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Fresh Water Ecology Unit for Secondary Education Science Courses

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FRESH WATER ECOLOGY UNIT

for

SECONDARY EDUCATION SCIENCE COURSES

by

Eric L. Hyer

A project submitted to the faculty of

Brigham Young University

in partial fulfillment of the requirements for the degree of

Master of Science

Department of Integrative Biology

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BRIGHAM YOUNG UNIVERSITY

GRADUATE COMMITTEE APPROVAL

of a project submitted by

Eric L. Hyer

This project has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

Date	Val J. Anderson, Chair
Date	R. Dwain Horrocks
Date	Richard R. Tolman

BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee, I have read the project of Eric L. Hyer in its final form and have found that (1) its format, citations and bibliographical style are consistent and acceptable and fulfill university and departmental style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

Date	Val J. Anderson Chair, Graduate Committee
Date	Keith A. Crandall Department Chair

Accepted for the Department

Date	Russell B. Rader Graduate Coordinator

Accepted for the College

Date	Rodney J. Brown Dean, College of Biology and Agriculture

ABSTRACT

FRESH WATER ECOLOGY UNIT

for

SECONDARY EDUCATION SCIENCE COURSES

Eric L. Hyer

Department of Integrative Biology

Master of Science

Science means "to know", a process for gaining knowledge and an understanding of the natural world. Students need to be involved in active learning. In other words, they must do science, not just hear about it. Good science encourages students to gain knowledge by doing science: observing, questioning, exploring, making and testing hypotheses, comparing predictions, evaluating data, and communicating conclusions.

This unit plan is designed to incorporate the components of fresh water, ecology, water quality, and a class-wide science project. Each lesson addresses selected standards from the state core curriculum and has specific objectives that are tied to the learning objectives associated with the state core curriculum.

The unit starts with five lessons that introduce fresh water and the role of fresh water in our lives. Students will learn the stages of the water cycle and participate in discussions and activities that will allow them to see the critical need to conserve, protect, and manage water properly. The next four lessons focus on the importance of

biodiversity and human impact on biodiversity. The last part of the unit pulls the lessons on fresh water and ecology together into a class-wide science project. Students will study how abiotic factors affect water quality and then participate in a project relating those concepts in a study of Hobble Creek, near Springville, Utah. The unit finishes with group presentations about the science project and then a unit test.

There is a good mix of regular classroom instruction and activities along with variation in learning styles. There is note taking, art expression, visual learning, verbal expression, group interaction, guided inquiry, different types of assessment, discussions involving higher level thinking, and hands on learning. The unit takes up nearly four weeks of school time. It will take considerable planning and preparation to teach the lessons, plan and carry out the activities and provide the needed accommodations.

TABLE OF CONTENTS

Title Page	i
Graduate Committee Approval	ii
Final Reading Approval and Acceptance	iii
Abstract	iv
Table of Contents	vi
Introduction	1
Unit Overview	6
Classroom Instruction	16
Fresh Water	17
Lesson 1 – Earth's Fresh Water	18
Lesson 2 – Group Poster on the Water Cycle	25
Lesson 3 – The Worth of Water	30
Lesson 4 – The Price of Water	37
Lesson 5 – Water Budget	42
Ecology	50
Lesson 6 – Ecology Terms	51
Lesson 7 – Biodiversity	62
Lesson 8 – Is Biodiversity A Good Thing?	68
Lesson 9 – Biodiversity and Extinction	74
Scientific Method	88
Lesson 10 – The Scientific Method	89
Class-Wide Science Project	100
Lesson 11 – Abiotic Factors Affecting Water Quality – 1	101
Lesson 12 – Walking Field Trip to Hobble Creek	131
Lesson 13 – Abiotic Factors Affecting Water Quality – 2	140
Lesson 14 – Testing in Class and Sharing Data	144
Lesson 15 – Analyzing Data and Drawing Conclusions	148
Lesson 16 – Group Presentations	152
Unit Test	155
Lesson 17 – Unit Test on Fresh Water Ecology	156
Reflection and Student Evaluations	165

INTRODUCTION

Science is a way of knowing, a process for gaining knowledge and an understanding of the natural world (Utah Science Core Curriculum 2003). It would be very difficult, if not impossible to accomplish the full intent of the State Core by having students read from textbooks or just by lecturing. For some, there exists a belief that teaching is like filling a bucket, pouring knowledge in like water or sand until the child's mind (the bucket) is overflowing. A study by Aguirre et al. (1990) used an open-ended questionnaire to elicit preservice science teachers' conceptions of teaching science. They found students entering preservice education programs "possessed a variety of views about science teaching and learning" with over half believing that teaching is simply a matter of knowledge transfer from teacher to the empty minds of children (Hewson et al 1995). While this strategy may seem sensible to the teacher, for some students, it is very ineffective (Hackett 1992).

Students need to be involved in active learning. In other words, they must do science, not just hear about it. This presents a challenge in teaching science courses. Some classrooms are not really set up or equipped for "hands on" learning. Older schools may not have the necessary facilities for demonstrations and experiments. Newer schools may have the facilities, but not the funding for supplies or equipment. Nevertheless, science teachers can do their very best to ensure that science becomes a tangible and a visual subject that is not limited to a textbook or the classroom. Inquiry becomes a necessary method that can be combined with traditional methods for effective teaching.

Inquiry is the process by which scientists pose questions about the natural world and seek answers and deeper understanding, rather than knowing by authority or other processes (National Science Education Standards 1992). When students study science using inquiry, they employ many different skills that enable them to fully explore a problem. While memorization and recitation is needed in creating a solid foundation to build upon, inquiry is an important technique to include. Inquiry allows students to learn and experience science firsthand by taking on the roles of scientists. Students can take a more active role in their learning rather than the passive role commonly seen in traditional science classrooms. Numerous research studies indicate positive outcomes for inquiry-based science (Krajcik et al. 1998).

Laboratory demonstrations and experiments as well as field experiences are not used as often as they should be. They are often thought to be too difficult, too time consuming, or too expensive. Some teachers avoid them because they don't want to deal with students outside of the classroom who may disrupt or ruin an activity or field trip. Other teachers may feel inadequate in planning and organizing such an activity. Units need to be designed not only to help teachers gain the confidence that is needed to teach science, but also provide students with useful "hands on" activities that add to the classroom instruction. With the current outcry for practical, relevant and hands-on science for secondary students, science educators need to search their local or regional environments for such science teaching opportunities (Glenn 1995).

It is also important for teachers to feel at ease with technological equipment, software, and other resources; and then be able to effectively integrate technology into the instruction to improve student motivation and learning. Computers in the classroom do not represent a cure-all for science education problems but should be seen as complementary to other approaches to teaching science (Hinerman 1994).

The relevance of science topics to the real world is important. By incorporating relevant and current science topics and research into the classroom lessons, we can motivate students to learn and even change their attitudes towards science (Manahan et al. 2006).

This unit has been organized in a way that allows it to be aligned with the Utah State Core Curriculum. Good science encourages students to gain knowledge by doing science: observing, questioning, exploring, making and testing hypotheses, comparing predictions, evaluating data, and communicating conclusions. The State Core is designed to encourage instruction with students in cooperative groups (Utah Science Core Curriculum 2003). There are multiple opportunities in this unit for students to be involved in group work.

Most of the information presented in this unit comes from textbooks that are currently being used at Springville Junior High. They include:

1. EXPLORING EARTH SCIENCE, 1999, Third Edition, Prentice-Hall Inc. Chapter 7 – Earth's Fresh Water, pages 244-249.

2. SCIENCE EXPLORER – ENVIRONMENTAL SCIENCE, 2000, Prentice-Hall Inc. Chapter 1 – Populations and Communities, pages 16-35., Chapter 2 – Ecosystems and Biomes, pages 42-50.

Other resources that were used to plan and implement this unit include:

1. STREAM SIDE SCIENCE – Lessons Plans and Water Related Activities for Utah 9th Grade Earth Systems Science, 2004, *Utah State University Water Quality Extension.*

2. VOLUNTEER STREAM MONITORING: A METHODS MANUAL, 2004, *United States Environmental Protection Agency*. Chapter 5 – Water Quality Conditions. http://www.epa.gov/volunteer/stream/vms50.html

3. IUCN 2004. 2004 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on 14 December 2004.

4. http://en.wikipedia.org/wiki/List_of_cities_by_population

5. http://en.wikipedia.org/wiki/List_of_countries_by_population

6. http://www.infoplease.com/ipa/A0883352.html

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1. SECONDARY CORE CURRICULUM, 2003, *Utah State Office of Education*. http://www.schools.utah.gov/curr/core/corepdf/Scie9-12.pdf

2. Aguirre, J.M., Haggerty, S.M., & Linder, C.J. 1990. Student-teachers' conceptions of science teaching and learning: A case study in preservice science education. *International Journal of Science Education*, 12, 381-390.

3. Hewson, P., et al. 1995. "Determining the Conceptions of Teaching Science Held by Experienced High School Teachers," *Journal of Research in Science* Teaching, 32 (5): 503-520.

4. Hackett, J. 1992. "Constructivism: Hands On and Minds On," *Science Matters* (Staff Development Series, Macmillan-McGraw Hill).

5. National Committee on Science Education Standards and Assessment. 1992. *National Science Education Standards: A Sampler* (Washington DC: National Research Council).

6. Krajcik, J., Blumenfeld, P., Marx, R., Bass, K., Fredricks, J., & Soloway, E. 1998. "Inquiry in project-based science classrooms: Initial attempt by middle school students". *Journal of Learning Sciences,* 7(3/4), 313-350.

7. Glenn, D.D. 1995. "Student field studies in forestry: A suggested paradigm for ecosystem research". *The American Biology Teacher*, 57(4): 240-242.

8. Hinerman, F. 1994. "Multimedia Labs". *Science Teacher,* 61(3): 38-41.

9. Manahan, A., DeCharon, A. 2006. "Bringing Ocean Science News to the Classroom". *Center for Ocean Sciences Education Excellence.*

UNIT OVERVIEW

Unit Plan Overview

This unit plan is designed to incorporate the components of fresh water, ecology, water quality, and a class-wide science project. In planning and organizing this unit, the Utah State Core Curriculum and Learning Objectives were reviewed and considered. Each lesson addresses selected standards from the state core curriculum and has specific objectives that are tied to the learning objectives associated with the state core curriculum.

The unit starts with five lessons that introduce fresh water and the role of fresh water in our lives. Students will learn the stages of the water cycle and participate in discussions and activities that will allow them to see the critical need to conserve, protect, and manage water properly.

The next four lessons are a review of ecology from the 8th grade science core curriculum and a focus on the importance of biodiversity and human impact on biodiversity. The review of ecology is essential as the unit progresses towards the class-wide science project.

The last part of the unit pulls the lessons on fresh water and ecology together into a class-wide science project. Students will study how abiotic factors affect water quality and then participate in a project relating those concepts in a study of Hobble Creek, near Springville, Utah. A review of the scientific method will also be necessary as the students work through the different sections of the science project. The unit finishes with group presentations about the science project and then a unit test.

There is a good mix of regular classroom instruction and activities along with variation in learning styles. There is note taking, art expression, visual learning, verbal expression, group interaction, guided inquiry, different types of assessment, discussions involving higher level thinking, and hands on learning.

The unit is quite long, nearly four weeks of school time. It will take considerable planning and preparation to teach the lessons, plan and carry out the activities and provide the needed accommodations.

Unit Title: Fresh Water Ecology

Time: 17 lessons. Eighteen 45-minute class periods.

Attention Grabber: Daily e-mails using a computer and a projector. Some type of humorous joke or short video clip.

Daily Review:

- Daily review of material learned the previous lesson.
- Regular reminders of missing assignments and due dates.

Objectives: Students will be able to (SWBT):

1. Use Science Process and Thinking Skills
    a. Observe objects, events and patterns and record both qualitative and quantitative information.
    b. Use comparisons to help understand observations and phenomena.
    c. Evaluate, sort, and sequence data according to given criteria.
    d. Select and use appropriate technological instruments to collect and analyze data.
    e. Plan and conduct experiments in which students may:
        - Identify a problem.
        - Formulate research questions and hypotheses.
        - Predict results of investigations based upon prior data.
        - Identify variables and describe the relationships between them.
        - Plan procedures to control independent variables.
        - Collect data on the dependent variable(s).
        - Analyze data and check it for accuracy
        - Select the appropriate format (e.g., graph, chart, diagram) and use it to summarize the data obtained.
        - Construct reasonable conclusions.
        - Prepare written and oral reports of investigations.
    f. Distinguish between factual statements and inferences.

    g. Construct models, simulations and metaphors to describe and explain natural phenomena.
    h. Use mathematics as a precise method for showing relationships.
    i. Form alternative hypotheses to explain a problem.
2. Manifest Scientific Attitudes and Interests
    a. Raise questions about objects, events and processes that can be answered through scientific investigation.
    b. Maintain an open and questioning mind toward ideas and alternative points of view.
    c. Accept responsibility for actively helping to resolve social, ethical and ecological problems related to science and technology.
    d. Evaluate scientifically related claims against available evidence.
3. Demonstrate Understanding of Science Concepts, Principles and Systems
    a. Know and explain science information specified for the subject being studied.
    b. Distinguish between examples and non examples of concepts that have been taught.
    c. Apply principles and concepts of science to explain various phenomena.
    d. Solve problems by applying science principles and procedures.
4. Communicate Effectively Using Science Language and Reasoning
    a. Provide relevant data to support inferences and conclusions.
    b. Use precise scientific language in oral and written communication.
    c. Use proper English in oral and written reports.
    d. Use mathematical language and reasoning to communicate information.
5. Demonstrate Awareness of Social and Historical Aspects of Science
    a. Cite examples of how science affects human life.
    b. Give instances of how technological advances have influenced the progress of science and how science has influenced advances in technology.

c. Understand the cumulative nature of scientific knowledge.

6. Demonstrate Understanding of the Nature of Science
   a. Science is a way of knowing that is used by many people, not just scientists.
   b. Science findings are based upon evidence.
   c. Understand that science conclusions are tentative and therefore never final. Understandings based upon these conclusions are subject to revision in light of new evidence.
   d. Understand that scientific conclusions are based on the assumption that natural laws operate today as they did in the past and that they will continue to do so in the future.
   e. Understand that various disciplines of science are interrelated and share common rules of evidence to explain phenomena in the natural world.
   f. Understand that scientific inquiry is characterized by a common set of values that include logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results and honest and ethical reporting of findings. These values function as criteria in distinguishing between science and non-science.
   g. Understand that science and technology may raise ethical issues for which science, by itself, does not provide solutions.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

b. Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).
c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.
d. Explain that energy enters the vast majority of Earth's ecosystems through photosynthesis, and compare the path of energy through two different ecosystems.
e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).
f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Objective 3: Examine Earth's diversity of life as it changes over time.

a. Observe and chart the diversity in a specific area.
b. Compare the diversity of life in various biomes specific to number of species, biomass, and type of organisms.
c. Explain factors that contribute to the extinction of a species.
d. Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.
e. Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere affect the other spheres of the Earth’s systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

a. Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally, and graph or chart relative amounts in the respective global reservoirs.

b. Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.

c. Relate the physical and chemical properties of water to a water pollution issue.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.

Vocabulary: Hydrologic, evaporation, condensation, precipitation, shortage, excess, ecology, ecosystem, habitat, biotic, abiotic, biodiversity, extinct, recreationist, conservationist, producer, consumer, decomposer, herbivore, carnivore, omnivore, species, evolution, mutation, adaptation, hypothesis, data, pH, acidic, basic, alkaline, turbidity, conductivity, turbulent, dissolved oxygen.

Daily Lessons:

Lesson 1 – Earth's Fresh Water.

Lesson 2 – Group Poster – Water Cycle.

Lesson 3 – The Worth of Water.

Lesson 4 – The Price of Water.

Lesson 5 – Water Budget.

Lesson 6 – Ecology Terms.

Lesson 7 – Biodiversity.

Lesson 8 – Is Biodiversity a Good Thing?

Lesson 9 – Biodiversity and Extinction.

Lesson 10 – The Scientific Method.

Lesson 11 – Abiotic Factors Affecting Water Quality - 1.

Lesson 12 – Walking Field Trip to Hobble Creek.

Lesson 13 – Abiotic Factors Affecting Water Quality – 2.

Lesson 14 – Testing in Class and Sharing of Data.

Lesson 15 – Analyzing Data and Drawing Conclusions.

Lesson 16 – Group Presentations.

Lesson 17 – Unit Test on Fresh Water Ecology.

Materials Needed:

- Computer and projector.
- Daily e-mail or humorous joke.
- PowerPoint presentation on Fresh Water Ecology, slides 1-54.
- Group and student worksheets for each lesson.
- Quizzes and the unit test.
- Poster boards, backing sheets and assorted markers.
- Current water rates and usage from Springville City.
- Overhead projector, blank overheads, colored pencils.
- Bill Nye video on biodiversity.
- “Princess Bride” video.
- Light bulb and base wired to two extension cords, quart jar, sugar, salt.
- Tape measure, flagging material, meter stick, stopwatch, rubber ball.
- Group packets for the science project.
- Assorted water containers – 1000 mL, 30 mL, 10 mL, 2 liter bottles.
- Ti -84 Calculators.

- Vernier - Logger Pro software, temperature probe, pH probe, turbidity sensor, conductivity probe, dissolved oxygen sensor.
- Students should have their own paper and pencils.

Accommodations:

- Provide a printout of the class notes for any students with reading/writing difficulties.
- Assign students with special needs to specific groups for group activities.
- Monitor groups and make changes and accommodations based on group members and their limitations.
- Since videos are checked out for a limited time from the District Office, students who miss the videos will be unable to view them and will need to be given an “excused” in the grade book for that assignment.
- Extra time on quizzes and the unit test.
- Students who are unable to participate in the field trip or other activities will need some type of alternative assignment.

CLASSROOM INSTRUCTION

FRESH WATER

Lesson 1 Overview

The first lesson is a good introduction to fresh water. The water cycle is an important concept of the Earth Systems curriculum. Students need to understand that it is cyclic and that there really isn't a starting stage. You could begin a discussion with any stage. The demonstration on the percentages of water is a good visual learning activity. A review of the material a day or two ahead of time allows for personal stories and examples of the water cycle that need to be included during the presentation of the notes. This lesson is also a good review of the 8th grade curriculum concerning the different phases of water.

Lesson: 1

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review: Starting a new unit, remind individual students of missing assignments from previous unit and due dates for late work.

Lesson Title: Earth's Fresh Water

Objectives: Students will be able to (SWBT):

- List and understand the four parts of the water cycle.
- Recognize the sun as the driving force behind the water cycle.
- Realize the small percentage of fresh water on the Earth.

State Core:

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

b. Illustrate the movement of water on Earth and describe how the processes that move water (eg., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.

Vocabulary: Hydrologic, evaporation, condensation, precipitation.

Lesson Body:

- View PowerPoint slide show on Fresh Water Ecology, slides 1-10.

- Have students take notes during the presentation. Carefully and thoroughly explain each slide. Allow enough time for students to write everything down on each slide.
- On slide #3, have a demonstration ready to show the percentages of salt vs. fresh water. Use a 1000 mL jar, a 30 mL container and a 10 mL container.

<u>Guided Practice:</u> At the end of the lesson, call on individual students to answer questions about the stages of the water cycle and water percentages.

<u>Review:</u> Part of guided practice.

<u>Closure:</u>

- Reminder of learning objectives.
- Tomorrow students will be doing group work, creating posters of the water cycle.
- Students should be thinking about how they will design their poster.

<u>Next Lesson:</u> Group work. Create a poster of the water cycle.

<u>Materials Needed:</u>

- Computer and projector.
- PowerPoint presentation on Fresh Water Ecology, slides 1-10.
- 1000mL jar
- 30 mL container
- 10 mL container
- Students should have their own paper and pencils.

<u>Accommodations:</u>

- Printout of class notes for any students with reading/writing difficulties.

<u>For next time:</u>

- Obtain poster paper, backing sheets, and markers.
- Prepare student worksheets on the group poster assignment.

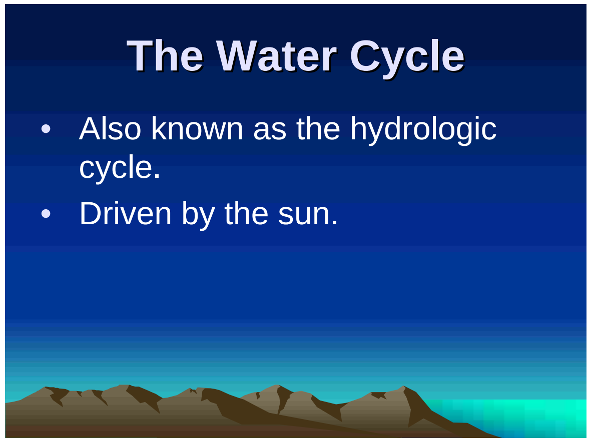
Earth's Fresh Water

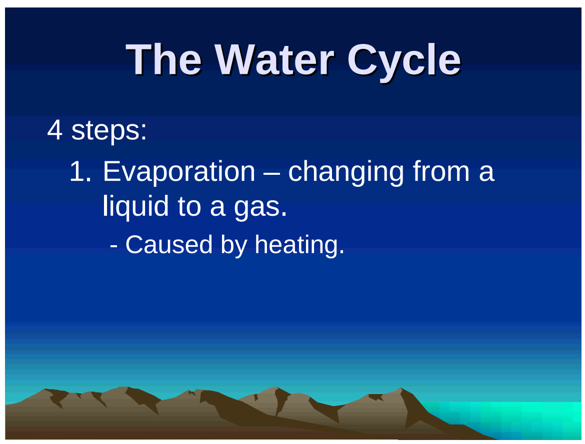
Fresh Water

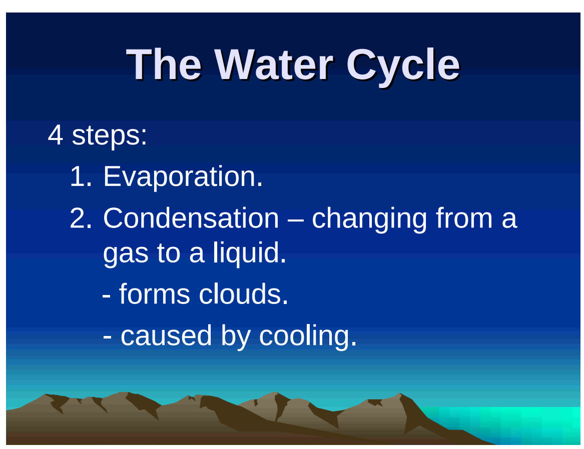
- Necessary to sustain life – all plants and animals.
- Too much – floods, disease, death.
- Too little – drought, starvation, death.

