students will:

- Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms. (Enviroscape activity)

Applications/Connections

Students will:

- Investigate how science can be used to solve environmental quality problems.
- Use science to investigate natural hazards and human induced hazards.
- Analyze the role science plays in everyday life.

Core Content:

Life Science: The interdependence of Organisms

- SC-H-3.5.5 Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems.

The Fruitvale Story Lesson Plan **General Science**

Note: *Investigating Groundwater: The Fruitvale Story* is an instructional module developed by SEPUP (The Science Education for Public Understanding Program), Lawrence Hall of Science, and the University of California at Berkeley. The module is purchased as a self-contained kit with all materials and an instruction book. Kits are available from **Lab-Aids, Inc.** All activities in these lessons are adapted from this module.

Rationale

The Fruitvale Story is a SEPUP module designed to allow students to investigate groundwater. The module presents process concepts and societal- issue concepts. At the beginning of the module students are presented with a problem that exists in a town: test wells have indicated the presence of a pesticide in the town's groundwater, which supplies the town. As students complete the module, they will collect and process scientific information and make decisions based on their findings. Students will learn about the factors affecting groundwater, the chemical tests used in water sampling, and the societal issues that come into play to try to correct the problem. In these activities, students are active learners performing a simulation that addresses a real-life problem

Student Objectives:

Student Objectives

1. Students will investigate factors affecting groundwater movement and make predictions.
2. Students will identify key information when presented a problem to develop a hypothesis.
3. Students will investigate the behavior of chemicals in a solution.
4. Students will investigate the chemical nature of pesticide and determine factors necessary for establishing safe limits.
5. Students will investigate methods of treating contaminated groundwater and present various clean-up options.
6. Students will evaluate options and make decisions.

7. Students will be able to examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms. (Enviroscape activity)
8. Students will be able to investigate how science can be used to solve environmental quality problems.
9. Students will be able to use science to investigate natural hazards and human induced hazards.
10. Students will be able to analyze the role science plays in everyday life.

Materials:

Fruitvale SEPUP materials:

1. Clay (30-35cc), gravel (30-35cc), sand (30-35cc), stopwatch, 4 25 cm * 3.75 cm plastic tubes, water, Student sheets presented *Investigating Groundwater: The Fruitvale Story* teacher supplement.
2. 15 Chemplates, 15 medicine droppers, 15 small cups for rinse water
3. Overhead transparencies: map of Fruitvale, contamination plumes
4. 40 well samples in dropping bottles, 4 bottles of universal indicating solution, centimeter rulers
5. Role-playing tip cards, audience participation tip cards

Other Materials:

1. Understanding Watersheds using Enviroscape model from “Sanitation District Number One”
2. Soda Sink activity from “Splashing in Kentucky”
3. Urban Runoff handout from “Splashing in Kentucky”
4. The Path of Water through Northern Kentucky handouts from “Sanitation District Number One”.

Activity Procedure:

Note: Each class period is 90 minutes.

Day One

1. Demonstration of the differences of the movement of water through different earth materials (sand, clay, and gravel) Each material is prepared ahead of time in a clear tube. Students make predications about how fast the water will move through the tubes.
2. Complete demonstration timing the movement of water through the materials in the tubes.
3. Students complete *Solids and Liquids* worksheet.
4. Discussion of the groundwater including porosity, permeability, aquifer, and aquitard.
5. Discussion of the concept of “parts per million”
6. *Parts per Million* Activity.

Day Two

1. Demonstration using Enviroscope model and Understanding Watershed Activity.
2. Discuss demonstration and Urban Runoff handout and The Path of Water through Northern Kentucky handouts.
3. Introduce ground water and non-point source pollution using Fruitvale lab
 1. Overview of problem in Fruitvale.
 2. Students read "The Fruitvale Story".
 3. Discussion of story
 4. Discussion of point and non-point sources with examples. Students make predictions of impacts on environment.
 5. Overview of procedure. Students receive transparencies of maps of Fruitvale. Students use the maps to gather information and create a drilling plan. They may only drill in 12 of the 40 wells due to financial restraints.
 6. Students describe the reasons for their choices made in creating the drilling plan.

Day 3

1. Review ground water, point source and non-point source pollution.
2. Complete Soda Sink Activity.
3. Do chemical analysis involved in Fruitvale lab.
 1. Overview of testing procedure.
 2. Students conduct chemical tests in 12 wells. Students may change their original plan as they gather information from the test results and record data on the Fruitvale map.
 3. Students use the information gathered in their well testing to draw contamination plumes on the map of Fruitvale.
 4. Class discussion of results.
 5. Independent Practice: *Movement of Plumes*.

Day 4/ Day 5

1. Over view of role-playing activity.
2. Assignment of roles
3. Individually students prepare for roles.
4. Class role play debating the clean-up procedure.
5. Journal reflection.

Assessment:

Fruitvale student study guide.

References:

Lab-Aids Inc. Investigating Ground Water: The Fruitvale Story. SEPUP.

Neeley, C. L. (1998). Splashing in Kentucky. Kentucky Waterways Alliance. Kentucky Division of Water.

Sanitation District Number One.

Lesson Three

Title: Water Quality

Objectives:

Kentucky State Learner Goals

- Goal 2 – Students develop their abilities to apply core concepts and principles from science to what they encounter throughout their lives.
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- Goal 6 – Students develop their abilities to connect and integrate experiences and new knowledge from what they have previously learned about water testing and build on past learning experiences to acquire new information.

