Peabody Fellows Program

PEABODY MUSEUM OF NATURAL HISTORY • YALE UNIVERSITY

Biodiversity and Human Health Curriculum Unit
"Forest Fires"

Lesson titles:	Field trip (Peabody Museum) Initial Assessment (pre-test maps and drawing) Introduction lesson (event and task) Layers of the Forest (Lesson 1) Forest Restaurant (Lesson 2) Wildfires and Controlled Burns (Lesson 3) Adaptation to Forest Fires (Lesson 4) Anatomy of Lungs (Lesson 5) Lung Volume and Vital Capacity (Lesson 6) We Didn't Start the Fire! (Lesson 7) Presentations (Lesson 8) Final Assessment (post-test map and drawing) (Lesson 9)
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Abstract

Biodiversity — the variety of life on earth — includes species, ecosystems, and the ecological processes of which they are a part (World Wildlife Fund). The concept of biodiversity and human health addresses the balance of ecosystems, which promotes human health through clean air and water, food sources, and protection from exotic viruses and toxic pollution (The Biodiversity Project).

The environment is always changing, sometimes subtly and sometimes dramatically. Fire is one of the important natural agents of change. Fire has helped shape North America's open spaces for thousands of years and has been essential for the survival of many plants and animals (U.S. Forest Service 2000). Since fire is an agent of change, and a changing environment can affect human health, it seems only fitting that today's science class of middle students should know about forest fires and their effects on the environment and human health.

This is a nine-lesson curriculum on wildfires targeted for seventh grade science students. Each lesson takes approximately one classroom period of 45 minutes. These Sheridan students will be using the Yale Peabody Museum BioAction Lab, which will be placed in our media center. The curriculum was designed to be taught over one month, allowing enough time between lessons with the BioAction Lab for the students to research various topics that coincide with the lesson plans.

The problem or event that will be given to the students will involve issues revolving around a proposed controlled burn in the West Rock area of New Haven by the local park ranger and the Regional Water Authority. The local residents of West Rock are concerned, because this has never been done before in this area.

Task

The seventh grade students at Sheridan Magnet School are also concerned with the effects of a controlled burn on their environment since most of the students live in the greater West Rock area. Mayor John DeStefano has asked the Sheridan students to prepare a presentation for WTNH News informing the public on the pros and cons of forest ecology. The presentation must discuss how the fire would affect the plants, animals, humans, soil and environment. The presentation needs to convince the public to either support or disapprove the controlled burn in the West Rock area. The BioAction Lab will be available for you to use as part of your demonstration.

Introduction

Problem or event

Humans have always been fascinated by fire. This amazing process creates heat and light, but can also bring death and destruction. When people figured out how to tame fire, how to start it on their own, and how to use it to improve their lives, they had taken one of the major steps toward civilization (Patent, 1998). Park rangers, fire ecologists and managers of the public lands now seem to understand the importance of fire in the cycles of nature. When fire caused by lightning poses no danger to people or buildings, some public agencies now let it burn (Patent, 1998). Our problem

is to examine the plan of the Regional Water Authority and our local West Rock park ranger to create a prescribed or controlled burn to thin out our West Rock Ridge forest area. The local residents of West Rock are concerned because this has never been done in this area. Since fire creates smoke, dust and ash, which will pollute our air, the residents are concerned about their health.

National Science Education Teaching Standards

- Teachers of science plan an inquiry-based science program for their students.
- Teachers of science guide and facilitate learning.
- Teachers of science engage in an ongoing assessment of their teaching and of student learning.
- Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.
- Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to learning science.
- Teachers of science actively participate in the ongoing planning and development of the school science program.

New Haven Public School Science Standards

- (PS1.1) Students will acquire and practice the ability to do scientific inquiry.
- (PS3.3) Students will understand the fundamental connections between organisms and their environment.
- (PS5.2) Students will develop abilities to distinguish between natural objects and objects made by humans.
- (PS6.2) Students will develop an understanding of the use of science and technology and its effect on the characteristic of changing populations, ecology resources, and changes in the environment.
- (PS7.1) Students will study the history of science as a human endeavor.