Fresh Water on the Surface of the Earth

- 70% of the Earth's surface is water.
- 97% of water is in oceans.
- 3% fresh water.
- Less than 1% is available for use by living things.


The Water Cycle
• Also known as the hydrologic cycle.
• Driven by the sun.


The Water Cycle
4 steps:
1. Evaporation – changing from a liquid to a gas.
- Caused by heating.


The Water Cycle
4 steps:
1. Evaporation.
2. Condensation – changing from a gas to a liquid.
- forms clouds.
- caused by cooling.

The Water Cycle

4 steps:

1. Evaporation.
2. Condensation.
3. Precipitation – water returns to Earth.
   - rain, snow, sleet, hail.

The Water Cycle

4 steps:

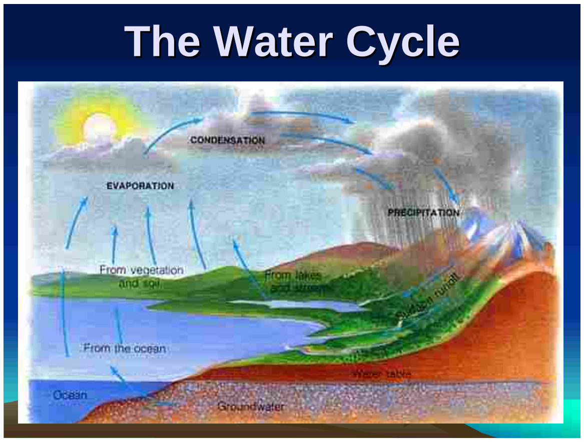
1. Evaporation.
2. Condensation.
3. Precipitation.
4. Runoff/groundwater – collects above ground and underground.

The Water Cycle

4 steps:

1. Evaporation.
2. Condensation.
3. Precipitation.
4. Runoff/groundwater.

– Where would a water droplet spend the least amount of time? The most?


The Water Cycle
CONDENSATION
EVAPORATION
PRECIPITATION
From vegetation and soil
From lakes and streams
Surface runoff
From the ocean
Water table
Ocean
Groundwater

Lesson 2 Overview

This particular lesson is a good activity for reinforcing the concepts learned in the previous lesson about the water cycle and the percentages of water found on the surface of the Earth. Most students enjoy working in groups. This allows for artistic expression and group interaction. Some students don't have much artistic ability. This assignment is frightening to them. By working in groups, it removes some of that anxiety. I never take away points if a student can't draw. It is more important that they make the attempt. It is enjoyable to see individual personalities and creativity expressed in the assignment. It is important to make sure that backing sheets are used to keep marks off the desks. Some students like to walk away with the markers at the end of class, so it is a good idea to know how many of each marker you start class with and to collect all of the markers when class is over.

Lesson: 2

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Review stages of the water cycle and percentages of Earth's water.
- Use direct questions to students as part of the review.
- Provide teacher notes to absent students from yesterday to copy into their own notes.

Lesson Title: Group Poster – Water Cycle

Objectives: Students will be able to (SWBT):

Create an original poster of the water cycle, showing and labeling all four stages.

State Core:

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

b. Illustrate the movement of water on Earth and describe how the processes that move water (eg., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.

Vocabulary: None

Lesson Body:

- Using the student handout, explain the directions for creating the poster.
- Explain the judging procedure and criteria. Allow students to select their own groups. No more than four to a group. If students can't find a group to join on their own, make assignments to groups for those students.

Guided Practice: None.

Review: Collect all posters and show to the class.

Closure: Tomorrow students will be discussing water conservation and usage.

Next Lesson: PowerPoint discussion on water usage and conservation

Materials Needed:

- Computer and projector.
- Student handout of assignment and judging criteria.
- Poster paper, 2' x 3'
- Backing sheets.
- Assortment of colored markers and pens.

Accommodations:

- All students should be able to participate. Even those who don't feel like drawing can contribute by offering ideas and making sure that directions are followed.
- Students who are absent will not be able to make the assignment up and will receive an "excused" for the assignment in the grade book.

For next time: Prepare student worksheets on conserving water.

Group Poster – Water Cycle

Names ______________________________ ______________________________

______________________________ ______________________________

Period _________

Score _____X/15___

1. As a group, answer the following questions:

    a. What is another name for the water cycle?

    b. What percent of the Earth's surface is covered by water?

    c. What percent of the Earth's water is fresh water?

    d. What percent of all water is available for living things to use?

    e. What is the driving force behind the water cycle?

2. Create a poster of the water cycle.
    a. Make sure you include all four steps.
    b. Use a **backing** sheet.
    c. You will have to share the markers.
    d. **Do not** get marker on the desks.
    e. Put your names on the **back** of the poster.
    f. Be creative. Be neat. Label all parts of the water cycle.
    g. The poster will be judged by students from other classes. The poster itself is worth 10 points.

Judging criteria: Judging will be based on creativity, neatness, accuracy, correct labeling, and eye appeal. Students judging will consider this question as they make their selection: "If you had to do a presentation to a 3^{rd} grade class about the water cycle and could take one poster to help with your presentation, which one would you take?" The winning poster will receive a 10/10. The next poster will receive a 9/10 and so on. No group will receive less than a 6/10 unless they make no attempt to do the assignment.

Group Poster – Water Cycle

Names ______________________________ ______________________________

______________________________ ______________________________

Period _________

Score _____X/15___

1. As a group, answer the following questions:

    a. What is another name for the water cycle?
    Hydrologic cycle

    b. What percent of the Earth's surface is covered by water?
    70%

    c. What percent of the Earth's water is fresh water?
    3%

    d. What percent of all water is available for living things to use?
    1%

    e. What is the driving force behind the water cycle?
    The sun

2. Create a poster of the water cycle.
    a. Make sure you include all four steps.
    b. **Use a backing sheet.**
    c. You will have to share the markers.
    d. **Do not** get marker on the desks.
    e. Put your names on the **back** of the poster.
    f. Be creative. Be neat. Label all parts of the water cycle.
    g. The poster will be judged by students from other classes. The poster itself is worth 10 points.

Judging criteria: Judging will be based on creativity, neatness, accuracy, correct labeling, and eye appeal. Students judging will consider this question as they make their selection: "If you had to do a presentation to a 3^{rd} grade class about the water cycle and could take one poster to help with your presentation, which one would you take?" The winning poster will receive a 10/10. The next poster will receive a 9/10 and so on. No group will receive less than a 6/10 unless they make no attempt to do the assignment.

Lesson 3 Overview

The students enjoy seeing the posters that were created in other classes. The judging of the other posters goes pretty fast and students are usually fairly objective in judging the other posters. It is important that they don't know the authors of the poster they are judging so that their vote is not biased. The discussion and presentation on the worth of water is usually a productive one. It is fun to see the students try and guess which cities and countries are the most populated. They are usually surprised to find out that the United States only represents 5% of the total population of the world. Often, students will suggest that melting icebergs is the solution for more available fresh water. They fail to see that the process of mining an iceberg is expensive and not very practical. The discussion then turns to water conservation. Most groups come up with some pretty good ideas for conserving water. The whole lesson comes together quite well when the water usage in the Unites States is compared to usage in the rest of the world. A reminder about the matching quiz is really helpful at the end of class.

Lesson: 3

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Show posters created from previous day.
- Judge posters from another class using the judging criteria. Each student gets one vote per round until all posters are judged.

Lesson Title: The Worth of Water

Objectives: Students will be able to (SWBT):

- Recognize that the amount of fresh water is staying constant while the population is increasing.
- Identify several ways to conserve and protect our fresh water supply.

State Core:

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.

Vocabulary: None

Lesson Body:

- PowerPoint presentation on the worth of water. Start with the quote from Benjamin Franklin – discuss.
- Show slides on increasing population.

- Discussion on water conservation – present ideas like shorter showers, full loads of laundry, hosing/brooming out the garage, turning off water while brushing teeth, washing cars on the lawn, etc.
- Break into groups (same as yesterday) and hand out the worksheet.

Guided Practice: Discussion and worksheet.

Review:

- Collect the worksheets.
- Ask for ideas on how to increase the amount of fresh water. Through guided discussion, let students come to the realization that new sources of fresh water are fairly impractical at this time. The best alternative is for conservation.

Closure:

- Review learning objectives.
- Tomorrow, students will receive a grade on their poster.
- Students will get their worksheet back from today.
- There will be a matching quiz on the water cycle and Earth's water percentages.

Next Lesson:

- Matching quiz on the water cycle and Earth's water percentages.
- Present group ideas on water conservation.
- Discussion on the price of water.

Materials Needed:

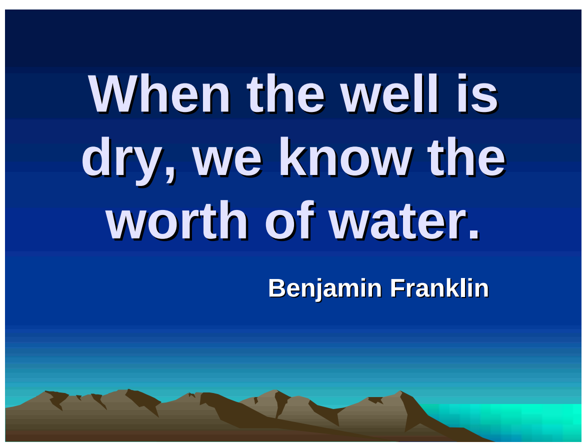
- Computer and projector.
- Group posters from yesterday.
- PowerPoint presentation on Fresh Water Ecology, slides 11-17.

Accommodations:

- Printout of class notes for any students with reading/writing difficulties.
- Some assignments may need to be made to groups for individuals with special needs.

For next time:

- Call Springville City and get current water rates and prices for water users in the city.
- Prepare the matching quiz on the water cycle and water percentages.



Most Populous Cities of the World

1.	Mumbai (Bombay),India	12,000,000
2.	Shanghai, China	11,000,000
3.	São Paulo, Brazil	10,900,000
4.	Seoul, South Korea	10,300,000
5.	Moscow, Russia	10,100,000
6.	Delhi, India	9,800,000
7.	Karachi, Pakistan	9,300,000
8.	Istanbul, Turkey	8,800,000
9.	Beijing, China	8,700,000
10.	Mexico City, Mexico	8,600,000

http://en.wikipedia.org/wiki/List_of_cities_by_population

Top 10 Countries by Population

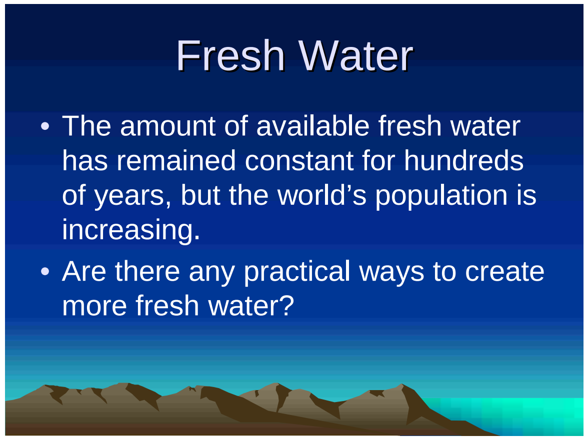
1.	China	1,500,000,000 (25%)
2.	India	1,200,000,000 (20%)
3.	United States	300,000,000 (5%)
4.	Indonesia	245,000,000
5.	Brazil	188,000,000
6.	Pakistan	165,000,000
7.	Bangladesh	147,000,000
8.	Russia	142,000,000
9.	Nigeria	131,000,000
10.	Japan	127,000,000

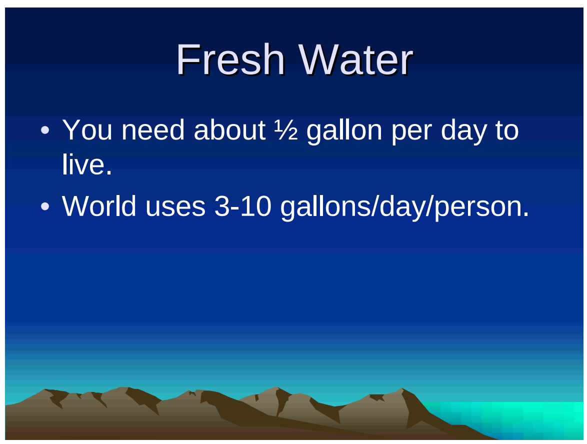
http://en.wikipedia.org/wiki/List_of_countries_by_population

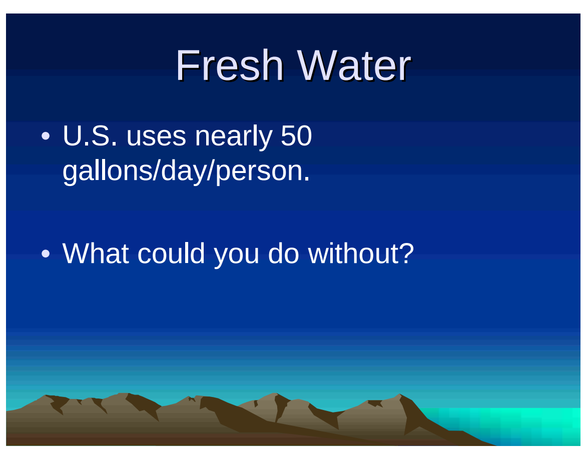
World Population Milestones

Source: United Nations Population Division

* 1 billion in 1804	
* 2 billion in 1927	(123 years later)
* 3 billion in 1960	(33 years later)
* 4 billion in 1974	(14 years later)
* 5 billion in 1987	(13 years later)
* 6 billion in 1999	(12 years later)


Fresh Water
• The amount of available fresh water has remained constant for hundreds of years, but the world's population is increasing.
• Are there any practical ways to create more fresh water?


Fresh Water
• You need about ½ gallon per day to live.
• World uses 3-10 gallons/day/person.


Fresh Water
• U.S. uses nearly 50 gallons/day/person.
• What could you do without?

Fresh Water

Names ________________________________ ________________________________

________________________________ ________________________________

Period _______ Score ___X/9___

We have spent several days talking about the Earth's fresh water. As you do your assignment, remember that 97% of all water is salt water and 2% is frozen, leaving only 1% for us to use and protect. Currently there are 6.5 billion people in the world with 300 million living in the United States. Estimates put the population at over 9 billion by the year 2050 with 450 million people living in the United States. The population is increasing, while fresh water supplies remain constant.

Your Assignment

Your group has been asked by the world's leaders to come up with some ideas for increasing the amount of available fresh water and protecting what we already have. List 3 ideas for increasing the amount of available fresh water and 6 ideas of what can be done to conserve and protect the fresh water we currently have. The world is depending on you, don't let us down! Be creative, but reasonable.

Ways to increase the amount of available fresh water:

1.

2.

3.

Ways to conserve and protect the amount of water we currently have:

1.

2.

3.

4.

5.

6.

Lesson 4 Overview

There is a certain amount of pride that students have in seeing their poster selected as the best and hung on the wall. Since I don't believe in penalizing those who can't draw, no group fails that part of the assignment. Because of random absenteeism, I always have a quick review session before each quiz or test. I review concepts in general without referring to specific questions. I also allow students to ask questions, again, without giving away specific answers. I never set time limits to finish a test or quiz. I don't want students to feel that pressure. If students are slow in finishing, I excuse them to the hall, skill building room, or library to finish up while the rest of the class corrects the quiz or test. We always exchange papers when assignments are corrected. I trust that students will honestly correct the assignments and quizzes.

Most students have no idea that their family pays for water. It is interesting to show them what water costs in this city and that the usage is generally way above the allotted amount. By the end of class, the idea usually comes out from a student that the only real motivations for conserving are for financial reasons. It's another good time to remind them that the population is increasing while the amount of available water remains constant and that the time to practice conservation should be now. Start with some simple things and build on those conservation practices.

Lesson: 4

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Show graded posters in order of finish. Winning posters from each class will be hung on the wall.
- Hand back the graded poster worksheet to each group.
- Hand back the worksheets from yesterday on fresh water conservation.
- Provide teacher notes to absent students from yesterday to copy into their own notes.
- Matching quiz on the water cycle and water percentages.
- Exchange papers and correct the quiz in class. Hand in when finished.

Lesson Title: The Price Of Water

Objectives: Students will be able to (SWBT):

Analyze the motivation for conserving water.

State Core:

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.

Vocabulary: None

Lesson Body: Using Springville City information, have a discussion on the price of water. Include topics such as: What should we pay? Do we pay too much? What is the motivation for conserving?

Guided Practice: Classroom discussion.

Review: Students will individually decide what their motivation for conserving water is and whether or not it is important. Emphasize the need of learning how to conserve. It takes practice.

Closure:

- Reminder of learning objectives.
- Tomorrow, students will be working on a graphing assignment about water budgets.

Next Lesson: Water budget graphing assignment.

Materials Needed:

- Computer and projector.
- Group posters on the water cycle.
- Graded worksheets on group posters and water conservation.
- Quiz on the water cycle and water percentages.
- Current water rates and prices for water users in Springville City.

Accommodations:

- Additional time may be needed on the quiz for some students with special needs.

For next time:

- Student worksheets on water budgets.

Quiz - Fresh Water

Name ________________________ **Period _______** **Score** ____X/12___

Matching

Match the correct answer in column B with the statement in column A. There is **one** answer used twice.

Column A	**Column B**
_____ 1. Rain, snow, sleet, hail.	A. Water cycle
_____ 2. The hydrologic cycle.	B. Evaporation
_____ 3. Total surface area covered by water.	C. Precipitation
_____ 4. Water changing from a liquid to a gas.	D. Groundwater
_____ 5. Amount of available water for living things.	E. Condensation
_____ 6. Water stored underground.	F. 1%
_____ 7. Amount of Earth's water that is salt water.	G. 3%
_____ 8. Clouds forming in the sky.	H. Conservation
_____ 9. Amount of fresh water in the world.	I. Pollution
_____10. Washing only full loads of dishes.	J. 70%
_____11. Dumping old paint down the drain.	K. 97%
_____12. Driven by the sun.	

Quiz - Fresh Water

Name ___________________________ **Period _______** **Score ____X/12___**

Matching

Match the correct answer in column B with the statement in column A. There is **one** answer used twice.

Column A	Column B
__C__ 1. Rain, snow, sleet, hail.	A. Water cycle
__A__ 2. The hydrologic cycle.	B. Evaporation
__J__ 3. Total surface area covered by water.	C. Precipitation
__B__ 4. Water changing from a liquid to a gas.	D. Groundwater
__F__ 5. Amount of available water for living things.	E. Condensation
__D__ 6. Water stored underground.	F. 1%
__K__ 7. Amount of Earth's water that is salt water.	G. 3%
__E__ 8. Clouds forming in the sky.	H. Conservation
__G__ 9. Amount of fresh water in the world.	I. Pollution
__H__10. Washing only full loads of dishes.	J. 70%
__I__11. Dumping old paint down the drain.	K. 97%
__A__12. Driven by the sun.	

Lesson 5 Overview

Most students know what a budget is, but have not made that connection to water. In this assignment, they get to work on charts and graphs. For some reason, creating a graph always seems to be a challenge to students. I have found that just explaining the directions is not enough. I have to get out the overhead projector with an overhead of a blank graph and walk them through the first few steps. At the end of the assignment, a short discussion on the real application of a water budget to communities and states is helpful. The discussion usually leads to comments about the large numbers of reservoirs that we have in the state of Utah and why those reservoirs need to be closely monitored to avoid floods or severe shortages. It is a good time to make sure the video that is needed in a few days has been scheduled.

Lesson: 5

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Students who were absent will take the quiz while the e-mail is being presented.
- Quick review on the price of water and the motivation for conserving.

Lesson Title: Water Budget

Objectives: Students will be able to (SWBT):

- Analyze the information given for "City A".
- Complete the chart and create a graph using the information.

State Core:

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

b. Illustrate the movement of water on Earth and describe how the processes that move water (e.g., evaporation of water, melting of ice/snow, ocean currents, movement of water vapor by wind) use energy from the sun.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

e. Analyze how communities deal with water shortages, distribution, and quality in designing a long-term water use plan.

Vocabulary: Shortage, excess

Lesson Body:

- Brief discussion on what a budget is and the different kinds of budgets.
- Hand out the worksheet on water budgets.
- Using the overhead of the worksheet, explain the directions for completing the chart.
- Using the overhead, explain the directions for creating the graph.
- Carefully monitor student performance.

Guided Practice: Completing the chart and creating the graph.

Review: Discuss why water budgets would be important to a community or state.

What might be done to deal with a shortage or an excess?

Closure:

- Reminder of learning objectives.
- Water budget assignment is due tomorrow.
- Tomorrow, students will be talking about ecology.

Next Lesson: Ecology terms.

Materials Needed:

- Computer and projector.
- Student worksheets on water budgets.
- Overhead projector and an overhead of the worksheet.
- Colored pencils.

Accommodations:

- Students should be able to do the assignment. If additional help is needed, pair up slower students with faster students who can help with the assignment.

For next time:

- PowerPoint presentation on ecology terms.
- Student worksheets on ecology terms.
- Make sure the Bill Nye video on biodiversity is scheduled for delivery.

Water Budget

Name ________________________ Period _______ Score ___X/15__

A budget is a record of income and outgo. In a water budget, precipitation such as rain or snow is the income. Evaporation and usage are the outgo.

For this activity, you will use the graph paper on the back of this sheet and two different colored pencils that I have provided. You will need to share the pencils. A calculator can be used, but is not necessary.

Using the chart, find the excess or shortage for each month. To do this, subtract the evaporation/usage from precipitation. Record these results in the row labeled "Precipitation – Evaporation/Usage". A positive value indicates an excess, while a negative value is a shortage (the first one has been done for you). Add the numbers across the "Precipitation" and "Evaporation/Usage" rows and enter the yearly totals.