Kentucky State Academic Expectations / Objectives

- 1.3 – Students will be able to interpret various things observed by participating in class discussion and hands on laboratory water testing.
- 2.1 – Students will be able to use scientific ways of thinking and working and use those methods to solve real life problem by learning about water quality and how they could apply to their lives.
- 6.2 – Students will be able to use what is already know to interpret new experiences by understanding water analysis.
- 6.3 – Students will be able to expand the understanding of existing knowledge by making connections with new knowledge, skills and experiences.

Program of Studies:

Scientific Inquiry and Scientific ways of Thinking and Working

Students will

- Conduct different kinds of scientific investigations for a wide variety of reasons.
- Use equipment (water chemistry kits), tools, techniques (measuring), technology (calculators, CBL's, LabProbes) and mathematics to improve scientific investigations and communications.

Chemical Reactions

Students will:

- Investigate chemical reactions. (Ph, dissolved oxygen)
- Investigate factors (temperature) affecting reaction rates.

Motions and Forces

Students will:

11. Investigate forces and the effects of forces on the motion of objects. (Rate of stream flow)

Applications/Connections

Students will:

12. Investigate how science can be used to solve environmental quality problems.
13. Use science to investigate natural hazards and human induced hazards.
14. Analyze the role science plays in everyday life.

Core Content:

Physical Science

- SC-H-1.3.1 Chemical reactions occur all around us.
- SC-H-1.3.2 Reaction rates depend on concentration, temperature, and properties of reactants.

Motions and Forces

- SC-H-1.4.1 Objects change their motion only when a net force is applied.
- SC-H-1.4.3 The electric force is a universal force that exists between any two charged objects.

Student Objectives:

- Students will be able to conduct different kinds of scientific investigations using science equipment.
 - Students will be able to use equipment (water chemistry kits), tools, techniques (measuring), technology (calculators, CBL's, LabProbes) and mathematics to improve scientific investigations and communications.
 - Students will be able to investigate chemical reactions. (Ph, dissolved oxygen)
 - Students will be able to investigate factors (temperature) affecting reaction rates.
15. Students will be able to investigate how science can be used to solve environmental quality problems.
 16. Students will be able to use science to investigate natural hazards and human induced hazards.
 17. Students will be able to analyze the role science plays in everyday life.

Materials:

Sample waters from different creeks and streams of watershed, Lamont testing kit, water chemistry sampling sheet.

Activity Procedure:

1. Demonstrate testing procedure.
2. Have each group of students test three different water samples.
3. Group discussion of water results.

Assessment:

Group sample results



Water Monitoring

General Science

Names of Group Members:

Date:

	Sample No. _____	Sample No. _____	Sample No. _____	Control
Temperature				
PH				
Dissolved Oxygen				
Conductivity				

Question:

1) Describe the water quality of each sample using your results and result indicator sheet.

2) Hypothesize the reasons for your results.

Lesson Four

Title: What is Our Impact?

Objectives:

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- Goal 6 – Students develop their abilities to connect and integrate experiences and new knowledge from what they have previously learned and build on past learning experiences to acquire new information.

Kentucky State Academic Expectations / Objectives

- 2.1 – Students will be able to use scientific ways of thinking and working and use those methods to solve real life problems by learning about water quality and watersheds and how they could apply to their lives.
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Program of Studies:

Scientific Inquiry and Scientific ways of Thinking and Working

Students will

- Identify and refine questions and scientific concepts to guide the design of scientific investigation.

The interdependence of Organisms

Students will:

18. Examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms.

Applications/Connections

Students will:

19. Investigate how science can be used to solve environmental quality problems.
20. Use science to investigate natural hazards and human induced hazards.
21. Analyze the role science plays in everyday life.

Core Content:

Life Science: The interdependence of Organisms

- SC-H-3.5.5 Human beings live within the world's ecosystems. Human activities can deliberately or inadvertently alter the dynamics in ecosystems.

Student Objectives:

- Students will able to identify and refine questions and scientific concepts to guide the design of scientific investigation.

22. Students will be able to examine interrelationships and interdependencies of organisms in ecosystems and the factors that influence the interactions between organisms.
23. Students will be able to investigate how science can be used to solve environmental quality problems.
24. Students will be able to use science to investigate natural hazards and human induced hazards.
25. Students will be able to analyze the role science plays in everyday life.

Materials:

Pollution Monitoring activity from “Splashing in Kentucky”, Pathogens, Excess nutrients and Toxic chemicals handout from “Splashing in Kentucky”, Annual drinking water quality report from “Boone County Water District”, Treating Waste Water from Northern Kentucky from “Sanitation District Number One” and Water Usage Quiz from “Sanitation District Number One”.

Activity Procedure:

1. Discuss water pollution and Pathogens, Excess nutrients and Toxic chemicals handout.
2. Take water usage quiz.
3. Discuss Northern Kentucky’s drainage setup.
4. Introduce portfolio project “How can we improve Boone County’s water quality?”
5. Discuss water quality report from Boone County.
6. Set up Pollution Monitoring Activity.

Assessment:

Portfolio and results of Pollution Monitoring observations.

References:

Neeley, C. L. (1998). Splashing in Kentucky. Kentucky Waterways Alliance.
Kentucky Division of Water.
Sanitation District Number One.