This unit will have met these standards by providing inquiry-based lessons and a learning environment using the BioAction Lab, by developing groups who will later present to the class a summary of what they have learned and experienced, and by having available teachers and volunteers to assist with all activities. This unit will integrate with Scientific Methodology, Life Science, Earth Science and Environmental Science. The students will conduct inquiry-based experiments that will focus on Forest Ecology and how it may relate to human health.

Background

The environment is always changing, sometimes subtly and sometimes dramatically. Fire is one of the important natural agents of change. Fire has helped shape North America's open spaces for thousand of years and has been essential for the survival of many plants and animals (U.S. Forest Service, 2000). Fire ecology is a branch of ecology that studies the origins of wildland fire and its relationship to the living and nonliving environment. Fire is studied as a natural process operating

as a component of an ecosystem. Fire, similar to floods, earthquakes and storms, can be viewed as one means of promoting changes in an ecosystem. Managing the effects of wildland fires is key for humans to coexist with the natural environment (www.discovery.com).

To survive a wildland fire, most plants have adaptive traits or abilities that allow them to reproduce or regenerate after the fire. A plant must be able to insulate itself from the heat of the flames. Some plants have thick bark while others use the soil for protection. Serotinous cones will not open to release their seed until a critical temperature is reached. Animals have adapted to wildland fires as well. Accomplished runners and jumpers use their skills to escape the flames, while others hide under the soil to escape the fire (www.discovery.com).

The human lung is the major body part that is most affected by fire. The heat and smoke affect the lung tissue and in severe cases cause death. Air pollution from a forest fire could affect the general public by being a trigger for asthma and other lung diseases.

Goals

The purpose of this forest fire unit is for seventh grade students to gain an understanding of the relationship between human health and forest ecology. The student will become familiar with the inquiry-based method by conducting learning activities that reflect fire, plant and animal adaptation, food webs, food chains, components of fire and fire extinguishers, and the anatomy of the human lung. Hopefully, by formulating their own hypotheses, collecting data, and interpreting those data with the guidance of the science teacher, students will better understand how they can make an impact on their ever-changing environment.

Assessment

The seventh grade science students at Sheridan Magnet School are also concerned with the effects of a controlled burn on their environment because most of the students live in the greater West Rock area. Mayor John DeStefano has asked the students to prepare a presentation for WTNH News informing the public of the pros and cons of a controlled burn. The presentation must discuss how the fire would affect the plants, animals, humans, soil and environment. The presentation needs to convince the public to either support or disapprove the controlled burn. You will have four members on your team, each having a different role: Principal Investigator, Materials Manager, Recorder, and Reporter. The BioAction Lab will be available for you to use as part of your presentation.

After each lesson students will be assessed by their participation and cooperation in the classroom. Some lessons will have a crossword puzzle, word search, or conceptual map to complete as an assessment tool. Throughout the lessons the students will keep a science journal with all their notes and data collection. The next to last lesson will be the presentation of each group of students to the science class.

Field Trip
(Visit to Peabody Museum)

Lynn Peckham Grade 7
Sheridan Magnet School

Peabody Scavenger Hunt (with answers)

While visiting the Yale Peabody Museum today, please visit all the exhibits on the second and third floors and find the items in this hunt.

Located on the third floor

1. Find the *Birds of Connecticut* displays. Find the section identified as "Storks, Herons, Allies."
   A. What is the classification name of this section? *Answer: ciconiiforms*
   B. List 3 observations about the Common Egret.
      1. *Answer: white*
      2. *Answer: long legs*
      3. *Answer: long beak*
   C. What do these birds eat?
      1. *Answer: fish*
      2. *Answer: frogs*

2. Find the dodo. (*Located on the third floor*)
   A. How did this bird gets its name? *Answer: Makes a cooing sound similar to a pigeon*
   B. Where did this bird live? *Answer: Madagascar*

3. Describe your favorite bird in the *Birds of Connecticut* section. What does the bird eat? What is its gender? In what season do we usually see this bird in Connecticut?