P = Precipitation
E/U = Evaporation/Usage

	Monthly Precipitation and Evaporation/Usage (in mm) for City A												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
P	15	20	30	60	80	110	95	80	70	55	40	20	
E/U	0	0	15	40	95	130	155	120	75	45	5	0	
P minus E/U	15												

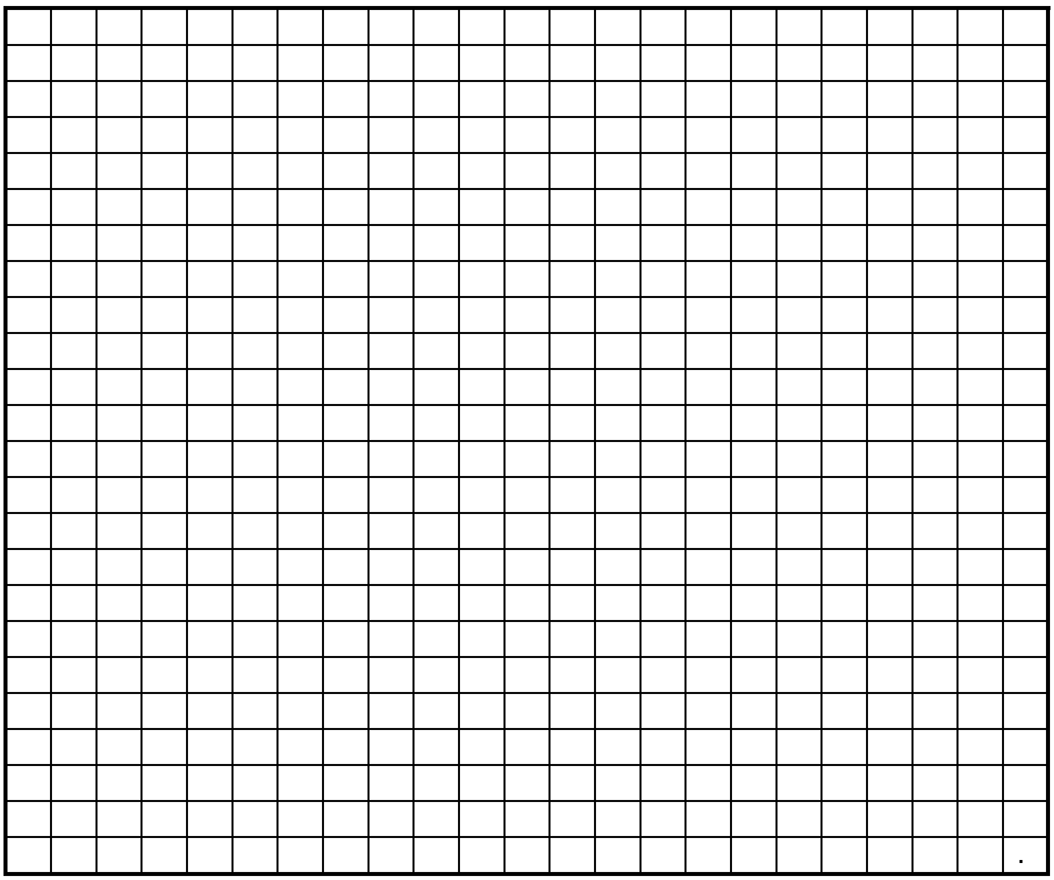
Answer the following questions:

1. Which month shows the greatest amount of precipitation?
2. Which month shows the greatest amount of evaporation/usage?
3. Which months show an excess?
4. Which months show a shortage?
5. How does an excess occur?
6. How does a shortage occur?
7. At the end of the year, did City A have an excess or a shortage? How can you tell?

On the graph paper, draw two axes. The vertical axis represents precipitation and evaporation/usage. The horizontal axis represents months.

Using the information in the chart and a colored pencil, plot a line graph of the monthly precipitation for City A. Using a different colored pencil, plot a line showing the monthly evaporation/usage for City A on the same axes.

Now shade in the area where the precipitation is greater than the evaporation/usage with one of the colored pencils. Label this area “Excess”. Shade in the area where the evaporation/usage is greater than the precipitation with the colored pencil. Label this area “Shortage”.



8. Based upon the information found in the chart and the graph, could City A be Springville? Explain your answer.

Water Budget

Name __________________________ Period _______ Score ___X/15__

A budget is a record of income and outgo. In a water budget, precipitation such as rain or snow is the income. Evaporation and usage are the outgo.

For this activity, you will use the graph paper on the back of this sheet and two different colored pencils that I have provided. You will need to share the pencils. A calculator can be used, but is not necessary.

Using the chart, find the excess or shortage for each month. To do this, subtract the evaporation/usage from precipitation. Record these results in the row labeled "Precipitation – Evaporation/Usage". A positive value indicates an excess, while a negative value is a shortage. Add the numbers across the "Precipitation" and "Evaporation/Usage" rows and enter the yearly totals.

P = Precipitation
E/U = Evaporation/Usage

	Monthly Precipitation and Evaporation/Usage (in mm) for City A												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
P	15	20	30	60	80	110	95	80	70	55	40	20	675
E/U	0	0	15	40	95	130	155	120	75	45	5	0	680
P minus E/U	15	20	15	20	-15	-20	-60	-40	-5	10	35	20	-5

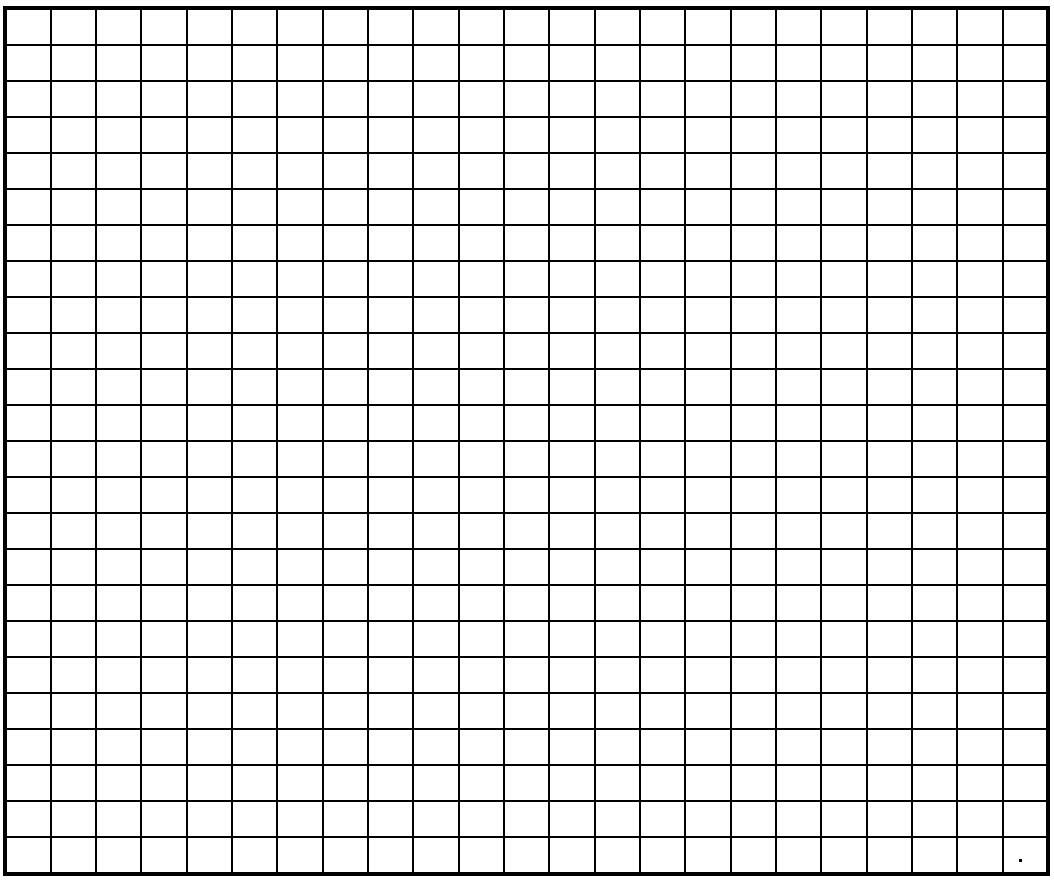
Answer the following questions:

1. Which month shows the greatest amount of precipitation?
   June
2. Which month shows the greatest amount of evaporation/usage?
   July
3. Which months show an excess?
   Jan., Feb., Mar., Apr., Oct., Nov., Dec.
4. Which months show a shortage?
   May, June, July, Aug., Sep.
5. How does an excess occur?
   More precipitation than evaporation/usage.
6. How does a shortage occur?
   More evaporation/usage that precipitation.
7. At the end of the year, did City A have an excess or a shortage? How can you tell? *A shortage. A negative number indicates a shortage.*

On the graph paper, draw two axes. The vertical axis represents precipitation and evaporation/usage. The horizontal axis represents months.

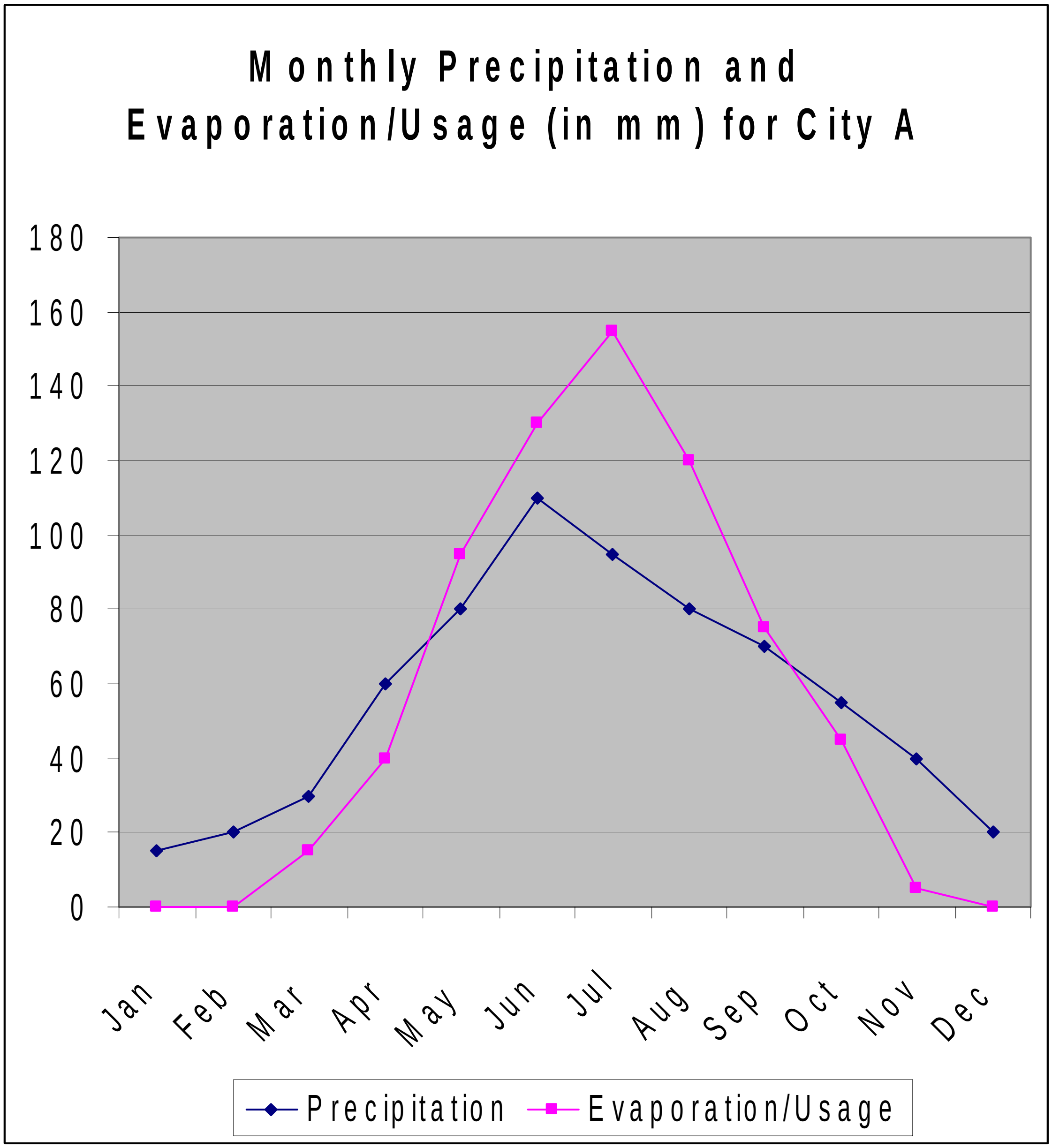
Using the information in the chart and a colored pencil, plot a line graph of the monthly precipitation for City A. Using a different colored pencil, plot a line showing the monthly evaporation/usage for City A on the same axes.

Now shade in the area where the precipitation is greater than the evaporation/usage with one of the colored pencils. Label this area “Excess”. Shade in the area where the evaporation/usage is greater than the precipitation with the colored pencil. Label this area “Shortage”.



8. Based upon the information found in the chart and the graph, could City A be Springville? Explain your answer.

No. Springville’s highest precipitation occurs during the winter months.


Monthly Precipitation and
Evaporation/Usage (in mm) for City A
180
160
140
120
100
80
60
40
20
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Precipitation
Evaporation/Usage

ECOLOGY

Lesson 6 Overview

This lesson is quite a change after discussing water for 5 days. I remind the students that we will combine the principles already learned with the principles of ecology towards the end of the unit. Learning the differences between biotic and abiotic is usually not a big problem, but seeing how those abiotic factors affect an ecosystem is more of a challenge. This lesson is pretty straight forward. Students hate to take notes, so by giving them part of the notes that are already printed, the burden is eased. Planning ahead on this lesson makes a big difference as you include personal stories and examples of the concepts. The short review at the end of the lesson reinforces the day's lesson.

Lesson: 6

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Quick discussion on the importance of managing water and knowing what your needs and uses are.
- Individual reminder of missing assignments.

Lesson Title: Ecology Terms

Objectives: Students will be able to (SWBT):

- Learn the ecology terms presented in class.
- Properly fill out the note sheet
- Know the difference between a biotic and an abiotic factor in an ecosystem.
- Know the definition of biodiversity.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

c. Predict how an ecosystem will change as a result of major changes in abiotic and/or biotic factor.

Vocabulary: Ecology, ecosystem, habitat, biotic, abiotic, biodiversity.

Lesson Body:

- PowerPoint presentation on Fresh Water Ecology, slides 18-29.
- Hand out the note sheet on ecology terms and notes.
- Have the students fill out the notes as they are presented in class.
- Briefly introduce the upcoming class-wide science project when talking about abiotic factors.

Guided Practice: Check for understanding by having students do the review on the back of the note sheet without looking at their notes. By raising hands, how many correctly identified 12/15? If less than 80%, review again the difference between biotic and abiotic factors.

Review:

- Mention again the upcoming class-wide science project where fresh water and abiotic factors will be combined into a project.
- Review how abiotic factors can influence biodiversity.

Closure:

- Reminder of learning objectives.
- Tomorrow, students will watch a Bill Nye video on biodiversity.

Next Lesson: Bill Nye video on biodiversity.

Materials Needed:

- Computer and projector.
- PowerPoint presentation – Fresh Water Ecology, slides 18-29.
- Student note sheets on ecology terms.
- Daily review on identifying biotic and abiotic factors.

Accommodations:

- Printout of class notes for any students with reading/writing difficulties.

For next time:

- Bill Nye video on biodiversity.
- Student worksheet that accompanies the video.

Ecology

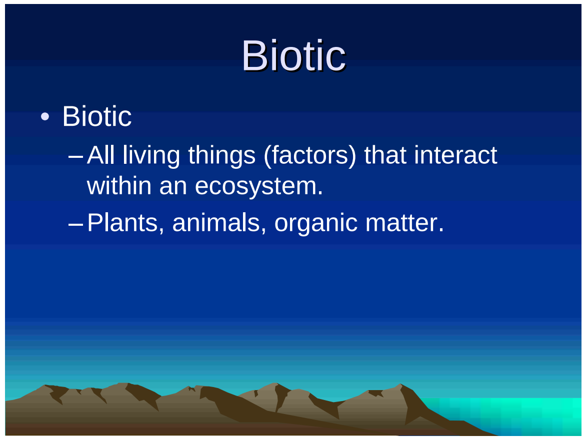
- The study of how living things interact with each other and with their environment.

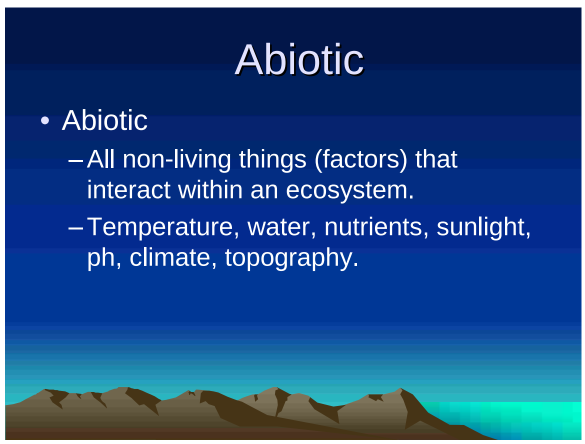
Ecology

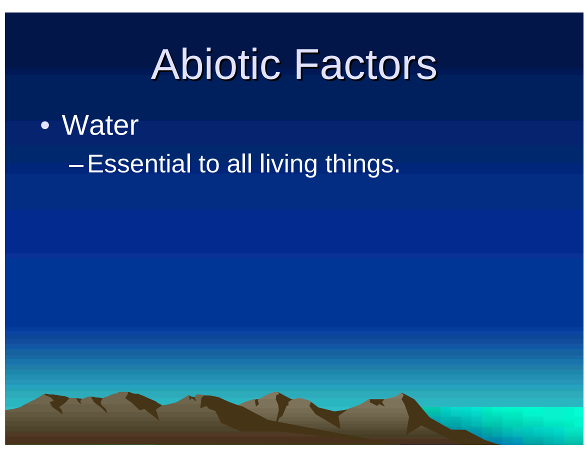
- Ecosystem
  - A unit consisting of all living and non-living things in a given area that interact with one another.
  - Can be large or small (prairie, stream, ocean, forest)

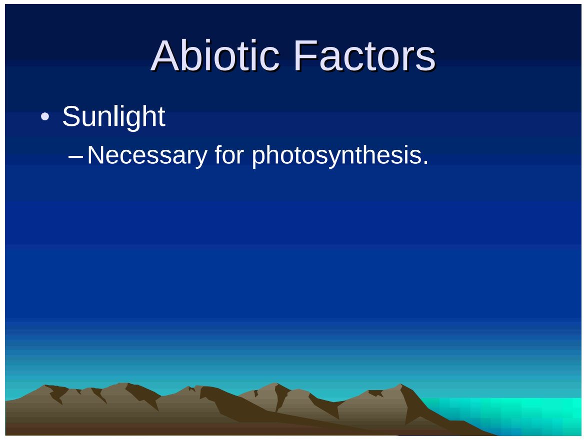
Ecology

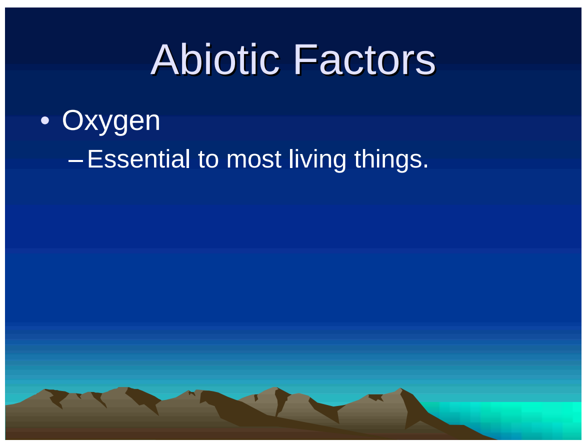
- Habitat
  - The place where an organism lives and provides the things the organism needs.
  - Food, shelter, water, temperature.

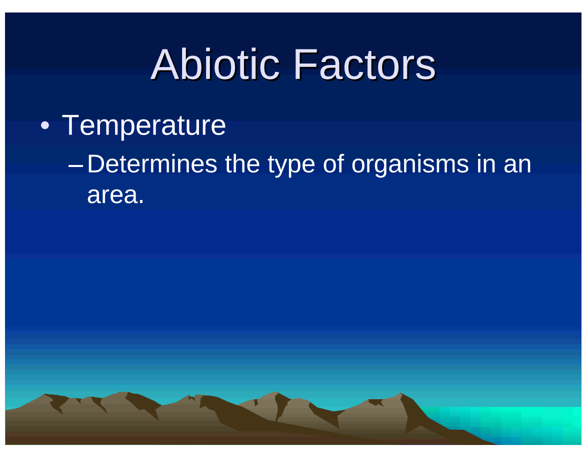

Biotic
• Biotic
– All living things (factors) that interact within an ecosystem.
– Plants, animals, organic matter.

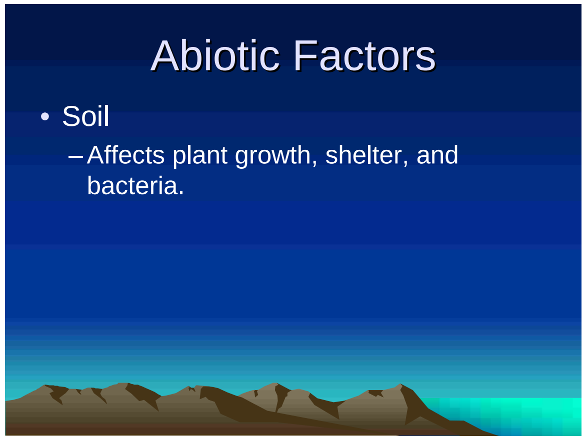

Abiotic
• Abiotic
– All non-living things (factors) that interact within an ecosystem.
– Temperature, water, nutrients, sunlight, ph, climate, topography.

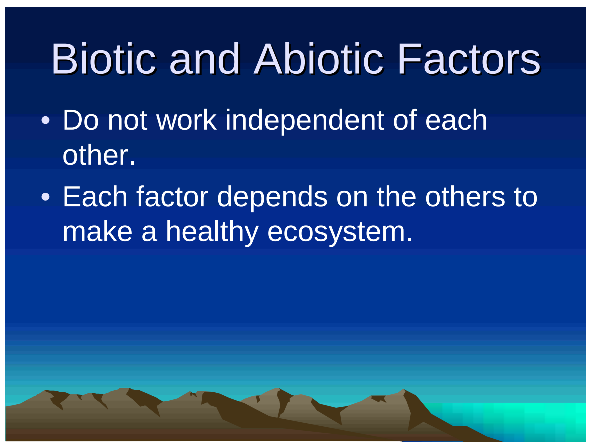

Abiotic Factors
• Water
– Essential to all living things.

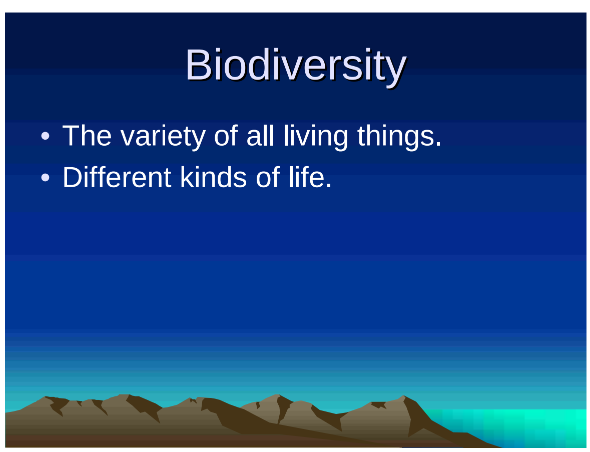

Abiotic Factors
• Sunlight
– Necessary for photosynthesis.


Abiotic Factors
• Oxygen
– Essential to most living things.


Abiotic Factors
• Temperature
– Determines the type of organisms in an area.


Abiotic Factors
• Soil
– Affects plant growth, shelter, and bacteria.


Biotic and Abiotic Factors
• Do not work independent of each other.
• Each factor depends on the others to make a healthy ecosystem.


Biodiversity
• The variety of all living things.
• Different kinds of life.

Ecology Terms and Notes

Name ___________________________ Period __________

Define the following terms as we take notes during class.

1. Ecology –

2. Ecosystem –

3. Habitat –

4. Biotic –

5. Abiotic –

6. How are each of the following abiotic factors important to organisms?

    a. Water –

    b. Sunlight –

    c. Oxygen –

    d. Temperature –

    e. Soil –

7. Biodiversity –

Review for the day. Without looking at your notes, decide if each of the following factors at Springville Jr. High is a biotic or an abiotic factor. Put a "B" if it is biotic and an "A" if it abiotic. Don't cheat, it is not on your grade. Correct your own to see how well you did.

_____ Students	_____ Spiders	_____ Sunlight
_____ Grass	_____ Dirt	_____ Rain
_____ Water	_____ Windows	_____ Wind
_____ Teachers	_____ Air	_____ Trees
_____Bacteria	_____ Principal	_____ Microorganisms

What does biodiversity mean?

Ecology Terms and Notes

Name ___________________________ Period _________

Define the following terms as we take notes during class.

1. Ecology – *The study of how living things interact with each other and with their environment.*

2. Ecosystem – *All the living and nonliving things that interact in a particular area.*

3. Habitat – *The place where an organism lives and that provides the things the organism needs.*

4. Biotic – *The living parts of the ecosystem.*

5. Abiotic – *The nonliving parts of the ecosystem.*

6. How are each of the following abiotic factors important to organisms?

    a. Water – *Essential to all living things.*

    b. Sunlight – *Necessary for photosynthesis.*

    c. Oxygen – *Essential for most living things.*

    d. Temperature – *Determines the types of organisms in an area.*

    e. Soil – *Affects plant growth, shelter, and bacteria.*

7. Biodiversity – *The variety of living things. Different kinds of life.*

Review for the day. Without looking at your notes, decide if each of the following factors at Springville Jr. High is a biotic or an abiotic factor. Put a "B" if it is biotic and an "A" if it abiotic. Don't cheat, it is not on your grade. Correct your own to see how well you did.

__B__ Students	__B__ Spiders	__A__ Sunlight
__B__ Grass	__A__ Dirt	__A__ Rain
__A__ Water	__A__ Windows	__A__ Wind
__B__ Teachers	__A__ Air	__B__ Trees
__B__Bacteria	__B__ Principal	__B__ Microorganisms

What does biodiversity mean? *Different kinds of life.*

<u>Lesson 7 Overview</u>

It has been my experience that most students enjoy Bill Nye videos. He does a great job of explaining science concepts and has some really nice demonstrations. Rarely do I show a video without some type of worksheet. If it's worth showing, the students will stay more interested if they are listening for answers to some questions. The video take up 30 minutes, so by the time a short review of the previous lesson is completed and the video shown and assignment corrected, there is very little time for discussion. If there are a few minutes remaining, I always pick out a few things from the video to discuss with the class. Right at the end of class, a quick mention that maybe we should drain Lake Powell always gets some students to react and get a little agitated. I send them out with the assurance that we will discuss it the next time.

Lesson: 7

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Review by asking individual questions to students about ecology terms.
- Review biotic vs. abiotic by having students identify the correct answer by giving some examples. Have the students hold up one finger under their chin for biotic and two fingers for abiotic.

Lesson Title: Biodiversity

Objectives: Students will be able to (SWBT):

- Fill out the video worksheet as they watch the video.
- Define biodiversity.
- Analyze the interactions of biotic and abiotic actors in an ecosystem.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (eg., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

b. Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).

c. Predict how an ecosystem will change as a result of major changes in abiotic and/or biotic factor.

Objective 3: Examine Earth's diversity of life as it changes over time.

c. Explain the factors that contribute to the extinction of a species.

d. Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.

e. Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.

Vocabulary: Extinct

Lesson Body:

- Hand out the video worksheet.
- Show the Bill Nye video on biodiversity.
- Correct the worksheet.
- Use the remaining few minutes to discuss anything of students' interest from the video, including biotic and abiotic interactions in an ecosystem.

Guided Practice:

- Worksheet during the video.
- Discuss the interactions of biotic and abiotic factors in an ecosystem.

Review:

- Discuss interactions of biotic and abiotic factors in an ecosystem.
- Mention again the upcoming science project where fresh water and abiotic factors will be combined into a project.

Closure:

- Reminder of learning objectives.
- Tomorrow, a group discussion/debate on biodiversity.
  Should we drain Lake Powell? What's really in Utah Lake?

Next Lesson: Group discussion/debate on biodiversity.

Materials Needed:

- Computer and projector.
- Bill Nye video on biodiversity.

- Student worksheet to accompany video.

Accommodations:

- Students who are absent will not be able to make the assignment up and will receive an "excused" for the assignment in the grade book.
- Special education students may need to be excused from the assignment based upon their individual needs.

For next time: Student worksheets that accompany the group discussion/debate.

Video – Biodiversity

Name___________________________ ***Period_____*** ***Score__<u>X/17</u>__***

1. Who is the "science guy"? ____.
2. Environments always have _______________________ and

   ________________________ parts.
3. Most of the world's living things are found in ________________________.
4. Biodiversity means ________________________ kinds of life.
5. The things that live in ecosystems ___________________ on each other.
6. An ___________________ is made up of the plants and animals that live together in an environment.
7. You can't pick a flower without jiggling a _____________.
8. True or False Just the plants and animals on a farm make an ecosystem.
9. Nature's problems are ___________ problems.
10. All of the following are examples of extinct animals: ________________ birds,

    ___________________ pigeons, and ________________ mussels.
11. The best way to wipe out a species is to remove them from their

    ________________ environment.
12. The largest ecosystem in the world is the ______________.
13. The more diverse the ___________________, the healthier the system.

Video – Biodiversity

Name_____KEY_______________________ Period______Score_X/18__

1. Who is the "science guy"? ______Bill____Nye_____________.

2. Environments always have ___ living________ and ___non-living___parts.

3. Most of the world's living things are found in ______water______________.

4. Biodiversity means _________ different__________ kinds of life.

5. The things that live in ecosystems _____depend_________ on each other.

6. An ____ecosystem_______ is made up of the plants and animals that live together in an environment.

7. You can't pick a flower without jiggling a ____ star_______.

8. True or **False** Just the plants and animals on a farm make an ecosystem.

9. Nature's problems are _____our____ problems.

10. All of the following are examples of extinct animals: ______Dodo_______

    birds,___Passenger_______ pigeons, and ____Pearly______ mussels.

11. The best way to wipe out a species is to remove them from their ___natural__ environment.

12. The largest ecosystem in the world is the ______sea______.

13. The more diverse the _____species________, the healthier the system.

Lesson 8 Overview

I had never tried this particular activity before. I figured that since Jr. High students like to talk so much, they would enjoy this. There were mixed results. Some students didn't really understand how a debate works and couldn't give up their own personal views to assume the role that they were assigned. Students recognized during the debate that biodiversity usually takes a back seat to development. The discussion on carp in Utah Lake and cheatgrass on western rangelands was interesting. The real life aspect of those examples led to some good comments. The proposal to drain Lake Powell is always a good discussion. Hopefully, students will learn that biodiversity at least needs to be addressed and just not neglected when development projects are proposed. The last part of the student worksheet causes each student to be reflective in their view of biodiversity. Make sure "The Princess Bride" video is scheduled for the next lesson.

Lesson: 8

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Quick review of what biodiversity is.
- Review by asking individual questions to students about ecology terms.
- Review biotic vs. abiotic by having students identify the correct answer from the examples given. Have the students hold up one finger under their chin for biotic and two fingers for abiotic. Use new examples, not the same ones that were used before.

Lesson Title: Is Biodiversity a Good Thing?

Objectives: Students will be able to (SWBT):

- Take part in a group discussion/debate on biodiversity.
- Learn that biodiversity is good in an ecosystem.
- Realize that biodiversity is often overlooked in the name of development, recreation, and money making.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

c. Predict how an ecosystem will change as a result of major changes in abiotic and/or biotic factors.

Objective 3: Examine Earth's diversity of life as it changes over time.

d. Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.

Vocabulary: Recreationist, conservationist

Lesson Body:

- Pose the question: Is biodiversity good?
  Use the examples of carp taking over Utah Lake and cheatgrass taking over western rangelands as evidence for the need of biodiversity.
- Assign students to groups of six.
- Explain the discussion/debate.
- Hand out the student worksheet.
- Walk around the class and monitor the discussions.
- Have the students fill out the worksheet as they discuss the topic.
- Hand in the worksheet.

Guided Practice: Discussion/debate

Review:

- Briefly talk about environmental impact statements that are required for government sponsored development projects.
- Is biodiversity good?
- Why does biodiversity usually take a backseat to development?

Closure:

- Reminder of learning objectives.
- Tomorrow, a fun video clip that talks about adaptation and pictures of some extinct animals.

Next Lesson: Class notes on human impact on biodiversity and extinction.

Materials Needed:

- Computer and projector.
- Student worksheet that accompanies the group discussion/debate.

Accommodations:

- All students should be able to participate. Some groups, depending on members, may need to have the community roles assigned as opposed to letting the students choose their own roles.
- Students who are absent will not be able to make the assignment up and will receive an “excused” for the assignment in the grade book.

For next time:

- PowerPoint presentation on extinction and human impact on biodiversity.
- Biodiversity graphs and worksheet.
- “Princess Bride” video clip on adaptation.

Biodiversity

Name _________________________ Period _______

Proposed project: Springville City is proposing to build a dam across the mouth of Hobble Creek canyon to provide irrigation water to farmers in the valley during the summer and drinking water to citizens in Utah and Salt Lake counties. The water will be backed up and will flood everything up left and right hand forks. All of the people living in the canyon will have to relocate. As part of the project, a marina and convenience store will be built near the new reservoir. You have been invited to a city council meeting to give your input on the proposed project. There are 5 other people who have been invited too. A decision to proceed or not must be reached during the meeting.

Assignment: Each person in your group, select (or assign) a community role from the list below. Assume the role of that person during the discussion, regardless of your own personal opinion.

Community roles for dam construction:

1. Farmer – Wants water stored for irrigation throughout the summer. Can't survive financially without the extra water.

2. Local businessman – Recreation will increase tourism and help businesses. This will finally put Springville on the map.

3. Recreationist – New opportunities for fishing, boating, water skiing.

Community roles against dam construction:

1. Tax payer – Is not a farmer. Doesn't want an increase in taxes to pay for dam construction. Why send drinking water to Salt Lake county?

2. Conservationist – Dam will affect the natural creek ecosystem.

3. River front property owner – Will lose property for a summer home and view of the creek. Property has been in the family for 100 years.

My community role : ____

During the discussion, answer the following:

What are some benefits of the dam:

1.

2.

3.

4.

What are some benefits of leaving the creek the same, without the dam:

1.

2.

3.

4.

In your role, do the benefits of the river outweigh the benefits of the dam?

Does your position help or hurt biodiversity?

Now that you've heard both sides, should the dam be built? Why?

Abandon your role now, in your own personal opinion, is biodiversity important to you? **Why or why not?**

Lesson 9 Overview

I debated on whether or not to include this lesson as part of this unit, but I finally decided that this was the best fit for these objectives. The thought being that a good background of ecosystems and extinction not only is required by the state core curriculum, but it is also good background knowledge for our science project as we discuss healthy streams. When abiotic factors in an ecosystem change on a long term basis, it forces organisms to adapt and if they can't, then extinction becomes a real possibility. The first 9 slides of this lesson are a review from 8th grade science classes. The slides on extinction are interesting to the students and they really get a feel for human impact on extinction rates. Evolution and adaptation are briefly touched on and discussed. Evolution is always an interesting topic for students and their own personal views. For my classes, the nature of the curriculum doesn't call for much discussion on evolution. Students seem to be pretty accepting of the idea as it relates to plants and animals. They easily grasp the concept of adaptation.

The "Princess Bride" video clip is shown mostly for fun, but it does include adaptation. The clip is only 5 minutes long and could be eliminated from the lesson without leaving a hole in the lesson. The assignment on biodiversity graphs is a good assignment that helps students learn how to pull information off a graph. Some students really struggle with that for whatever reason. The end-of-level test in the spring asks students to interpret graphs, so this assignment is good practice in preparation for the year-end test. If time permits, a reminder of the quiz for next time is helpful..

Lesson: 9

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Is biodiversity good? Have students give some examples of where biodiversity doesn't exist and how that has affected the ecosystem.
- Individual reminders of missing assignments.

Lesson Title: Biodiversity and Extinction

Objectives: Students will be able to (SWBT):

- Identify the energy roles in an ecosystem.
- Know how animals become extinct.
- Realize that adapting can help animals from becoming extinct.
- Identify several animals that are extinct.
- Infer that humans are the major cause of extinction.
- Complete the biodiversity graphs.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

b. Observe and list biotic factors (e.g., plants, animals, organic matter) that affect a specific ecosystem (e.g., wetlands, deserts, aquatic).

c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.

d. Explain that energy enters the vast majority of Earth's ecosystems through photosynthesis, and compare the path of energy through two different ecosystems.

Objective 3: Examine Earth's diversity of life as it changes over time.

c. Explain factors that contribute to the extinction of a species.

d. Compare evidence supporting various theories that explain the causes of large-scale extinctions in the past with factors causing the loss of species today.

e. Evaluate the biological, esthetic, ethical, social, or economic arguments with regard to maintaining biodiversity.

Vocabulary: Producer, consumer, decomposer, herbivore, carnivore, omnivore, species, evolution, mutation, adaptation.

Lesson Body:

- PowerPoint presentation on energy roles and extinction, slides 30-46.
- Have students take notes during the presentation.Use the last slide #46 to check for understanding on adaptation.
- Hand out the biodiversity graph worksheet. Explain the assignment.

Guided Practice: Biodiversity graph worksheet. Walk around the class to check for understanding.

Review: Biotic and abiotic interactions in an ecosystem. What is the human impact on extinction?

Closure:

- Reminder of learning objectives.
- Tomorrow, a matching quiz on biodiversity, introduction to the class-wide science project on water quality, and a review of the scientific method.

Next Lesson:

- Quiz on biodiversity.

- Introduction to science project on water quality.
- Review of scientific method.

Materials Needed:

- Computer and projector.
- PowerPoint presentation – Fresh Water Ecology, slides 30-46.
- Biodiversity graph worksheets.
- Video – “The Princess Bride”

Accommodations:

- Printout of class notes for any students with reading/writing difficulties.
- Students should be able to do the assignment. If additional help is needed, pair up slower students with faster students who can help with the assignment.

For next time:

- Matching quiz on biodiversity.
- PowerPoint presentation on the scientific method.

Energy Roles

- Determined by how an organism obtains energy and how it interacts with the other living things in its ecosystem.

1. Producer
2. Consumer
3. Decomposer

Energy Roles

1. Producer – An organism that can make its own food.

   (Trees, grass, plants, algae, microorganisms)

- Use sun's energy – photosynthesis.

Energy Roles

2. Consumer – an organism that obtains energy by feeding on other organisms.

   a. Herbivore – an organism that eats only plants.

      (deer, cows, caterpillars)

Energy Roles

b. Carnivore – an organism that eats only animals.

(lions, snakes, spiders)

c. Omnivore – an organism that eats both plants and animals.

(bears, humans, crows)

Energy Roles

3. Decomposer – organisms that break down wastes and dead organisms.

(bacteria, fungi, small bugs)

Food Chain

- A series of events in which one organism eats another and obtains energy.

  (grass – mouse – hawk)

Energy Pyramid

- Shows the amount of energy that moves from one feeding level to another.
- Producers on the bottom.

Species

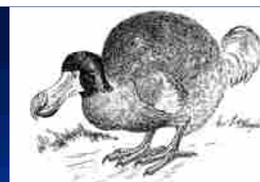
- A group of similar organisms that can interbreed and produce fertile offspring.

Biodiversity

- The variety of all living things.

Human Impact on Biodiversity

- Endangered – in serious danger of becoming extinct.
- Extinct – no longer exists.
  (25,000 species per year)



Extinct

Mauritius, an island in the Indian Ocean, was the only home of the **dodo**, a large, flightless bird that weighed up to 14 kg. Dodos were an easy-to-catch source of food for sailors and settlers.

Having developed in isolation, the dodo easily fell victim to this new pressure. In addition, forest clearing destroyed the bird's habitat, and introduced pigs, goats, cats, rats, and monkeys became competitors as well as predators.

First seen by Europeans in 1507, the dodo was extinct by 1681. Today it is represented in museums by only parts of skeletons and one complete skeleton made up of many individuals.

Extinct

Once a common bird of eastern North America, the **passenger pigeon** became extinct very quickly. Early records, beginning in 1630, describe its migrations, roosting and nesting in enormous numbers, but by 1912 there were rewards offered for evidence of a live, wild bird.

Although there is a question of the natural survival of a bird that roosted in numbers that destroyed forests, that laid one or two eggs in a flimsy nest, and that suffered losses from overcrowding and nestling mortality, humans finally doomed the bird to extinction. Shot, trapped, and clubbed for market, hog food, and sport, it could not survive. The world's last passenger pigeon died in a zoo in 1914.

Extinct

With the spread of agriculture, this brilliantly colored bird developed a liking for the seeds of many kinds of fruit and grain crops. For this, and its habit of gathering in great destructive flocks, it was condemned as a pest and subjected to wholesale slaughter. Many were also sold as pets.

Once common in the southeastern United States, the **Carolina parakeet** became increasingly scarce as deforestation reduced its habitat. Already rare by the mid 1880s, its last stand was in Florida, where, in 1920, a flock of 30 birds was the last ever seen of the only native parrot of the United States.

http://www.iucnredlist.org/info/gallery2004

Human Impact on Biodiversity

- Evolution – Change in a species over time.
- Mutation –Change in genes. Produces a change in the offspring of an organism.

Human Impact on Biodiversity

- Adaptation – A positive mutation that increases an organism’s chances of survival.

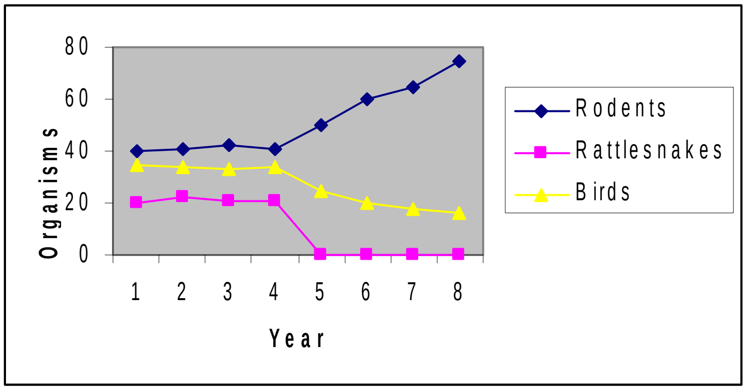
Adaptation

Skunk –
Baby deer –
Prairie Dog –
Coconut –
Wasp –
Hummingbird –
Bacteria -

Biodiversity Graphs

Name ___________________________ Period _______ Score __X/12_

In year 4, a community decided to get rid of a population of rattlesnakes. Examine the accompanying graph, then answer the questions.



1. Did the bird population benefit from the elimination of the rattlesnakes? Why or why not?

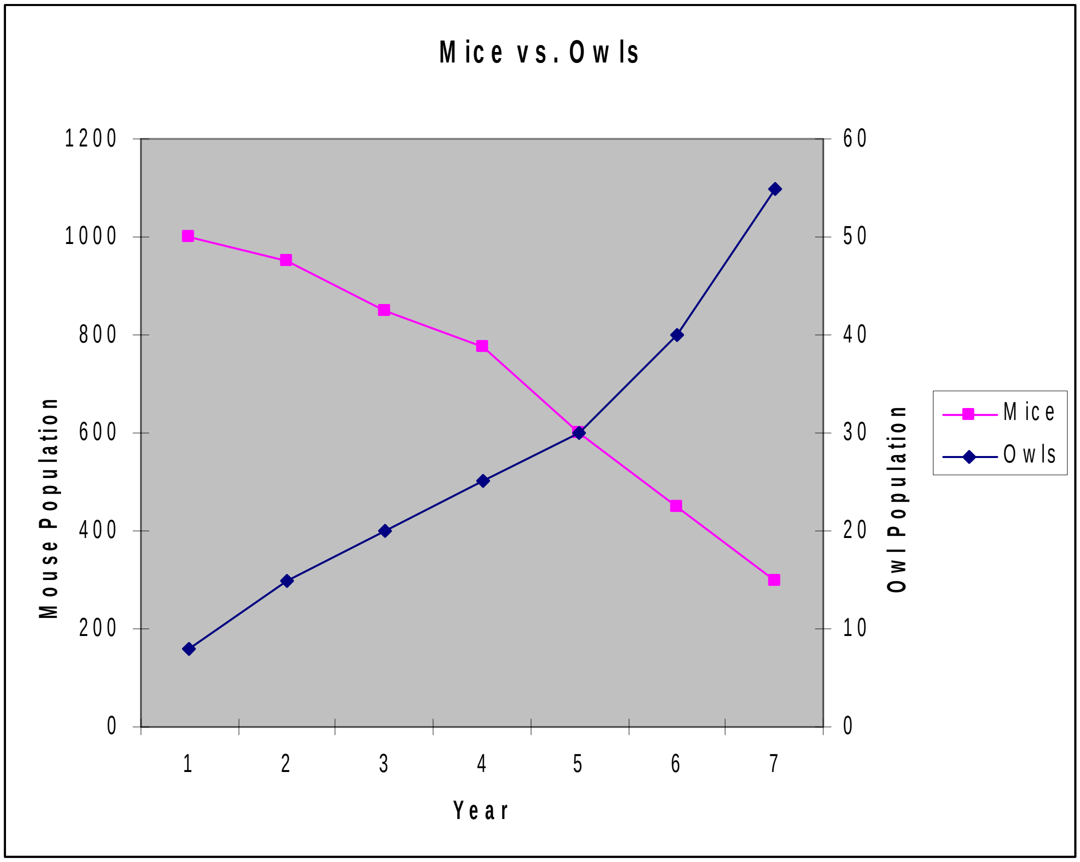
2. Did the rodent population benefit from the elimination of the rattlesnakes? Why or why not?