4. Find the O.C. Marsh legacy display and read about him. Answer the following questions.

   A. What was O.C. Marsh looking for in the Indian country? *Answer: bones*
   B. What did the Indians think he was really looking for? *Answer: gold*
   C. Mr. Marsh admired the Indians and built a house in the form of a _____.

   Answer: wigwam. This house is still standing today in New Haven. What street is this house located on in New Haven, and who lives there now?
   Answer: Prospect Street. The building is now part of Yale's School of Forestry & Environmental Studies.

5. In the Discovery Room, find the display of tree barks. There are six different examples of tree barks. What are the names of the first and last samples?

1. Answer: *Black birch*
2. Answer: *White pine*

6. Find the *Rocks of Connecticut* display on the third floor. Locate picture number 7 (West Rock Ridge). Now find where that picture is located on the tectonic map. What state park is located behind the West Rock Ridge?
   Answer: *Sleeping Giant*

7. Find the *Southern New England Habitats* dioramas.
   A. List three animals that live in a cold bog.
      1. *Answer: rabbit*
      2. *Answer: bird*
      3. *Answer: frog*
   B. List three plants that survive in a cold bog.
      1. *Answer: lady slipper*
      2. *Answer: moss*
      3. *Answer: black spruce*

8. Find the *Forest Margin* diorama.
   A. Where is the raccoon? *Answer: on the tree branch*
   B. Where is the porcupine? *Answer: behind the tree*
   C. What does a porcupine eat?
      1. *Answer: bark*
      2. *Answer: ticks*
      3. *Answer: leaves*
   D. What does a porcupine use for protection?
      1. *Answer: quills*
   E. Locate the red squirrel and tell me what it eats.
      1. *Answer: seeds*
      2. *Answer: mushrooms*
      3. *Answer: nuts*

9. Find the *Coastal Region* diorama.
   A. Find the butterfly and describe it using qualitative data.
      1. *Answer: orange*
      2. *Answer: white dots*
      3. *Answer: wings*
   B. Find the osprey.
      1. What number is the osprey on the diagram? *Answer: 2*
      2. Can you find its nest? Describe its location. *Answer: at the edge of the marsh very high in a tree*
   C. Find the earthworm in the display.
      1. What number is it on the diagram? *Answer: 24*
      2. What is happening to the worm? *Answer: it is being eaten by a robin*

10. Find the *Connecticut Native Americans* exhibit.
    A. What is the man doing? *Answer: making arrowheads*
    B. Read about the display and tell me what animal has become extinct.
       Answer: mammoth

Initial Assessment

Biodiversity Observational Drawing Pre-test

Lynn Peckham Grade 7
Sheridan Magnet School

Preliminary Lesson

Imagine your field trip to Edgewood Park in New Haven. Remember your walk through the wooded area and how pretty it was with the trees beginning to change color. You saw some pine trees, hardwood trees and maple trees, and some animals, flowers and plants. Hopefully you noticed the layers of the forest and what lives in each layer. But what would this pretty area look like if it had caught fire? What would it look like one month later?

I would like you to draw for me what you think a forest looks like one month after a major forest fire.

Pre-test: Biodiversity Conceptual Map

Answer Key: Biodiversity Conceptual Map

Introduction Lesson

Lynn Peckham Grade 7
Sheridan Magnet School

Set induction

View the video "Fire and the Longleaf." Follow with a discussion with the students of the video, a presentation of their task, questions, explanation, group assignments, and expectations. The fire game will be the first group activity.

Problem or event

Humans have always been fascinated by fire. This amazing process creates heat and light, but can also bring death and destruction. When people figured out how to tame fire, how to start it on their own, and how to use it to improve their lives, they had taken one of the major steps toward civilization. Park rangers, fire ecologists and managers of public lands now seem to understand the importance of fire in the cycles of nature. When fire caused by lightning poses no danger to people or buildings, some public agencies now let it burn. Our problem is to examine the plan of the Regional Water Authority and our local West Rock park ranger to create a prescribed or controlled burn to thin out our West Rock Ridge forest area. The local residents of West Rock are concerned because this has never been done in this area.

What is the task the students will be charged with completing? What are the roles for each member of the group?