3. What was the main source of food for the rattlesnakes?

4. Why did the bird population begin decreasing the year after the rattlesnakes were eliminated?

5. To maintain biodiversity, what might be a proposed solution?

Using the Mice vs. Owls graph, answer the following questions.



1. In which year was the mouse population the greatest?

2. In which year was the owl population the greatest?

3. In which year was the mouse population about 600?

4. In which year was the owl population about 40?

5. In which year did mouse population equal owl population?

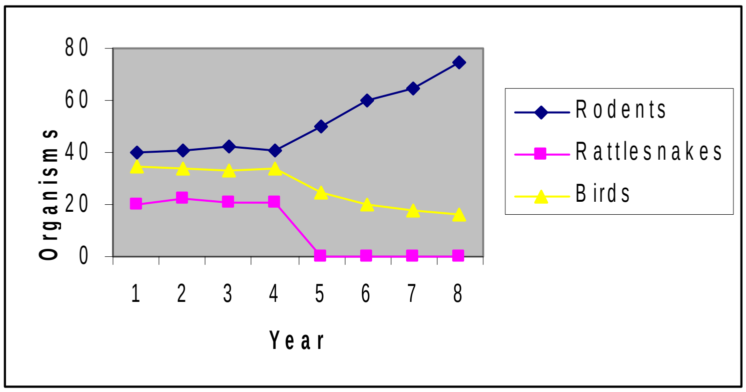
6. What is the most likely cause for the decline in the mouse population?

7. Predict what might happen to the owl population in the 10th year of the study?

Biodiversity Graphs

Name ___________________________ Period _______ Score __X/12_

In year 4, a community decided to get rid of a population of rattlesnakes. Examine the accompanying graph, then answer the questions.



1. Did the bird population benefit from the elimination of the rattlesnakes? Why or why not?

   No. No snakes to eat.

2. Did the rodent population benefit from the elimination of the rattlesnakes? Why or why not?

   Yes. No snakes to prey on them.

3. What was the main source of food for the rattlesnakes?

   Rodents

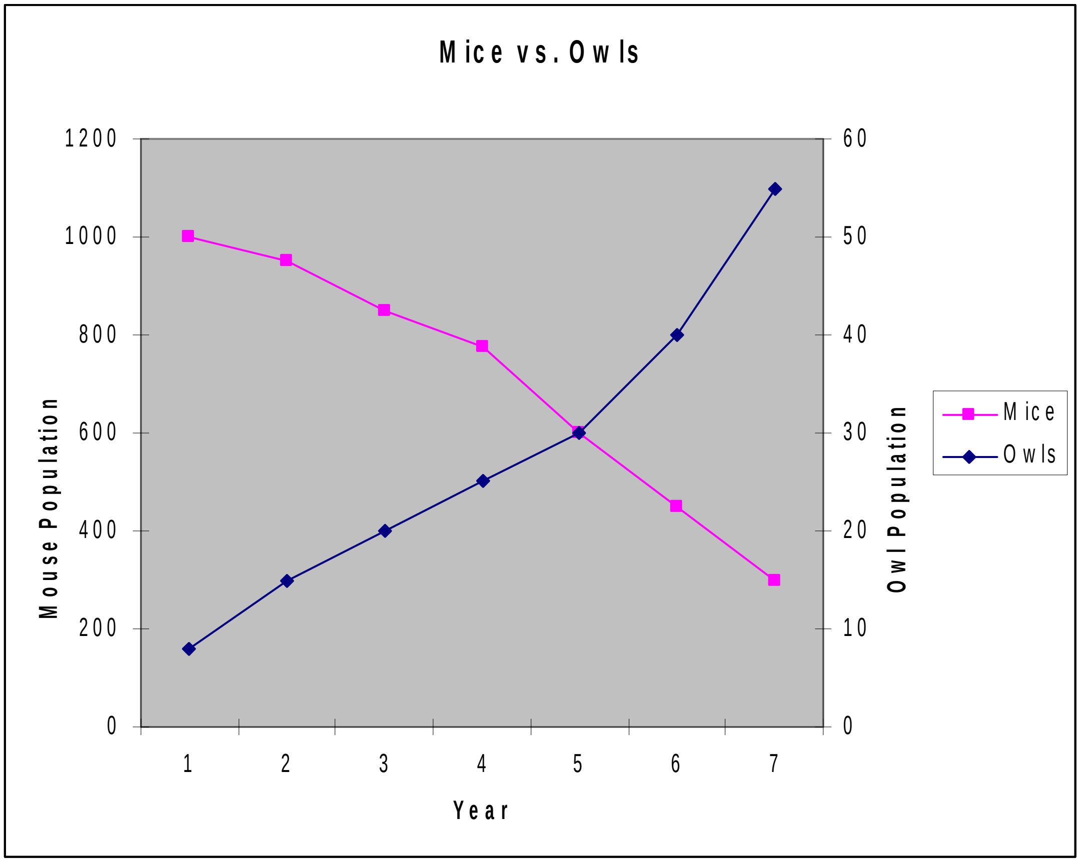
4. Why did the bird population begin decreasing the year after the rattlesnakes were eliminated?

   Part of the birds' food source was eliminated.

5. To maintain biodiversity, what might be a proposed solution?

   Bring in a population of non-poisonous snakes.

Using the Mice vs. Owls graph, answer the following questions.



1. In which year was the mouse population the greatest?
   Year 1

2. In which year was the owl population the greatest?
   Year 7

3. In which year was the mouse population about 600?
   Year 5

4. In which year was the owl population about 40?
   Year 6

5. In which year did mouse population equal owl population?
   They were never equal.

6. What is the most likely cause for the decline in the mouse population?
   Increase in the owl population.

7. Predict what might happen to the owl population in the 10th year of the study?
   They will be declining. Food source has greatly diminished.

SCIENTIFIC METHOD

Lesson 10 Overview

The review part of the day's lesson and correcting the biodiversity graphs should be sufficient preparation for the quiz. However, due to random absenteeism, I always have a quick review session before each quiz or test. I review concepts in general without referring to specific questions. I also allow students to ask questions, again, without giving away specific answers. I never set time limits to finish a test or quiz. I don't want students to feel that pressure. If a student is slow in finishing, I excuse them to the hall, skill building room, or library to finish up while the rest of the class corrects the quiz or test. We always exchange papers when assignments are corrected. I trust that the students will honestly correct the assignments and quizzes.

After the quiz, it is really critical that students understand the scientific method. The scientific method has been taught earlier in the year, but it is crucial that students know the steps and how to use them in preparation for the science project. Carefully explaining why the steps are in the order they are is also helpful. The lesson comes together nicely as students realize that there are many occupations that use the scientific method. At some point they also realize that they use the scientific method everyday as they make decisions. Using common examples of occupations that use the scientific method and allowing students to give their own examples and personal insight into the scientific method adds to the discussion. Depending on student level of understanding, finishing this lesson in one class period may be difficult. If that is the case, the lesson will need to be finished next time.

Lesson: 10

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Review by asking individual questions to students about energy roles, adaptation, and extinction.
- Review using questions such as: Why do animals become extinct? Do humans have a direct impact on extinction? How? Can you name some animals that have become extinct? What is evolution? What is adaptation? Give an example of an organism that has adapted?
- Exchange papers and correct the biodiversity graphs.
- Brief discussion, as a follow-up, to the graphing assignment on biodiversity.
- Quiz on biodiversity.

Lesson Title: The Scientific Method

Objectives: Students will be able to (SWBT):

- Complete the quiz on biodiversity.
- Name the six steps of the scientific method in order.
- Know why the steps of the scientific method are in the order they are in.
- Identify how abiotic factors affect biodiversity.
- Apply the scientific method to the proposed project.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Vocabulary: Hypothesis, data.

Lesson Body:

- Take the quiz on biodiversity.
- Exchange papers and correct in class. Hand in for recording.
- PowerPoint presentation on the scientific method, slides 47-54.
- Have students take notes during the presentation.
- Explain carefully each step and why one step follows another.
- Make application of each step to the upcoming project.

Guided Practice:

- In the margin of their notes, without looking, list the six steps of the scientific method.
- Go from student to student having each one repeat one step of the scientific method. Go until every student has had a chance to participate.

Review: Examples of occupations other than scientists that use the scientific method, such as doctors, dentists, police, investigators, mechanics, everyone as they go through their lives.

Closure:

- Reminder of learning objectives.
- Tomorrow, students will begin the class-wide science project on water quality and abiotic factors. Students will be working in groups of four.

Next Lesson:

- Introduction to the class-wide science project on water quality.
- Review of the scientific method.

Materials Needed:

- Computer and projector.
- Quiz on biodiversity.

- PowerPoint presentation – Fresh Water Ecology, slides 47-54.
- Students will need to bring their own paper and pen/pencil.

Accommodations:

- Printout of class notes for any students with reading/writing difficulties.
- Use common examples of occupations that use the scientific method. Allow students to give their own example and personal insight into the scientific method.

For next time:

- Student packets on the class-wide science project.
- Hand back the graded biodiversity graph assignment.

Ecology - Biodiversity

Name ________________________ Period _______ Score ___X/15__

Matching

Match the correct answer in column B with the statement in column A.

Column A	Column B
_____ 1. All the non-living parts of an ecosystem.	A. Evolution
_____ 2. The place where an organism lives and that provides the things the organism needs.	B. Biodiversity
_____ 3. A species that no longer exists	C. Adaptation
_____ 4. All the living and non-living things that interact in a particular area.	D. Biotic
_____ 5. All the living parts of an ecosystem.	E. Abiotic
_____ 6. A group of organisms that are physically similar and can reproduce with each other to produce fertile offspring.	F. Ecosystem
_____ 7. The study of how living things interact with each other and with their environment.	G. Habitat
_____ 8. A change in a species over time	H. Species
_____ 9. Many different forms of life in an ecosystem.	I. Ecology
_____10. A positive mutation that increases an organisms chance of survival.	J. Extinct

Matching

Match the correct answer in column B with the statement in column A.

Column A	Column B
______1. An organism that feeds on other organisms.	A. Herbivore
______2. Eats only plants.	B. Omnivore
______3. An organism that breaks down dead organisms.	C. Consumer
______4. Eats plants and animals.	D. Producer
______5. An organism that can make its own food.	E. Decomposer

Ecology - Biodiversity

Name ________KEY_____________ Period _______ Score ___X/15__

Matching

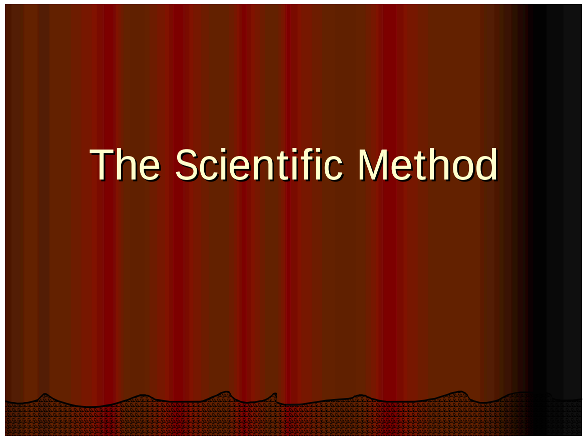
Match the correct answer in column B with the statement in column A.

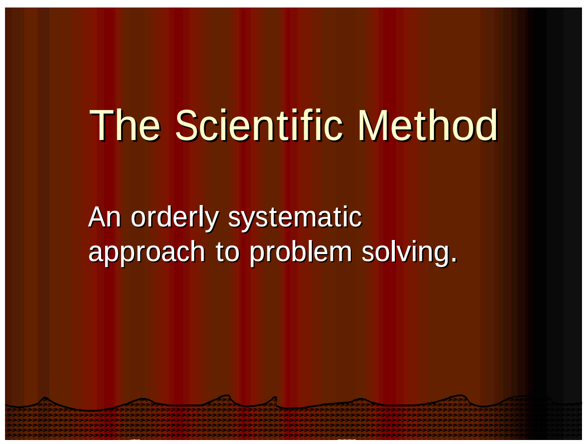
Column A	Column B
__E__ 1. All the non-living parts of an ecosystem.	A. Evolution
__G__ 2. The place where an organism lives and that provides the things the organism needs.	B. Biodiversity
__J__ 3. A species that no longer exists	C. Adaptation
__F__ 4. All the living and non-living things that interact in a particular area.	D. Biotic
__D__ 5. All the living parts of an ecosystem.	E. Abiotic
__H__ 6. A group of organisms that are physically similar and can reproduce with each other to produce fertile offspring.	F. Ecosystem
__I__ 7. The study of how living things interact with each other and with their environment.	G. Habitat
__A__ 8. A change in a species over time	H. Species
__B__ 9. Many different forms of life in an ecosystem.	I. Ecology
__C__10. A positive mutation that increases an organisms chance of survival.	J. Extinct

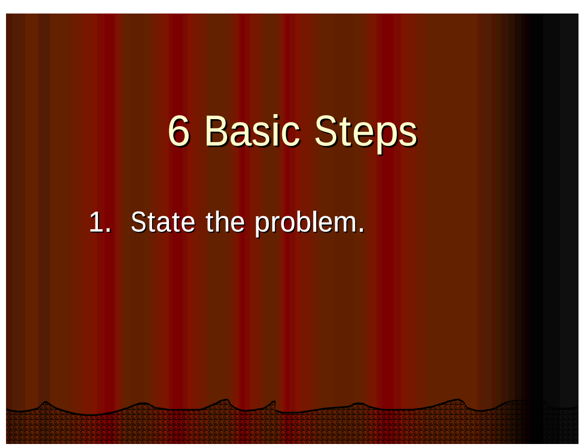
Matching

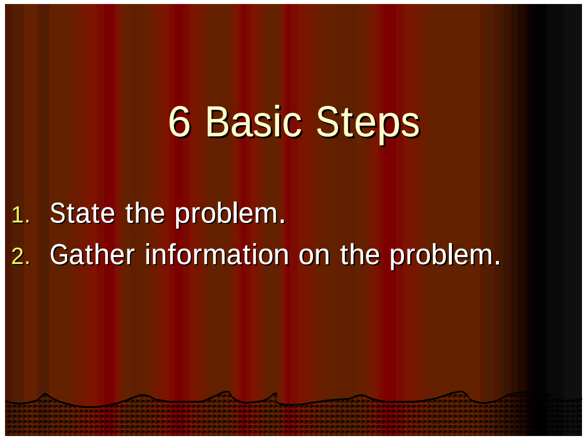
Match the correct answer in column B with the statement in column A.

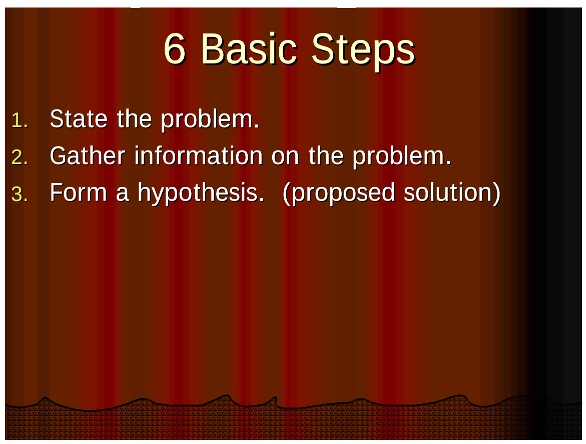
Column A	Column B
__C__ 1. An organism that feeds on other organisms.	A. Herbivore
__A__ 2. Eats only plants.	B. Omnivore
__E__ 3. An organism that breaks down dead organisms.	C. Consumer
__B__ 4. Eats plants and animals.	D. Producer
__D__ 5. An organism that can make its own food.	E. Decomposer

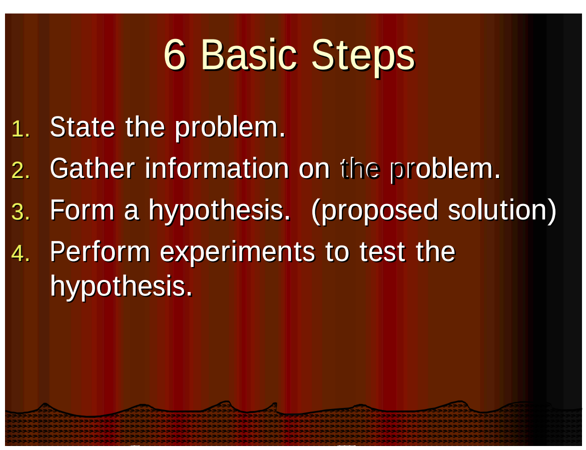

The Scientific Method

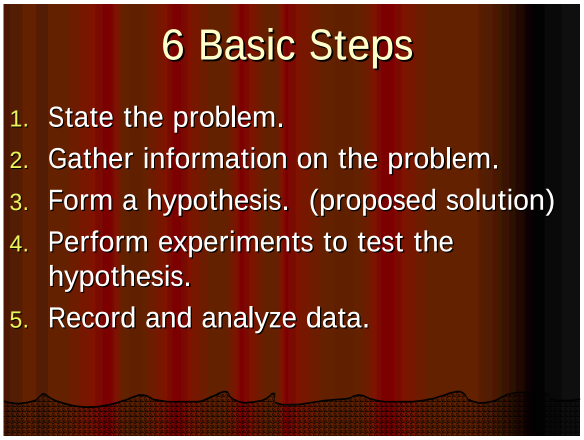

The Scientific Method
An orderly systematic approach to problem solving.

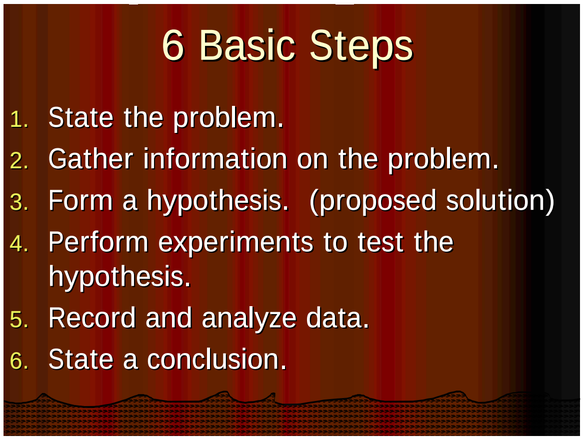

6 Basic Steps
1. State the problem.


6 Basic Steps
1. State the problem.
2. Gather information on the problem.


6 Basic Steps
1. State the problem.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)


6 Basic Steps
1. State the problem.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)
4. Perform experiments to test the hypothesis.


6 Basic Steps
1. State the problem.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)
4. Perform experiments to test the hypothesis.
5. Record and analyze data.


6 Basic Steps
1. State the problem.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)
4. Perform experiments to test the hypothesis.
5. Record and analyze data.
6. State a conclusion.

CLASS-WIDE SCIENCE PROJECT

Lesson 11 Overview

This lesson will take two days to complete. This is where everything finally comes together. The components of fresh water, ecology, biodiversity, and the scientific method are all combined at this point. Major group projects are always interesting. You never know if all of the students will participate. I thought it was important to have group members evaluate all the members of their group and make that evaluation part of each student's grade. I also debated whether or not to assign the groups or let the students choose their own groups. I settled on the latter, hoping that by choosing their own groups, participation will be better.

It is important to carefully go over the factors of temperature, pH, turbidity, conductivity, and dissolved oxygen. If the students don't understand what each of those factors are, they will struggle with the assignment. I really like the demonstration on conductivity. I wish I could describe how the light bulb and base are wired, but I don't remember how I did that. I do know that when one end is plugged into the outlet and the other end put in tap water, the light does not come on. When sugar is added to the water, the light still does not come on, but when a small amount of salt is added to the water and dissolved, the ions in the water complete the circuit and the light bulb turns on. It's a pretty amazing demonstration that always keeps the students' attention. Students need to be reminded of the field trip for the next lesson and to dress appropriately. It is also a good idea to let the administration know what is going on in case students need to be located or something else comes up. Permission slips are not needed. That could possibly change in another year depending on administrators, policies and traveling distance.

Lesson: 11

Time: Two 45-minute class periods.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Hand back the biodiversity graph assignment with the recorded grade.
- Remind individual students of missing assignments.
- Review by asking individual questions to students about the scientific method.

Lesson Title: Abiotic Factors Affecting Water Quality - 1.

Objectives: Students will be able to (SWBT):

- Complete section 2 of the student packet for the science project.
- Understand the role of abiotic factors as they relate to stream quality.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.

e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).

f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

Vocabulary: pH, acidic, alkaline, turbidity, conductivity, turbulent, dissolved oxygen.

Lesson Body:

- Have students get in groups of four. Make assignments if needed.
- Hand out student packets.
- Explain the project, including a hand-drawn map on the board of the locations along Hobble Creek.
- Explain the assignment, section 2, using the new vocabulary terms.
- Demonstration of conductivity using the light bulb and extension cords in a glass of water, with sugar and with salt.

Guided Practice: Monitor group work during the class period by listening and offering help.

Review: How the scientific method is used to answer questions.

Closure:

- Reminder of learning objectives.
- Tomorrow, field trip to Hobble Creek. Students will be walking. Dress appropriately.

- Collect group packets after each day's use.

Next Lesson: Walking field trip to Hobble Creek.

Materials Needed:

- Computer and projector.
- Recorded worksheets on biodiversity.
- Group packets on the science project.
- Materials for conductivity demonstration – light bulb and base wired to two extension cords. Glass of water, sugar, salt.

Accommodations:

- Some students will need to be assigned to groups to make sure they are included.
- Group numbers may need to be expanded beyond four or broken into groups of three to include some students.

For next time:

- Laptop computer and Vernier probes to test temperature, pH, turbidity, conductivity, and dissolved oxygen.
- Measure stream flow – tape measure, 4 flags or flagging material, meter stick, stopwatch, rubber ball or other floating object.
- Paper and pencil to record data.
- Let front office know what will be happening tomorrow.
- Water boots.
- Selected readings on ecology given to the study skills teacher for those students who cannot go on the field trip.

Abiotic Factors Affecting Water Quality – Science Project

Names: ____________________________ ______________________________

____________________________ ______________________________

Period _______

Score ___X/50____

Scientific Method

1. State the problem/question.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)
4. Perform experiments to test the hypothesis.
5. Record and analyze data.
6. State a conclusion.

1. Problem/Question – Will the abiotic factors of temperature, dissolved oxygen, turbidity, pH, and conductivity change in Hobble Creek as you move from Left and Right Forks towards Utah Lake? If yes, how will they change? Where will each factor have highest value and where will each factor have the lowest value? Will the values of these factors indicate a healthy stream?

2. Gather Information (Research) – Class notes, PowerPoint discussions.

I. Read through the following pages about abiotic factors and answer the questions.

a. **Temperature** – The measure of how much heat energy water contains. Aquatic organisms, from microbes to fish, are dependent on certain temperature ranges for survival. A healthy mountain stream needs to maintain temperatures below 22° C. A stream's temperature is affected by the season, but also by the source of water, the geographic area of the stream, the shape of the channel and whether the stream is shaded.