The seventh grade students at Sheridan Magnet School are also concerned with the effects of a controlled burn on their environment, since most of the students live in the greater West Rock area. Mayor John DeStefano has asked the Sheridan students to prepare a presentation for WTNH News informing the public of the pros and cons of a controlled burn. The presentation must discuss how the fire would affect the plants, animals, humans, soil and environment. The presentation needs to convince the public to either support or disapprove the controlled burn in the West Rock Ridge area. You will have four members on your team, each having a different role: Principal Investigator, Materials Manager, Recorder and Reporter. Remember that your presentation must be informative, creative and interesting. The BioAction Lab will be available for you to use as part of your demonstration.

Student directions

Your program should include some information on the different layers of the forest, the habitants of the forest, the types of forest fires and what is good or bad about them. You should also include how animals and plants have adapted to fire and how forest fires can affect human health. Include some information about the firefighters and their equipment.

There will be at least three to four members in your group. Each member will have a different role, as an investigator, manager, recorder or reporter. For each lesson, give a different person the opportunity to try out a new role, so that everyone gets a chance to be in charge of a lesson. For each lesson, you should put what job you had in your science journal. There will be badges for each member to wear to help with remembering who has not had a turn at a new job. For the end presentation though, there will be only one reporter, investigator, recorder and manager of the final project. Research information using the computers, the BioAction Lab, the Mantis microscope, books and articles, and by interviewing a fire ecologist. Your teacher will be available to assist you in class as well as after school if needed. This unit ends with the last class, so you will have one month to complete it. Perhaps we will have someone from our school's video lab tape the presentation for the Peabody Museum.

Job descriptions

Principal Investigator
This person is in charge of the group's lesson and keeps the group on task. This person will change with each lesson. Write in your daily science journal who has what job for that lesson. The principal investigator is the person from the group who brings questions from the group to the teacher. He or she makes sure that everyone is working and behaving appropriately. In the final presentation, this person oversees the organization of the presentation to the class.

Materials Manager
This person collects materials for the group and is responsible for having group members clean up after the lesson and return items to the BioAction Lab. This person may assign a helper. In the final presentation, this person with help from others will create a poster to enhance the presentation.

Recorder
This person will keep a written record of the group's observations. If the activity includes a separate test or experiment, each person in the group will perform the test, and this person will record the results on a group chart, journal or graph.

Reporter
This person writes down the group's conclusions and reports to the class. The reporter may also need to record the group's data on a class graph or chart.

Forest Fire Spelling Game

Objectives

Introduce various concepts about forest fires and learn how to work together in a group while having some fun.

Materials

6 sets of 10 forest fire spelling game cards, which are 8 1/2" x 11" cards each with one letter on each side:
Card 1: F/A
Card 2: O/D
Card 3: R/L
Card 4: E/N
Card 5: S/W
Card 6: T/U
Card 7: I/G
Card 8: P/H
Card 9: A/B
Card 10: Y/M

Lesson Procedure

1. Give each group of students their set of 10 cards. Groups will be competing against each other.
2. Explain that you will be reading aloud a sentence about forest fires and repeating one word from each sentence. Members of each team are to arrange themselves in the correct order to spell the target word. There is no trading of cards in this game, just moving bodies. Anyone holding a letter that is not needed must step back out of the way. Words need to be spelled from left to right. Anyone not on a team can serve as a judge to determine which team spelled each word correctly first.

Forest Fire Sentences

- **Water** is essential for all life to exist.
- **Plants** need water to transport nutrients and minerals necessary for plant metabolism, and for photosynthesis.
- Fire requires **heat**, oxygen and fuel to burn.
- There are three different l**ayers** of the forest.
- When a fire occurs, most of the large **animals** just walk away from the fire unharmed.

- Either wildfires or a controlled burn causes **forest** fires.
- A forest fire gets its **fuel** from the understory layer of the forest.
- Long-lived trees, such as the ponderosa pine and redwoods, have thick fire-resistant bark that helps the tree to **adapt** to forest fires.
- **Soil** is made up of decomposed rock.
- Campers, arson or lightning often cause **wildfires**.