1. Typically, will a wide, shallow stream be warmer or colder than a narrow, deep stream? Why?

2. Will trees along the banks cause the stream to heat up or cool down? Why or why not?

3. Is surface water entering a stream usually, (during the summer), colder or warmer than ground water entering a stream? Why?

4. What effect does elevation usually have on temperature?

b. **pH –** The measurement of how acidic or alkaline the water is. The pH scale takes its name from the words *potential of hydrogen*. pH is measured on a scale of 0 to 14 with 0 being the most acidic, and 14 being the most alkaline. Distilled water, which has no impurities, is neutral and has a pH of 7. Examples of acidic fluids would be battery acid, stomach acid, oranges and lemons, and tomatoes. Examples of alkaline substances would be ammonia, drain cleaner, shampoo, veggies, and alka-seltzer. Healthy streams need pH levels between 6 and 8 to maintain diversity.

1. Will acid rain falling into a stream increase or decrease the pH levels? Why?

2. How would pollution being dumped into a stream affect pH?

c. **Turbidity –** The measure of water clarity and of how much suspended material is in the water. The more suspended material in the water, the murkier it seems and the higher the turbidity. Turbidity may be caused by eroded sediment, suspended minerals, or by microscopic plants growing in the water. Turbidity levels can be quite high for certain periods of the year, but generally diverse plant and animal life depends on low turbidity, levels below 300 NTU's.

1. Why does turbidity often increase in a stream when the flow increases?

2. Would a high turbidity increase or decrease photosynthetic activity? Why?

3. In which season would turbidity be the highest? Why?

4. Would a high turbidity cause the water to be colder or warmer? Why?

d. **Conductivity –** The measure of the ability of water to pass an electric current. Conductivity is affected by the presence of ions. Sodium, magnesium, chloride, calcium, nitrate, sulfate, and phosphate all contain ions that increase conductivity. Significant changes in conductivity could be an indicator that a discharge of some type of pollution has entered a stream. Pollution, sewage and fertilizers can increase conductivity. Conductivity is measured in micromhos per centimeter (µmhos/cm). Fresh water streams supporting good diversity have ranges from 150 to 1000 (µmhos/cm).

1. Would you expect the water in a stream below a sewage treatment facility to have a higher or lower conductivity? Why?

2. Why does the addition of salt increase conductivity?

3. Would runoff from fertilized golf fairways increase conductivity? Why or why not?

e. **Dissolved Oxygen –** Dissolved oxygen measures the concentration of oxygen that is dissolved in the water. This is the form of oxygen that fish and aquatic insects need. Running water, because of its churning and tumbling, dissolves more oxygen than still water. Plants also produce oxygen during photosynthesis. The decomposition of dead materials can use up dissolved oxygen. Ranges of desired dissolved oxygen readings should be between 4 and 10 mg/L or parts per million (ppm).

1. Would turbulent water have more or less dissolved oxygen? Why?

2. How will dissolved oxygen concentrations be affected by the dumping of yard clippings or leaves into the stream? Why?

II. Fill out the spreadsheet by predicting where each abiotic factor will be highest and where each will be lowest along Hobble Creek. Indicate "highest', "lowest" or "no change".

Predicting - Where do you predict each of the following abiotic factors will be						
	highest and where will they be the lowest along Hobble Creek?					
	Indicate highest, lowest, or no change.					
					Dissolved	
	Location	**Temp**	**pH**	**Conductivity**	**Oxygen**	**Turbidity**
		(°C)		**(µmhos/cm)**	**(mg/L)**	**(NTU'S)**
1	Left Fork - End of asphalt					
2	Left Fork - Halfway down canyon					
3	Right Fork – Cherry Campground					
4	Kelly's Grove					
5	After Debris Basin					
6	Near High School					
7	Near Jr. High					
8	400 West					
9	Near Freeway					.

Do you think that the values of these factors will indicate that Hobble Creek is a healthy stream?

Problem/Question - Will the abiotic factors of temperature, dissolved oxygen, turbidity, pH, and conductivity change in Hobble Creek as you move from Left and Right Forks towards Utah Lake? If yes, how will they change? Where will each factor have highest value and where will each factor have the lowest value? Will the values of these factors indicate a healthy stream?

3. What is your hypothesis? (make sure it answers the questions)

4. Experiments – Test each abiotic factor at least 3 times at 9 different locations. Use the Vernier probes and sensors. Follow the steps given for each probe to collect the data. Collect stream flow information first.

Each group will be assigned to collect data from one location, then each group will share their data with each of the other groups. You will have to check out the probes, sensors, and other supplies from the teacher. You decide amongst yourselves who will be responsible for collecting the data. Remember – the other group members will be grading you on your participation.

1. Left Fork – end of asphalt
2. Left Fork – Halfway down canyon
3. Right Fork – Cherry Campground
4. Kelly's Grove
5. After Debris Basin
6. Near High School
7. Near Jr. High
8. 400 West
9. Near Freeway

Our assigned location is ______________________________.

What is stream flow and why is it important?

Stream flow, or discharge, is the volume of water that moves over a designated point over a fixed period of time. It is often expressed as cubic feet per second (ft^3/sec).

The flow of a stream is directly related to the amount of water moving off the watershed into the stream channel. It is affected by weather, increasing during rainstorms and decreasing during dry periods. It also changes during different seasons of the year, decreasing during the summer months when evaporation rates are high and shoreline vegetation is actively growing and removing water from the ground. August and September are usually the months of lowest flow for most streams and rivers in most of the country. Water withdrawals for irrigation purposes can seriously deplete water flow, as can industrial water withdrawals. Dams used for electric power generation, particularly facilities designed to produce power during periods of peak need, often block the flow of a stream and later release it in a surge.

Flow is a function of water volume and velocity. It is important because of its impact on water quality and on the living organisms and habitats in the stream. Large, swiftly flowing rivers can receive pollution discharges and be little affected, whereas small streams have less capacity to dilute and degrade wastes.

Stream velocity, which increases as the volume of the water in the stream increases, determines the kinds of organisms that can live in the stream (some need fast-flowing areas; others need quiet pools). It also affects the amount of silt and sediment carried by the stream. Sediment introduced to quiet, slow-flowing streams will settle quickly to the stream bottom. Fast moving streams will keep sediment suspended longer in the water column. Lastly, fast-moving streams generally have higher levels of dissolved oxygen than slow streams because they are better aerated.

This section describes one method for estimating flow in a specific area or reach of a stream. It is adapted from techniques used by several volunteer monitoring programs and uses a float (an object such as a plastic ball to measure stream velocity. Calculating flow involves solving an equation that examines the relationship among several variables including stream cross-sectional area, stream length, and water velocity. One way to measure flow is to solve the following equation:

$$\text{Flow} = ALC / T$$

Where:

A = Average cross-sectional area of the stream (stream width multiplied by average water depth).

L = Length of the stream reach measured (usually 20 ft.)

C = A coefficient or correction factor (0.8 for rocky-bottom streams or 0.9 for muddy-bottom streams). This allows you to correct for the fact that water at the surface travels faster than near the stream bottom due to resistance from gravel, cobble, etc. Multiplying the surface velocity by a correction coefficient decreases the value and gives a better measure of the stream's overall velocity.

T = Time, in seconds, for the float to travel the length of L

How to Measure and Calculate Stream Flow

Task 1 - Prepare before leaving for the sampling site

- 4 flags to mark 20 feet along each shoreline.
- Tape measure (at least 30 feet).
- Yardstick to measure water depth.
- A plastic ball partially filled with water.
- Stopwatch
- ***Common sense – Wear boots or shoes that can get wet. Be careful. We don’t need any funerals. If the water is moving too fast for your safety, don’t do this part.***

Task 2 - Go to your assigned location

The stream stretch chosen for the measurement of discharge should be straight (no bends), at least 6 inches deep, and should not contain an area of slow water such as a pool. The length that you select will be equal to *L* in solving the flow equation. Twenty feet is a standard length used by many programs. Measure your length and set the flags along each shore.

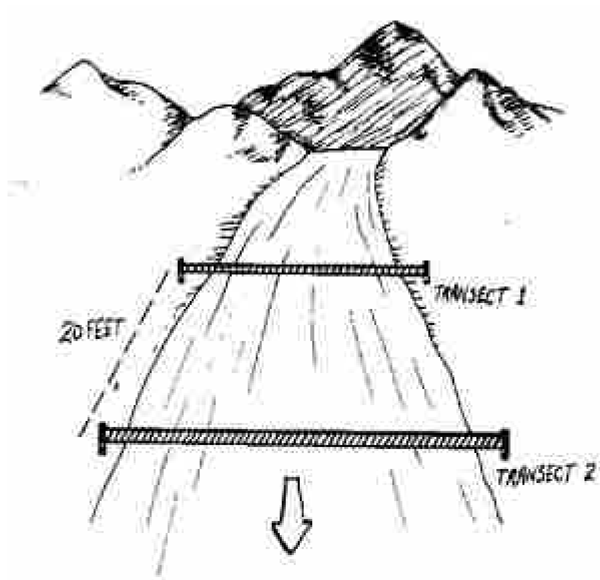


Figure 5.4

A diagram of a 20-foot transect

Task 3 - Calculate the average cross-sectional area

Cross-sectional area (A in the formula) is the product of stream width multiplied by average water depth. To calculate the average cross-sectional area for the study stream, determine the cross-sectional area for each transect, add the results together, and then divide by 2 to determine the average cross-sectional area for the stream reach.

To measure cross-sectional area:

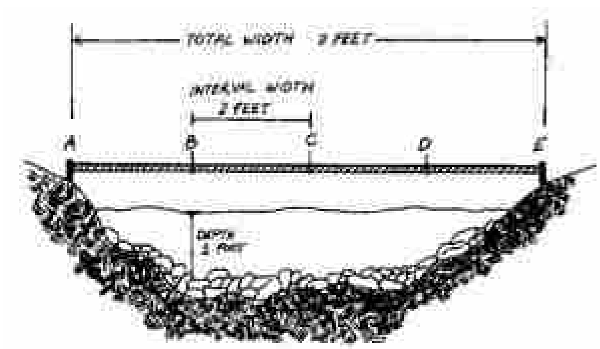


Figure 5.5

A cross section view to measure stream width and depth

1. Determine the average depth along the transect by measuring at several intervals. The intervals can be one-fourth, one-half, and three-fourths of the distance across the stream. Measure the water's depth at each interval point (Fig. 5.5). To calculate average depth for each transect, divide the total of the three depth measurements by 4. (You divide by 4 instead of 3 because you need to account for the 0 depths that occur at the shores.)
2. Determine the width of each transect by measuring the distance from shoreline to shoreline.
3. Calculate the cross-sectional area of each transect by multiplying width times average depth.
4. To determine the average cross-sectional area of the entire stream reach (A in the formula), add together the average cross-sectional area of each transect and then divide by 2.

Task 4 - Measure travel time Students should time with a stopwatch how long it takes for a plastic ball to float from the upstream to the downstream transect. A partially filled ball is a good object to use because it has enough buoyancy to float just below the water surface. It is at this position that maximum velocity typically occurs.

The student who lets the ball go at the upstream flag should position it so it flows into the fastest current. The clock stops when the ball passes fully under the downstream flag. Once past the last flag, the ball can be taken out of the water. This "time of travel" measurement should be conducted at least three times and the results averaged--the more trials you do, the more accurate your results will be. The averaged results are equal to *T* in the formula. You should discard any float trials if the object gets hung up in the stream (by cobbles, roots, debris, etc.)

Task 5 - Calculate flow

Recall that flow can be calculated using the equation:

Flow = ALC / T

Say the average time of travel for the ball between flag #1 and #2 is 15 seconds and the stream had a rocky bottom. The calculation of flow would be:

Where:		
A	=	5.42 ft2
L	=	20 ft
C	=	0.8 (coefficient for a rocky-bottom stream)
T	=	15 seconds
Flow = 15 seconds (5.42 ft^2) (20 ft) (0.8) / 15 sec.		
Flow = 86.72 ft^3/ 15 sec.		
Flow = 5.78 ft3/sec.		

Determining Stream Flow				
Location -				
Width	**Results**		**Time**	**Results**
1			1	
2			2	
Avg.			3	
			Avg.	
Depth				
Flag #1				
1				
2				
3				
4				
Avg.				
Flag #2				
1				
2				
3				
4				
Avg.				

We will do the math in class. Just bring in the numbers if you are having trouble.

	Actual results	
		Flow
	Location	(cfs)
		(gpm)
1	Left Fork - End of asphalt	
2	Left Fork - Halfway down canyon	
3	Right Fork – Cherry Campground	
4	Kelly's Grove	
5	After Debris Basin	
6	Near High School	
7	Near Jr. High	
8	400 West	
9	Near Freeway	

5. Fill out the spreadsheets with the actual results. Analyze the results.

Actual Results							
						Dissolved	
	Location	Trial	Temp	pH	Conductivity	Oxygen	Turbidity
			(° C)		(µmhos/cm)	(mg/L)	(NTU'S)
1	Left Fork - End of asphalt						
		1					
		2					
		3					
		Avg.					
2	Left Fork - Halfway down canyon						
		1					
		2					
		3					
		Avg.					
3	Right Fork – Cherry Campground						
		1					
		2					
		3					
		Avg.					
4	Kelly's Grove						
		1					
		2					
		3					
		Avg.					
5	After Debris Basin						
		1					
		2					
		3					
		Avg.					
6	Near High School						
		1					
		2					
		3					
		Avg.					
7	Near Jr. High						
		1					
		2					
		3					
		Avg.					
8	400 West						
		1					
		2					
		3					
		Avg.					
9	Near Freeway						
		1					
		2					
		3					
		Avg.					

6. What are your conclusions? (Do they support your hypothesis?)

Copy your hypothesis from step 3.

1. Do your conclusions support your hypothesis? Why or why not?

2. Give 2 reasons why water temperatures would be the coldest at location #1 and warmest at location #9.
    a.

    b.

3. Why does stream flow double between location #3 and #4?

4. Why might location #3 have the highest pH value and the highest conductivity value?

5. Why would another water sample from the Right Fork of Hobble Creek be helpful in answering question #4?

6. Based upon the values obtained, is Hobble Creek a healthy stream? Why or why not?

Fill out the group evaluation for each member of your group. Make sure the values for all members of your group total 20 points. Do not put your name on the group evaluation. Turn them into the teacher.

James			Keilani			Kyle	
Ericka			Lydia			Hudson	
Mitch			Logan			Adam	
Melissa			Andrew			Lindsey	
	20			**20**			**20**
Andrea			Aaron			Austin	
Jana			Mitch			Alfonso	
Taysha			Taylor			Tayt	
Mateo			Corbin			Lance	
	20			**20**			**20**
Hannah			Heather			Madison	
Brett			Chandler			Joe	
Brandon			Nikki			Alec	
Shaylie			Dallas				**20**
	20			**20**			

Abiotic Factors Affecting Water Quality – Science Project

Names: ______________________________ ________________________________

______________________________ ________________________________

Period _______

Score ___X/50____

Scientific Method

1. State the problem/question.
2. Gather information on the problem.
3. Form a hypothesis. (proposed solution)
4. Perform experiments to test the hypothesis.
5. Record and analyze data.
6. State a conclusion.

1. Problem/Question – Will the abiotic factors of temperature, dissolved oxygen, turbidity, pH, and conductivity change in Hobble Creek as you move from Left and Right Forks towards Utah Lake? If yes, how will they change? Where will each factor have highest value and where will each factor have the lowest value? Will the values of these factors indicate a healthy stream?

2. Gather Information (Research) – Class notes, PowerPoint discussions.

I. Read through the following pages about abiotic factors and answer the questions.

a. **Temperature** – The measure of how much heat energy water contains. Aquatic organisms, from microbes to fish, are dependent on certain temperature ranges for survival. A healthy mountain stream needs to maintain temperatures below 22° C. A stream's temperature is affected by the season, but also by the source of water, the geographic area of the stream, the shape of the channel and whether the stream is shaded.

1. Typically, will a wide, shallow stream be warmer or colder than a narrow, deep stream? Why?

Warmer. More surface area to receive sunlight.

2. Will trees along the banks cause the stream to heat up or cool down? Why or why not?

Cool down. Water surface is shaded from direct sunlight.

3. Is surface water entering a stream usually, (during the summer), colder or warmer than ground water entering a stream? Why?

Warmer. Exposed to sunlight.

4. What effect does elevation usually have on temperature?

As elevation increases, air temperatures decrease.

b. **pH –** The measurement of how acidic or alkaline the water is. The pH scale takes its name from the words *potential of hydrogen*. pH is measured on a scale of 0 to 14 with 0 being the most acidic, and 14 being the most alkaline. Distilled water, which has no impurities, is neutral and has a pH of 7. Examples of acidic fluids would be battery acid, stomach acid, oranges and lemons, and tomatoes. Examples of alkaline substances would be ammonia, drain cleaner, shampoo, veggies, and alka-seltzer. Healthy streams need pH levels between 6 and 8 to maintain diversity.

1. Will acid rain falling into a stream increase or decrease the pH levels? Why?

Decrease. The concentrations of acid in the water will increase.

2. How would pollution being dumped into a stream affect pH?

It will most likely decrease the pH levels, depending on the pollutant.

c. **Turbidity –** The measure of water clarity and of how much suspended material is in the water. The more suspended material in the water, the murkier it seems and the higher the turbidity. Turbidity may be caused by eroded sediment, suspended minerals, or by microscopic plants growing in the water. Turbidity levels can be quite high for certain periods of the year, but generally diverse plant and animal life depends on low turbidity, levels below 300 NTU's.

1. Why does turbidity often increase in a stream when the flow increases?

Faster moving currents increase the amount of suspended particles in the water.

2. Would a high turbidity increase or decrease photosynthetic activity? Why?

   Decrease. Sunlight cannot penetrate as far into the water due to all the suspended particles.

3. In which season would turbidity be the highest? Why?

   Spring. Increased runoff and stream flows.

4. Would a high turbidity cause the water to be colder or warmer? Why?

   Warmer. Suspended particles absorb more heat.

d. **Conductivity –** The measure of the ability of water to pass an electric current. Conductivity is affected by the presence of ions. Sodium, magnesium, chloride, calcium, nitrate, sulfate, and phosphate all contain ions that increase conductivity. Significant changes in conductivity could be an indicator that a discharge of some type of pollution has entered a stream. Pollution, sewage and fertilizers can increase conductivity. Conductivity is measured in micromhos per centimeter (µmhos/cm). Fresh water streams supporting good diversity have ranges from 150 to 1000 (µmhos/cm).

1. Would you expect the water in a stream below a sewage treatment facility to have a higher or lower conductivity? Why?

   Higher. More conducting ions added to the water.

2. Why does the addition of salt increase conductivity?
   Salt contains conduction ions sodium and chlorine.

3. Would runoff from fertilized golf fairways increase conductivity? Why or why not?

Increase. Fertilizers contain nitrates, sulfates, and phosphorus
All are conducting ions.

e. **Dissolved Oxygen –** Dissolved oxygen measures the concentration of oxygen that is dissolved in the water. This is the form of oxygen that fish and aquatic insects need. Running water, because of its churning and tumbling, dissolves more oxygen than still water. Plants also produce oxygen during photosynthesis. The decomposition of dead materials can use up dissolved oxygen. Ranges of desired dissolved oxygen readings should be between 4 and 10 mg/L or parts per million (ppm).

1. Would turbulent water have more or less dissolved oxygen? Why?

More. The churning water submerges oxygen where some is dissolved.

2. How will dissolved oxygen concentrations be affected by the dumping of yard clippings or leaves into the stream? Why?

It will decrease. Decaying material uses up dissolved oxygen in the water.

II. Fill out the spreadsheet by predicting where each abiotic factor will be highest and where each will be lowest along Hobble Creek. Indicate "highest', "lowest" or "no change".

Predicting – Where do you predict each of the following abiotic factors will be						
	highest and where will they be the lowest along Hobble Creek?					
	Indicate highest, lowest, or no change.					
					Dissolved	
	Location	**Temp**	**pH**	**Conductivity**	**Oxygen**	**Turbidity**
		(°C)		**(μmhos/cm)**	**(mg/L)**	**(NTU'S)**
1	Left Fork – End of asphalt					
2	Left Fork – Halfway down canyon					
3	Right Fork – Cherry Campground					
4	Kelly's Grove					
5	After Debris Basin					
6	Near High School					
7	Near Jr. High					
8	400 West					
9	Near Freeway					.

Do you think that the values of these factors will indicate that Hobble Creek is a healthy stream?

Problem/Question – Will the abiotic factors of temperature, dissolved oxygen, turbidity, pH, and conductivity change in Hobble Creek as you move from Left and right Forks towards Utah Lake?, If yes, how will they change? Where will each factor have highest value and where will each factor have the lowest value? Will the values of these factors indicate a healthy stream?

3. What is your hypothesis? (make sure it answers the questions)

4. Experiments – Test each abiotic factor at least 3 times at 9 different locations. Use the Vernier probes and sensors. Follow the steps given for each probe to collect the data. Collect stream flow information first.

Each group will be assigned to collect data from one location, then each group will share their data with each of the other groups. You will have to check out the probes, sensors, and other supplies from the teacher. You decide amongst yourselves who will be responsible for collecting the data. Remember – the other group members will be grading you on your participation.

1. Left Fork – end of asphalt
2. Left Fork – Halfway down canyon
3. Right Fork – Cherry Campground
4. Kelly's Grove
5. After Debris Basin
6. Near High School
7. Near Jr. High
8. 400 West
9. Near Freeway

Our assigned location is ________________________________.

What is stream flow and why is it important?

Stream flow, or discharge, is the volume of water that moves over a designated point over a fixed period of time. It is often expressed as cubic feet per second (ft^3/sec).

The flow of a stream is directly related to the amount of water moving off the watershed into the stream channel. It is affected by weather, increasing during rainstorms and decreasing during dry periods. It also changes during different seasons of the year, decreasing during the summer months when evaporation rates are high and shoreline vegetation is actively growing and removing water from the ground. August and September are usually the months of lowest flow for most streams and rivers in most of the country. Water withdrawals for irrigation purposes can seriously deplete water flow, as can industrial water withdrawals. Dams used for electric power generation, particularly facilities designed to produce power during periods of peak need, often block the flow of a stream and later release it in a surge.

Flow is a function of water volume and velocity. It is important because of its impact on water quality and on the living organisms and habitats in the stream. Large, swiftly flowing rivers can receive pollution discharges and be little affected, whereas small streams have less capacity to dilute and degrade wastes.

Stream velocity, which increases as the volume of the water in the stream increases, determines the kinds of organisms that can live in the stream (some need fast-flowing areas; others need quiet pools). It also affects the amount of silt and sediment carried by the stream. Sediment introduced to quiet, slow-flowing streams will settle quickly to the stream bottom. Fast moving streams will keep sediment suspended longer in the water column. Lastly, fast-moving streams generally have higher levels of dissolved oxygen than slow streams because they are better aerated.

This section describes one method for estimating flow in a specific area or reach of a stream. It is adapted from techniques used by several volunteer monitoring programs and uses a float (an object such as a plastic ball to measure stream velocity. Calculating flow involves solving an equation that examines the relationship among several variables including stream cross-sectional area, stream length, and water velocity. One way to measure flow is to solve the following equation:

Flow = ALC / T		
Where:		
A	=	Average cross-sectional area of the stream (stream width multiplied by average water depth).
L	=	Length of the stream reach measured (usually 20 ft.)
C	=	A coefficient or correction factor (0.8 for rocky-bottom streams or 0.9 for muddy-bottom streams). This allows you to correct for the fact that water at the surface travels faster than near the stream bottom due to resistance from gravel, cobble, etc. Multiplying the surface velocity by a correction coefficient decreases the value and gives a better measure of the stream's overall velocity.
T	=	Time, in seconds, for the float to travel the length of L

How to Measure and Calculate Stream Flow

Task 1 – Prepare before leaving for the sampling site

- 4 flags to mark 20 feet along each shoreline.
- Tape measure (at least 30 feet).
- Yardstick to measure water depth.
- A plastic ball partially filled with water.
- Stopwatch
- ***Common sense – Wear boots or shoes that can get wet. Be careful. We don't need any funerals. If the water is moving too fast for your safety, don't do this part.***

Task 2 – Go to your assigned location

The stream stretch chosen for the measurement of discharge should be straight (no bends), at least 6 inches deep, and should not contain an area of slow water such as a pool. The length that you select will be equal to *L* in solving the flow equation. Twenty feet is a standard length used by many programs. Measure your length and set the flags along each shore.

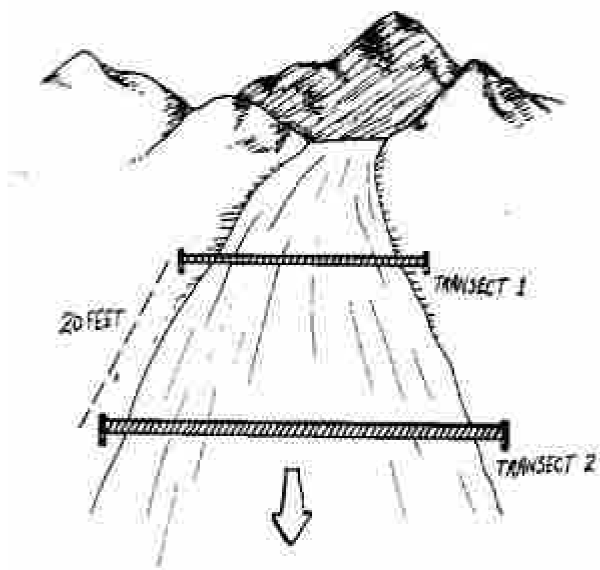


Figure 5.4

A diagram of a 20-foot transect

Task 3 – Calculate the average cross-sectional area

Cross-sectional area (A in the formula) is the product of stream width multiplied by average water depth. To calculate the average cross-sectional area for the study stream, determine the cross-sectional area for each transect, add the results together, and then divide by 2 to determine the average cross-sectional area for the stream reach.

To measure cross-sectional area:

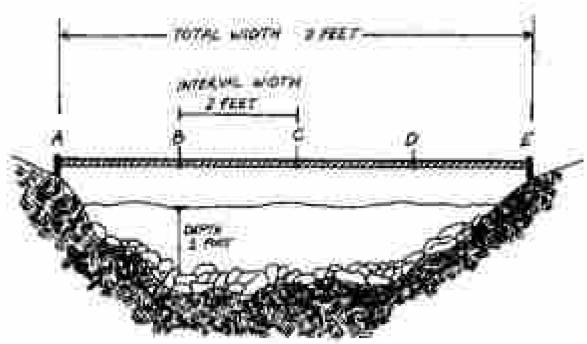


Figure 5.5

A cross section view to measure stream width and depth

1. Determine the average depth along the transect by measuring at several intervals. The intervals can be one-fourth, one-half, and three-fourths of the distance across the stream. Measure the water's depth at each interval point (Fig. 5.5). To calculate average depth for each transect, divide the total of the three depth measurements by 4. (You divide by 4 instead of 3 because you need to account for the 0 depths that occur at the shores.)
2. Determine the width of each transect by measuring the distance from shoreline to shoreline.
3. Calculate the cross-sectional area of each transect by multiplying width times average depth.
4. To determine the average cross-sectional area of the entire stream reach (A in the formula), add together the average cross-sectional area of each transect and then divide by 2.

Task 4 - Measure travel time

Students should time with a stopwatch how long it takes for a plastic ball to float from the upstream to the downstream transect. A partially filled ball is a good object to use because it has enough buoyancy to float just below the water surface. It is at this position that maximum velocity typically occurs.

The student who lets the ball go at the upstream flag should position it so it flows into the fastest current. The clock stops when the ball passes fully under the downstream flag. Once past the last flag, the ball can be taken out of the water. This "time of travel" measurement should be conducted at least three times and the results averaged--the more trials you do, the more accurate your results will be. The averaged results are equal to *T* in the formula. You should discard any float trials if the object gets hung up in the stream (by cobbles, roots, debris, etc.)

Task 5 - Calculate flow

Recall that flow can be calculated using the equation: Flow = ALC / T

Say the average time of travel for the ball between flag #1 and #2 is 15 seconds and the stream had a rocky bottom. The calculation of flow would be:

Where:		
A	=	5.42 ft2
L	=	20 ft
C	=	0.8 (coefficient for a rocky-bottom stream)
T	=	15 seconds
Flow = 15 seconds (5.42 ft^2) (20 ft) (0.8) / 15 sec.		
Flow = 86.72 ft^3/ 15 sec.		
Flow = 5.78 ft3/sec.		

Determining Stream Flow				
Location -				
Width	**Results**		**Time**	**Results**
1			1	
2			2	
Avg.			3	
			Avg.	
Depth				
Flag #1				
1				
2				
3				
4				
Avg.				
Flag #2				
1				
2				
3				
4				
Avg.				

We will do the math in class. Just bring in the numbers if you are having trouble.

Actual Results		
		Flow
	Location	**(cfs)**
		(gpm)
1	Left Fork - End of asphalt	**18.2**
		136
2	Left Fork - Halfway down canyon	**22.2**
		166
3	Right Fork – Cherry Campground	**24.3**
		182
4	Kelly's Grove	**52.6**
		393
5	After Debris Basin	**66.8**
		500
6	Near High School	**70.1**
		524
7	Near Jr. High	**72.6**
		543
8	400 West	**92.4**
		690
9	Near Freeway	**N/A**

5. Fill out the spreadsheets with the actual results. Analyze the results.

Actual Results							
						Dissolved	
	Location	Trial	Temp	pH	Conductivity	Oxygen	Turbidity
			(° C)		(µmhos/cm)	(mg/L)	(NTU'S)
1	Left Fork - End of asphalt						
		1	3.8	7.0	648	Average	Average
		2	3.8	7.0	648	of 20	of 20
		3	3.8	7.0	648	samples	samples
		Avg.	**3.8**	**7.0**	**648**	**6.5**	**31.7**
2	Left Fork - Halfway down canyon						
		1	3.9	6.5	569	Average	Average
		2	3.9	6.5	569	of 20	of 20
		3	3.9	6.5	569	samples	samples
		Avg.	**3.9**	**6.5**	**569**	**7.4**	**29.2**
3	Right Fork – Cherry Campground						
		1	4.2	7.2	895	Average	Average
		2	4.2	7.2	895	of 20	of 20
		3	4.2	7.2	895	samples	samples
		Avg.	**4.2**	**7.2**	**895**	**6.6**	**40.6**
4	Kelly's Grove						
		1	5.0	6.5	717	Average	Average
		2	5.0	6.5	717	of 20	of 20
		3	5.0	6.5	717	samples	samples
		Avg.	**5.0**	**6.5**	**717**	**6.5**	**41.8**
5	After Debris Basin						
		1	5.9	6.5	648	Average	Average
		2	5.9	6.5	648	of 20	of 20
		3	5.9	6.5	648	samples	samples
		Avg.	**5.9**	**6.5**	**648**	**7.1**	**36.3**
6	Near High School						
		1	6.2	6.6	727	Average	Average
		2	6.2	6.6	727	of 20	of 20
		3	6.2	6.6	727	samples	samples
		Avg.	**6.2**	**6.6**	**727**	**7.2**	**30.4**
7	Near Jr. High						
		1	6.4	6.8	707	Average	Average
		2	6.4	6.8	707	of 20	of 20
		3	6.4	6.8	707	samples	samples
		Avg.	**6.4**	**6.8**	**707**	**6.9**	**16.2**
8	400 West						
		1	7.0	6.4	687	Average	Average
		2	7.0	6.4	687	of 20	of 20
		3	7.0	6.4	687	samples	samples
		Avg.	**7.0**	**6.4**	**687**	**6.8**	**32.1**
9	Near Freeway						
		1	7.1	6.6	677	Average	Average
		2	7.1	6.6	677	of 20	of 20
		3	7.1	6.6	677	samples	samples
		Avg.	**7.1**	**6.6**	**677**	**7.1**	**30.8**

6. What are your conclusions? (Do they support your hypothesis?)

Copy your hypothesis from step 3.

1. Do your conclusions support your hypothesis? Why or why not?

2. Give 2 reasons why water temperatures would be the coldest at location #1 and warmest at location #9.
    a. *Higher elevation.*

    b. More shading from the sun.

3. Why does stream flow double between location #3 and #4?

    Left and right forks have combined.

4. Why might location #3 have the highest pH value and the highest conductivity value?
    Don't know for sure. A campground is nearby. Something different is happening up right fork.

5. Why would another water sample from the Right Fork of Hobble Creek be helpful in answering question #4?

    You would have another sample to get an average.

6. Based upon the values obtained, is Hobble Creek a healthy stream? Why or why not?

    Yes. All values for the abiotic values fall within acceptable limits for a healthy stream.

Fill out the group evaluation for each member of your group. Make sure the values for all members of your group total 20 points. Do not put your name on the group evaluation. Turn them into the teacher.

James	**20**		Keilani	**20**		Kyle	**22**
Ericka	**20**		Lydia	**20**		Hudson	**16**
Mitch	**20**		Logan	**20**		Adam	**22**
Melissa	**20**		Andrew	**20**		Lindsey	**20**
Andrea	**19**		Aaron	**20**		Austin	**20**
Jana	**21**		Mitch	**21**		Alfonso	**20**
Taysha	**22**		Taylor	**19**		Tayt	**20**
Mateo	**18**		Corbin	**21**		Lance	**20**
Hannah	**17**		Heather	**20**		Madison	**19**
Brett	**21**		Chandler	**20**		Joe	**20**
Brandon	**19**		Nikki	**20**		Alec	**21**
Shaylie	**23**		Dallas	**20**			

Lesson 12 Overview

This lesson finally gets the students outside and they can do a little "hands on" learning. There is a site on Hobble Creek at 400 East and 350 South in Springville that is easily within walking distance from the Jr. High. This particular site has a stream bank that the students can get down on and be safe and off the city street. It is a good idea to let the main office know where you will be throughout the day in case they are looking for particular students. Field trips are always interesting. By walking, it avoids all the hassles of busses and permission slips. It is good to keep the group together as you walk, to keep students from goofing off and getting into trouble.

Once at the site, try to involve as many students as possible in taking the measurements and obtaining the data. Choosing a few students the day before to help will aid in this field trip. That way, they can come prepared with water boots and the proper attire to collect data. It is very important to model how each probe or sensor is used and how to measure stream flow. Having students call out the instructions for each step is helpful. Modeling and collecting data several times with each class reinforces the objectives for the field trip. Stressing safety is important. We don't need anyone getting hurt or drowned.

Some students may not be able to go on the field trip due to physical limitations. Those students, and any others who choose not to participate, will need to be sent to the study skills room or the library to do selected readings on ecology or some other project/assignment. Make sure those teachers/librarian are notified in advance and are willing to accommodate those students.

Lesson: 12

Time: One 45-minute class period.

Attention Grabber: Display of probes and sensors on front desk.

Daily Review: Quick review of the project, including temperature, pH, turbidity, conductivity, and dissolved oxygen.

Lesson Title: Walking Field Trip to Hobble Creek.

Objectives: Students will be able to (SWBT):

- Safely complete the field trip.
- Learn how to operate the Vernier probes.
- Obtain measurements for temperature, pH, turbidity, conductivity, and dissolved oxygen.
- Obtain the measurements for stream flow.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

f. Plan and conduct an experiment to investigate how biotic factors influence organisms and how organisms influence the physical environment.

Vocabulary: None

Lesson Body:

- Quickly demonstrate how each probe or sensor works.
- Have students help carry the equipment.
- Walk with the class to Hobble Creek on 400 East and 350 South.
- Obtain measurements on stream flow and obtain data on temperature, pH, turbidity, conductivity, and dissolved oxygen.

- Record all information.
- Return to class.

Guided Practice: Involve students as much as possible in obtaining measurements and data.

Review: Different abiotic factors being measured.

Closure:

- Reminder of learning objectives.
- Tomorrow, students will be working in groups again on the student packet.

Next Lesson: Science project – group packets.

Materials Needed:

- Laptop computer or TI-84 calculator and the Vernier probes/sensors for temperature, pH, turbidity, conductivity, and dissolved oxygen.
- Measure stream flow – tape measure, 4 flags or flagging material, meter stick, stopwatch, rubber ball or other floating object.
- Paper and pencil to record data.
- Water boots.
- Instructions for operating each sensor/probe.

Accommodations: Some students may not be able to go on the field trip due to physical limitations. Those students will be sent to the study skills room to do selected readings on ecology.

For next time:

- Science project – group packets.
- Assignments for collecting water data and measurements for each group.

Measuring Temperature

1. Start the *Logger Pro* software program on the computer.
2. Connect the *Go Link* to any USB port on the computer.
3. Connect the Temperature probe to the *Go Link*.
4. The calculator will automatically identify the probe.
5. You are now ready to collect data.
6. Click on *Collect*
7. Insert the Temperature probe into the stream of water.
8. Allow at least 10 seconds for an accurate reading.
9. Readings are provided as ° C.

Measuring pH

1. Start the *Logger Pro* software program on the computer.
2. Connect the *Go Link* to any USB port on the computer.
3. Connect the pH sensor to the *Go Link*.
4. You are ready to collect data. *Logger Pro* will identify the pH sensor. No calibration is necessary as it has been set before shipping. Remove the storage bottle from the electrode by first unscrewing the lid, then removing the bottle and lid. Thoroughly rinse the lower section of the probe, especially the region of the bulb, using distilled water.
5. Click on *Collect* and begin collecting data.
6. When you are finished making measurements, rinse the tip of the electrode with distilled water. Slide the cap onto the electrode body, then screw the cap onto the storage bottle.

The sensor is designed to make measurements in the pH range of 0 to 14.

Measuring Turbidity

1. Start the *Logger Pro* software program on the computer.
2. Connect the *Go Link* to any USB port on the computer.
3. Connect the Turbidity sensor to the *Go Link*.
4. *Logger Pro* will identify the Turbidity sensor. Calibrate the sensor.
5. If your sample of water is very clear, you might want to let the Turbidity sensor warm up for about 5 minutes to assure a stable voltage.
6. Obtain the cuvette containing the Turbidity Standard (100 NTU) and gently invert it four times to mix any particles that may have settled to the bottom. Do not shake the standard. Shaking will introduce tiny air bubbles that will affect turbidity readings.
7. Wipe the outside of the cuvette with a soft, lint-free cloth or tissue.
8. Holding the standard by the lid, place it in the Turbidity Sensor. Align the mark on the cuvette with the mark on the Turbidity sensor.
9. Close the lid.
10. Enter “100” as the value in NTU.
11. Remove the standard.
12. Prepare a *blank* by rinsing the empty cuvette with distilled water, then filling it to the top of the line with distilled water.
13. Screw the lid on the cuvette. Gently wipe the outside with a soft, lint-free cloth or tissue.
14. Holding the cuvette by the lid, place it into the slot of the Turbidity sensor. Make sure the marks are aligned.
15. Close the lid.
16. Enter”0” as the value in NTU.
17. You are now ready to collect turbidity data.

Collecting Data

1. Gently invert the sample water to mix in any particles that may have settled to the bottom. Do not shake.
2. Empty the distilled water from the cuvette and rinse it with sample water. Fill the cuvette to the top of the line with sample water.
3. Screw the lid on the cuvette. Gently wipe the outside with a soft. Lint-free cloth or tissue.
4. Holding the cuvette by the lid, place it into the Turbidity sensor. Make sure the marks are aligned.
5. Close the lid.
6. Monitor the turbidity value. Take the reading soon after placing the cuvette in the sensor, before settling occurs.

Infrared light is directed at a cuvette containing the sample water. This light is scattered in all directions off the particles in the water. A detector, consisting of a photodiode, is placed at a 90° angle to the light source. The amount of light being scattered directly into the detector is measured in volts and translated into turbidity units.

Measuring Conductivity

1. Start the *Logger Pro* software program on the computer.
2. Connect the *Go Link* to any USB port on the computer.
3. Connect the Conductivity probe to the *Go Link*.
4. *Logger Pro* will identify the Conductivity probe.
5. You are ready to collect data.
6. Rinse the tip of the Conductivity probe with distilled water.
7. Insert the tip of the probe into the sample to be tested. Make sure electrode surfaces are completely submerged in the liquid.
8. While gently swirling the probe, wait for the reading on the computer to stabilize.
9. This should take no more than 5 to 10 seconds.
10. Rinse the end of the probe with distilled water before taking another measurement.

The probe measures the ability of a solution to conduct an electric current between two electrodes. In solution, the current flows by ion transport. Therefore, an increasing concentration of ions in the solution will result in a higher conductivity values. Measured as μS/cm.

Measuring Dissolved Oxygen

1. Start the *Logger Pro* software program on the computer.
2. Connect the *Go Link* to any USB port on the computer.
3. Connect the Dissolved Oxygen probe to the *Go Link.*
4. *Logger Pro* will identify the Dissolved Oxygen probe.
5. Allow the probe warm up for at least 10 minutes. To warm up the probe, leave it in the water and connected to the *Go Link* . The probe must stay connected at all times.
6. After warm up, place the tip of the probe into the sample to be measured.
7. Submerge the probe tip to a depth of 4-6 cm. Gently stir the probe in the water sample. Keep stirring the probe at all times.
8. Click *START* to begin data collection.

The probe is used to measure the concentration of dissolved oxygen in water samples tested. Measurements are in mg/L (or ppm).

Lesson 13 Overview

The first part of this lesson is a review of the past few days. This is important as students prepare to create their hypotheses and get ready to collect data in the field on their own. To make sure that each group is understanding the role of abiotic factors, it is appropriate to correct section 2 of the group worksheets so that all groups have the right answers as they formulate their hypotheses.

After reviewing, allow each group time to complete section 3 of the group worksheets. Have groups make sure that each hypothesis answers the questions that were proposed in section 1. At this time, locations along Hobble Creek need to be assigned to each group. Groups could request certain sites, but most likely, they will all want the closest or perceived easiest ones to collect data from.

It would be best to have enough laptops and sensors/probes to send with every group. TI-84 calculators are cheaper and the measurements of temperature, pH, and stream flow are really the only ones that need to be done in the field. Groups will need to decide who will collect the data, at least 2 people from each group, and check out the calculator and probes. Instructions will need to go out with them as well as the materials for calculating stream flow. A 2-liter or larger bottle will also need to be sent out and brought back for the next class period. At best, this lesson needs to be presented on a Friday or the last school day of the week so that several days are allowed to collect the data and water samples.

Lesson: 13

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Review of field trip and measurements/data that were taken.
- Review of instructions for measuring stream flow.
- Review of instructions for using the probes/sensors.
- Review proposing a hypothesis.

Lesson Title: Abiotic Factors Affecting Water Quality - 2.

Objectives: Students will be able to (SWBT):

- Complete section 3 of the group packet.
- Make assignments within their group for obtaining measurements and data for their assigned location.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.

e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).

f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

<u>Vocabulary:</u> None

<u>Lesson Body:</u>

- Break into groups.
- Quickly review the science project.
- Correct all questions from section 2. Write in the correct answers of the questions that were missed. Record scores.
- Have groups complete section 3 of the group packet.
- Make group assignments for locations to take measurements and collect data.

<u>Guided Practice:</u> Monitor group work during the class period by listening and offering help.

<u>Review:</u> What a hypothesis is.

<u>Closure:</u>

- Reminder of learning objectives.
- Make sure each group has the instructions for collecting the measurements and data.

- Collect the group packets for next time.

Next Lesson: Sharing data with all of the groups.

Materials Needed:

- Group packets.
- Group assignments on locations along Hobble Creek.
- Materials to be checked out for student use in collecting measurements and data.
    - TI-84 calculator and Vernier probes/sensors for temperature and pH.
    - 2 liter bottle for each group.
    - Measure stream flow – tape measure, 4 flags or flagging material, meter stick, stopwatch, rubber ball or other floating object.
    - Paper and pencil to record data.
    - Instructions for operating each sensor/probe.

Accommodations:

- Due to expense, laptop computers and all of the probes will most likely not be available. Temperature and pH need to be measured in the field. The other readings can be measured in the classroom, so each group will need to bring back a water sample in a 2-liter plastic bottle.
- Make sure at least 2 students from each group can collect the data at each location. Advise the students of safety issues and to move their assigned locations a few yards if necessary.
- Groups who fail to collect the information will have to share water collected from other classes.

For next time: Class-wide science project – group testing of collected water samples.

Lesson 14 Overview

This lesson makes or breaks the unit. If groups actually go and do what they were assigned to do, it will be a good experience. If they don't, the project will be frustrating to some students. The teacher will also need to collect water from each site and collect data at each site in case some groups fail to do their assigned location. This information may need to be shared with some groups. Another option to consider might be to have groups take pictures of where they collected the data and how they went about doing it.

The actual measuring in class is another way to get students out of their desks and involved. Some students may not have gone and collected data at their assigned location, this activity will give those students a chance to participate. This lesson also demonstrates the use of modern technology to collect data. It is important that each group obtains all of the data from each of the other groups that has been recorded. They will have a hard time drawing conclusions if they don't. Stream flow is not one of the abiotic factors being measured. I thought it would be interesting just to see how the creek changes in flow as it moves down the canyon towards Utah Lake.

Lesson: 14

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Collecting of data in the field.
- Instructions for measuring turbidity, conductivity, and dissolved oxygen.
- Calculating stream flow

Lesson Title: Testing in Class and Sharing of Data.

Objectives: Students will be able to (SWBT):

- Groups will test their water samples for turbidity, conductivity, and dissolved oxygen.
- Groups will share their results with every other group in the class.
- Groups will fill out the tables for all locations in the group packets.
- Groups will be able to accurately determine stream flow based upon their measurements.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

a. Observe and list abiotic factors (e.g., temperature, water, nutrients, sunlight, pH, topography) in specific ecosystems.

c. Predict how an ecosystem will change as a result of major changes in an abiotic and/or biotic factor.

e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).

f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

Vocabulary: None

Lesson Body:

- Break into groups. Hand back the group worksheets.
- Quickly review the science project.
- Have each group test their water samples for turbidity, conductivity, and dissolved oxygen.
- Each group will share their results with every other group in the class, including temperature, pH, and stream flow measurements.
- Help groups calculate stream flow if necessary.
- Have each group record all of the data on the proper form (in the packet) for all locations.

Guided Practice:

- Using the probes and sensors in class to gather measurements.

- Monitor group work during the class period by listening and offering help.

Review: Why each of the different abiotic factors was used.

Closure:

- Reminder of learning objectives.
- Make sure each group recorded all of the data that was presented.
- Collect group packets for the next lesson.
- Tomorrow - drawing conclusions.
- Unit test coming up soon.

Next Lesson: Drawing conclusions.

Materials Needed:

- Group packets.
- Computer and Logger Pro software.
- Probes/sensors to collect turbidity, conductivity, and dissolved oxygen measurements.
- Water samples collected by each group.

Accommodations: The teacher will also need to collect water from each site and collect measurements at each site in case some groups fail to do their assigned location. This information may need to be shared with some groups.

For next time:

- Group packets.
- Group evaluations.

Lesson 15 Overview

This lesson allows groups to analyze the data that has been recorded and then make conclusions based on that data. It is important that students understand that their conclusions should answer the original problem/question and that their conclusions should be tied to their hypothesis. Some students will worry that if their conclusions prove their hypothesis to be incorrect they will lose points. They need to understand the purpose of doing research.

Groups should be able to complete the last sections of the group packets and then prepare their thoughts for a short group presentation about the water quality of Hobble Creek.

The group evaluation is an interesting aspect of the unit. Group work can be great for some students because they can get away without doing much and frustrating to others because they feel like they did everything for the group. This anonymous evaluation allows each individual in a group to evaluate every other member of the group and score them based upon their value to the group. I don't prescribe how they do that, only that all scores must equal 20 points. Other than that, individual students can assign those points any way they would like.

Lesson: 15

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review:

- Scientific method, especially the steps on analyzing data and drawing conclusions.
- Make sure each group has all of the data recorded for each location.

Lesson Title: Analyzing Data and Drawing Conclusions.

Objectives: Students will be able to (SWBT):

- Analyze the data given and draw conclusions that are related to their hypothesis.
- Finish section 6 of the group packets.
- Assign a score to all members of their group based upon participation and input towards the group effort.
- As a group, prepare to give a short presentation to the class based upon their conclusions.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).

f. Plan and conduct an experiment to investigate how abiotic factors influence organisms and how organisms influence the physical environment.

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

Vocabulary: None

Lesson Body:

- Break into groups. Hand back the group worksheets.
- Have each group finish section 6 of the group packet by analyzing the data and then drawing conclusions. Make sure the groups understand that their conclusions need to be tied to their hypothesis. It's okay if their hypothesis is wrong, they won't lose points if it is.
- Answer the questions at the end of section 6.
- Have groups prepare to give short presentations for the next time based upon their conclusions.
- Pass out the group evaluations to each student and explain how they are to be filled out – distribute 20 points to the members of your group based upon their participation and input to the success of your group. All scores must add up to 20 points. Do not put your name on the evaluation and fill it out in private so that no one knows what your scores are.
- Collect all of the group packets and evaluations.

Guided Practice:

- Completing section 6 of the group packets.
- Monitor group work during the class period by listening and offering help.

Review: Drawing conclusions from data.

Closure:

- Reminder of learning objectives.
- Tomorrow – group presentations based upon their conclusions.
- Unit test coming up soon.

Next Lesson: Group presentations and review for the test.

Materials Needed:

- Group packets.
- Group evaluation slips.

Accommodations: If some groups are missing data, this will need to be provided.

For next time:

- Group presentations and review for the unit test.
- All previous quizzes that have been graded and recorded.

Lesson 16 Overview

Some groups may be unsure about the format for presenting their conclusions to the class. Having the teacher model a presentation should help take some of the anxiety away. The teacher should be prepared to effectively model a short presentation. Groups will present their conclusions to the class. It is not necessary that every member of each group participate. Some students may feel uneasy in presenting in front of the class. Each group can decide for themselves how they want to go about presenting. Presentations do not need to be lengthy, 3-4 minutes is sufficient. They need to be that short in order to get through all of the groups. They will most likely be fairly repetitive by the end, so short presentations are a good thing.

This unit has lasted for 16 lessons by this point, which is 3+ weeks of actual school time. A lot of information has been covered. A good review is helpful in preparing for the unit test. Handing back the previous quizzes and a strong suggestion to review those quizzes is an important part of the review.

Lesson: 16

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review: Stating conclusions that are tied to the hypothesis.

Lesson Title: Group Presentations.

Objectives: Students will be able to (SWBT):

- As groups, present their conclusions about Hobble Creek to the class.
- Presentations will last only 3-4 minutes each.
- Review the concepts and material that has been presented in this unit.

State Core:

Standard 2: Students will understand that the features of Earth's evolving environment affect living systems, and that life on Earth is unique in the solar system.

Objective 2: Analyze how ecosystems differ from each other due to abiotic and biotic factors.

e. Analyze interactions within an ecosystem (e.g., water temperature and fish species, weathering and water pH).

Standard 4: Students will understand that water cycles through and between reservoirs in the hydrosphere and affects the other spheres of the Earth's systems.

Objective 1: Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

d. Make inferences about the quality and/or quantity of freshwater, using data collected from local water systems.

Vocabulary: None

Lesson Body:

- Break into groups. Hand back the group worksheets.
- Model a presentation to the class.
- Have each group present their conclusions to the class about the water quality of Hobble Creek. Presentations should only be 3-4 minutes each.
- With the remaining time, quickly review the concepts that have been taught in this unit in preparation for the unit test next time.

Guided Practice: None

Review: Is Hobble Creek a healthy stream?

Closure:

- Reminder of learning objectives.
- Tomorrow – unit test.
- Hand back all previous quizzes that have been graded and recorded.

Next Lesson: Unit test.

Materials Needed: Group packets.

Accommodations: If some students are unable participate in the presentation due to special circumstances, don't force them

For next time:

- Prepare the unit test.
- Have group packets graded, group evaluations tabulated and ready to hand back.

UNIT TEST

Lesson 17 Overview

This is the final lesson of a jam-packed unit. This unit test covers lots of information. Hopefully, the quizzes that were taken along the way will be helpful in preparing for the test. If students will use those quizzes to review from, they will do better on the test. While there isn't a perfect type of test, this one has multiple choice, true/false, and short answer segments to give the students a variety of assessment techniques.

Allow time for all students to complete the test, even if they have to finish during the next class time. For those students who have missed some of the unit, they may additional time to prepare for the test. Some questions may need to be omitted if a student missed the science project portion of the unit.

The student feedback is important. It allows the teacher to modify the unit for future classes. Hopefully, students will feel inclined to provide feedback. It is crucial that students are assured that negative comments will not lower their grade. Doing this anonymously helps to overcome that hesitation.

Lesson: 17

Time: One 45-minute class period.

Attention Grabber: Daily e-mail using computer and projector. Some type of humorous joke or short video clip.

Daily Review: Review anything that the students would like to review in preparation for the unit test.

Lesson Title: Unit Test on Fresh Water Ecology.

Objectives: Students will be able to (SWBT):

- Complete the unit test.
- Receive the group scores on their packets and individual evaluation scores.
- Provide feedback on the completed unit.

Vocabulary: None

Lesson Body:

- Review for the test.
- Take the test. When everyone is finished, exchange tests and correct them.
- Respond to any questions about the test and scoring.
- Collect the tests.
- Hand back the group packets scores and the individual evaluation scores.
- Ask students to provide anonymous written feedback on the unit.

Guided Practice: None

Review: Anonymous written feedback from the students on the whole unit. The good, bad, and ugly.

Closure:

- Reminder of learning objectives.
- Announce that students now have one week to turn in any late assignments for this unit.
- Tomorrow – new unit on Earth's Oceans – is that an oxymoron?

Next Lesson: Pre-test on Earth's Oceans. Is the term Earth's Oceans somewhat of an oxymoron?

Materials Needed:

- Unit test.
- Graded group packets.
- Individual evaluation scores.

Accommodations:

- Allow time for all students to complete the test, even if they have to finish the next time.
- For those students who have missed some of the unit, they may need additional time to prepare for the test. Some questions may need to be omitted if they missed the science project part of the unit.

For next time:

- Pre-test on Earth's Oceans.
- PowerPoint presentation on Earth's Oceans – an Oxymoron? slides 1-4.

EARTH SCIENCE
Test - Fresh Water Ecology

Name____________________________ Period_______ Score_X/30__

Multiple Choice
Write the letter of the correct answer on the line at the left of the question.

_____ 1. Ocean water cannot be used to nourish land animals because it
- a. contains sediments.
- b. is too warm.
- c. contains oxygen.
- d. contains salt.

_____2. Most of the fresh water on Earth is not usable because it is
- a. polluted.
- b. in the oceans.
- c. frozen in ice.
- d. permanently stored in the clouds.

_____3. We do not run out of fresh water because
- a. the rock cycle renews it.
- b. evaporation fills lakes.
- c. we can make water in laboratories.
- d. the hydrologic cycle renews it.

_____4. Of all the water on Earth, fresh water makes up approximately
- a. 2 percent.
- b. 3 percent.
- c. 5 percent.
- d. 10 percent.

_____5. Some water returns to the atmosphere through
- a. participation.
- b. evaporation.
- c. precipitation.
- d. condensation.

_____6. All of the following are forms of precipitation except
- a. snow.
- b. hail.
- c. water vapor.
- d. rain.

_____7. In the process of condensation
- a. water changes to ice.
- b. water vapor becomes liquid water.
- c. liquid water changes to water vapor.
- d. ice changes to water vapor.

_____ 8. Forecasters predict that the population will continue to increase while the amount of available fresh water will
- a. remain constant.
- b. decrease.
- c. increase.
- d. be all used up.

______ 9. Which of the following would be a good way to conserve water?

a. shower for 20 minutes.
b. leave the water running while brushing your teeth.
c. only wash clothes when a full load is being washed.
d. plant flowers, shrubs, and trees that are heavy water users.

______10. Which of the following is **not** considered an abiotic factor in an ecosystem?

a. sunlight.
b. temperature.
c. bacteria.
d. water.

______11. Which of the following is **not** an energy role in an ecosystem?

a. consumer.
b. supplier.
c. decomposer.
d. producer.

______12. An herbivore is an organism that eats only

a. plants.
b. plants and animals.
c. other animals.
d. dead organisms.

______13. A healthy ecosystem should have

a. more consumers than producers.
b. more consumers than decomposers.
c. more scavengers than producers.
d. more producers than consumers.

______14. Dodo Birds and Passenger Pigeons are examples of

a. birds that can fly, but are stupid.
b. birds that are endangered.
c. birds that are extinct.
d. birds that are fun to hunt.

______15. An unknown solution has a pH of 4.0. This solution is

a. an acid solution.
b. an alkaline solution.
c. a neutral solution.
d. distilled water.

______16. Which of the following would **not** affect stream temperature?

a. elevation.
b. aquatic animals.
c. shaded areas.
d. season.

______ 17. What is the main cause of acid rain?

a. pollution.
b. too much evaporation.
c. climate changes.
d. global warming.

______18. Pollution, sewage, and fertilizers can cause a stream's conductivity to

a. stay the same.
b. decrease.
c. remain unchanged.
d. increase.

True or False

_____19. Humans have very little impact on biodiversity.

_____20. Nature's problems are our problems.

_____21. A positive mutation that increases an organism's chances of survival is called an adaptation.

_____22. Only 1% of all the Earth's water is available for use by living things.

_____23. Generally speaking, eliminating several species from an area can actually improve the biodiversity of the ecosystem.

_____24. Biotic and abiotic factors work independent of each other.

Short Answer

25. Will photosynthetic activity in a stream increase or decrease with high turbidity? Why or why not? (2 points)

26. Why is the amount of dissolved oxygen in a stream important?

27. Why does the addition of salt, sodium chloride, to water increase conductivity?

28. Will trees planted along the banks cause the stream to heat up or cool down? Why or why not? (2 points)

EARTH SCIENCE
Test - Fresh Water Ecology

Name________KEY____________________ Period_______ Score_X/30__

Multiple Choice
Write the letter of the correct answer on the line at the left of the question.

__D__ 1. Ocean water cannot be used to nourish land animals because it
- a. contains sediments.
- b. is too warm.
- c. contains oxygen.
- d. contains salt.

__C__ 2. Most of the fresh water on Earth is not usable because it is
- a. polluted.
- b. in the oceans.
- c. frozen in ice.
- d. permanently stored in the clouds.

__D__ 3. We do not run out of fresh water because
- a. the rock cycle renews it.
- b. evaporation fills lakes.
- c. we can make water in laboratories.
- d. the hydrologic cycle renews it.

__B__ 4. Of all the water on Earth, fresh water makes up approximately
- a. 2 percent.
- b. 3 percent.
- c. 5 percent.
- d. 10 percent.

__B__ 5. Some water returns to the atmosphere through
- a. participation.
- b. evaporation.
- c. precipitation.
- d. condensation.

__C__ 6. All of the following are forms of precipitation except
- a. snow.
- b. hail.
- c. water vapor.
- d. rain.

__B__ 7. In the process of condensation
- a. water changes to ice.
- b. water vapor becomes liquid water.
- c. liquid water changes to water vapor.
- d. ice changes to water vapor.

__A__ 8. Forecasters predict that the population will continue to increase while the amount of available fresh water will
- a. remain constant.
- b. decrease.
- c. increase.
- d. be all used up.

__C__ 9. Which of the following would be a good way to conserve water?
a. shower for 20 minutes.
b. leave the water running while brushing your teeth.
c. only wash clothes when a full load is being washed.
d. plant flowers, shrubs, and trees that are heavy water users.

__C__10. Which of the following is **not** considered an abiotic factor in an ecosystem?
a. sunlight.
b. temperature.
c. bacteria.
d. water.

__B__11. Which of the following is **not** an energy role in an ecosystem?
a. consumer.
b. supplier.
c. decomposer.
d. producer.

__A__12. An herbivore is an organism that eats only
a. plants.
b. plants and animals.
c. other animals.
d. dead organisms.

__D__13. A healthy ecosystem should have
a. more consumers than producers.
b. more consumers than decomposers.
c. more scavengers than producers.
d. more producers than consumers.

__C__14. Dodo Birds and Passenger Pigeons are examples of
a. birds that can fly, but are stupid.
b. birds that are endangered.
c. birds that are extinct.
d. birds that are fun to hunt.

__A__15. An unknown solution has a pH of 4.0. This solution is
a. an acid solution.
b. an alkaline solution.
c. a neutral solution.
d. distilled water.

__B__16. Which of the following would **not** affect stream temperature?
a. elevation.
b. aquatic animals.
c. shaded areas.
d. season.

__A__ 17. What is the main cause of acid rain?
a. pollution.
b. too much evaporation.
c. climate changes.
d. global warming.

__D__18. Pollution, sewage, and fertilizers can cause a stream's conductivity to
a. stay the same.
b. decrease.
c. remain unchanged.
d. increase.

True or False

__F__19. Humans have very little impact on biodiversity.

__T__20. Nature's problems are our problems.

__T__21. A positive mutation that increases an organism's chances of survival is called an adaptation.

__T__22. Only 1% of all the Earth's water is available for use by living things.

__F__23. Generally speaking, eliminating several species from an area can actually improve the biodiversity of the ecosystem.

__F__24. Biotic and abiotic factors work independent of each other.

Short Answer

25. Will photosynthetic activity in a stream increase or decrease with high turbidity? Why or why not? (2 points)

    Decrease. The sunlight will not be able to penetrate the water as far.

26. Why is the amount of dissolved oxygen in a stream important?

    It is essential for fish and other aquatic insects.

27. Why does the addition of salt, sodium chloride, to water increase conductivity?

    Sodium and chlorine have conductive ions.

28. Will trees planted along the banks cause the stream to heat up or cool down? Why or why not? (2 points)

    Cool down. The trees will shade the direct sunlight from hitting the water.

REFLECTION AND STUDENT EVALUATIONS

Reflection

Now that this unit has been completed and implemented into the classroom, it is appropriate to look back and evaluate how the unit went. In previous years, I had taught a unit on fresh water, but had never paired that unit with a unit on ecology and implemented a class-wide science project. Anytime something new is done in class, it is easy to look back and pick out all the things that can be improved on, but I will also highlight the parts of the unit that I felt went well.

I tried to write this unit in a way that if a substitute teacher had to come in and teach any part or the entire unit, they could. I included specific steps, insights, and outlines that would allow a substitute to do that. Humor is an important part of my classroom and I always start each class with some type of joke or humorous video clip. It focuses the attention of the students and gets everyone started off together each day.

Duane Merrell from BYU was helpful with this unit. He allowed me to use his TI-84 calculators and Vernier probes and sensors. I have some probes, but he was very willing to let me use some that I did not have. In the future, I plan on trying to secure more probes and calculators. With some timely funding, laptop computers would be the best.

I will address my viewpoints on the teaching component of the unit, student involvement, and the overall student learning that took place.

Teaching Component

Obviously, this wasn't the right time of year to be outside wading in the creek. When I realized that this unit needed to be taught before my project defense date, it was already into the fall and I was in the middle of a unit on astronomy. The science teachers in our school try to follow a similar schedule in our teaching units. Breaking away from the middle of a major unit would have been very disruptive. It was November 13th before any instruction began. I was hopeful that we would have some decent weather that would cooperate more, but that was not the case.

When I teach this unit again, I will start the school year with it. That way, temperatures will be warm, I think there will be more variation in the creek, there will be more daylight, and students will have a better experience collecting and analyzing data. I would not teach this unit in the spring as increased runoff would make the creek unsafe for students to be wading in collecting data. Safety issues were very minimal this year.

Overall, I think the unit went well. There was a good mix of regular classroom instruction and activities. Drawing posters of the water cycle was fun and effective. There was some great creativity and reinforcement of the water cycle stages during this activity. Classroom discussions concerning water conservation were very productive. The students were able to see, from a demonstration, that the amount of available fresh water is limited and needs to be protected.

The ecology and biodiversity elements of this unit were also new this year. I think the students were surprised at the impact humans have on biodiversity, especially on rates of extinction. The science project component of the unit ended up taking a little longer than I had planned, mostly because of weather factors. In the future, I need to spend a little more time on the scientific method. Students still have a hard time creating a hypothesis and how conclusions are tied to their hypothesis. A little more background information and explanation of the abiotic factors we chose to test would also be beneficial.

I thought my level of preparedness was sufficient for the classroom instruction. You are always looking for new ways to present ideas, but I felt good about how things went for the most part.

Student Involvement

I think there was a good mix of learning styles. There was note taking, art expression, visual learning, verbal expression, group interaction, guided inquiry, different types of assessment, discussions involving higher level thinking, and some hands on learning. Next time, I know I need to involve the students more in the hands on experiences. Even though we did experiments in class, not every student was able to participate. Watching is not the same as doing. Again, some of that was due to the weather, but I also underestimated the data that should have been collected in the field and the number of water samples that needed to be brought back to the classroom for analyzing. I didn't allow enough time to collect the water samples either. The weather played a role in that as well. The road going up right fork was snow packed, so only one sample was collected from right fork. Another sample from right fork would have been nice to have as a comparison. We definitely need to use some laptop computers next time and increase the number of probes and sensors that can be taken from the classroom and used in the field.

Anytime students can get out of the classroom and into the field, it is usually productive. I struggle going on field trips because it only takes one or two students to ruin the activity for everyone. This year was no exception. I had a student go doorbell ditching on the way to the creek, another throw snowballs at other students, and several disrupt other classes on their way in and out of the building. As a teacher, those things are frustrating and make you really consider the usefulness of leaving the classroom. For those students who really participated, the hands on learning was beneficial to them.

For whatever reason, there are a small number of students who choose not to get very involved. A key for better success next time will be to look for additional techniques and teaching styles the will appeal to those students.

Student Learning

I think there was a great deal of student learning that took place. Test scores were very good. The average score of one class was 27 points out of 30 possible points. The group work frustrated some students, largely because they felt like some of the members of their group did not participate fully. If nothing else, they learned the importance of all contributing to a successful group effort. Absenteeism is also an issue. What do you do with those students that miss the field component of the unit? It is nearly impossible to have them make up what they missed. I need to do a better job of explaining to those students what took place while they were gone.

An individual write up and a longer presentation from each group would be helpful in assessing student learning. Also, a small essay component of the unit test would give each student the opportunity to show what they learned and understood.

Most of the students enjoyed the unit. Usually, the more interest and enjoyment students have in a subject, the better they do in learning and paying attention. Most of the negative feedback I received focused on the weather and need for more student involvement in the actual measuring. Other than that, I feel like successful student learning took place.

Finally, I asked my students for feedback, the positive and the negative. Jr. High students will usually tell you what they think. My students were happy to provide feedback, especially when they understood that I wanted their responses and that I would not feel hurt or penalize them in any way for negative feedback. The student evaluations are actual responses from several students.

Student Evaluations

I liked the project on Hobble Creek. It was fun to do things hands-on for a change. The only thing I think that would make it better would be to do it at a warmer time of the year. Rachel Thompson

Yes, I liked the project. It let me know more about the river. More tests and more experiments, possible at different times of year, would be cool. Maybe we could do it several times throughout the year so we could learn more about the river all year round.

Brett Chatwin

I personally liked the unit. It wasn't boring to me. Actually, it got me into thinking about things like water quality. I now understand more about the water cycle and everything. I wouldn't change or add anything to the project. I think it was already a big assignment. Andrea Fullmer

This unit has been beneficial to me. I never knew anything about dissolved oxygen or turbidity before this. I liked the project, but it might have been better to do a little more background learning before doing the experiments. Jana Dunn

I really enjoyed it. I thought it was interesting. Maybe if we tested the creek in the fall and in the spring we could compare the results. It would be cool to see the differences if any. Andrea LeVasseur