Layers of the Forest

Lesson 1

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Identify three layers of the forest.
- Report to the class which plant or animal lives in which layer of the forest.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Define the following terms: canopy, understory, habitat, conifer, forest floor, deciduous and decomposers.

Materials

Lab manuals
Pencils
Measuring tape
Scale
Specimens from the Peabody Museum BioAction Lab
Computers
Mantis microscope

Set up

The students will be broken into six groups; five of the groups will have four students and one group will have three students. In this activity the students will move between two stations, the computer and the BioAction Lab. The groups using the computer will be instructed to research key words such as forest layers or forest habitats. The other group will be using the BioAction Lab. They will be instructed to examine a specimen from the BioAction cart. The science teacher and the museum educator will be assisting the students in the BioAction Lab. The classroom teacher will assist the students on the computers.

Staffing needs

Classroom teacher
Museum educator
Science teacher or Museum volunteer

Background student information

The forest can be divided into three main layers. These layers increase the number of available habitats and allow more species of plants and animals to live in the forest community.

The *canopy* or topmost layer consists of the tallest trees in the forest. The conifer pine tree is an example of the tallest tree in the North American forest. The canopy receives full sunlight and absorbs or scatters more than half of all available sunlight. This canopy is constantly changing as individual trees die from old age, disease, fire, insect attacks and lightning, allowing more sunlight to get through. This helps the smaller trees to grow and fill the gaps.

The *understory* or second layer of the forest consists of small trees, bushes, grasses and wildflowers. This area only gets 2 to 5% of the sunlight available to the canopy. This limited amount of light encourages plants and animals to devise unique ways to survive. Many animals, such as snakes, frogs, mountain cats and insects, live in the understory.

The *forest floor*, also know as the litter layer, consists of the soil, which is quite alive with microscopic growth, and the dead matter of the forest. It is the home of decomposers such as earthworms. Bacteria, fungi and insects all aid in the process of decomposing.

Vocabulary

Habitat A place where humans, animals or plants live.
Conifer Known as the tallest trees in the forest, conifers have cones and make up the canopy layer of the forest.
Canopy The topmost layer of the forest.
Understory The second layer of the forest. Includes small plants and animals.
Forest Floor The bottom layer of the forest, also known as the litter layer. Home of decaying matter.
Deciduous Trees whose leaves fall to the ground each year.
Decomposer An organism that breaks down cells of dead plants and animals into simpler substances.

Set induction

In preparation for this lesson, the student will take a closer look at the 12-minute video "Fire and the Longleaf." This short video invites the viewer to look for the unsuspected: What is hidden in the grass or poking through the leaf litter? Who is visiting the flower? The video sets the stage for the inquiry method to learn about forest ecology. The video was shown in an earlier lesson.

Lesson procedure

1. Students assigned to use the BioAction Lab will gather specimens found in each layer of the forest. Group A will be asked to find items from the canopy layer, group B will find items from the understory layer, and group C will find items from the forest floor. The lab students will be encouraged to use the Mantis microscope to enhance their inquiry.
2. The students assigned to the computers will be asked to research key words, such as forest habitats, and layers of the forest. They will make a journal entry on what animals live in which layer.
3. After 15 minutes each group will change stations, and do the activity for that station.
4. Ten minutes before the end of the class, the groups will clean up their area, and make a journal entry. The reporter from each group will report to the class the group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

Closure

The students will sit with their group and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Extension activity

Students will get a detailed picture of a forest animal or plant and color it with colored pencils. They will need to research what color it is by using some of the texts on the BioAction Lab. The students could also research information on rainforest layers and the animals that live in the rainforest. A crossword puzzle will also be provided for homework or class work.

Computer usage directions
Layers of the Forest
Lesson 1

Find forest web sites by entering the following key words in an internet search engine. Remember that we are interested in the forest, not the rainforest, for this lesson. Later on, for extra credit you can look up information about rainforests.

Layers of the forest
Forest fires
Understory

Here are some websites you can visit.

www.fs.fed.us/r4/boise/field_trip/forest/forlayer.html
www.mightytrees.com/science/foreststrat.html

In your biodiversity manual please define the following words:

Habitat
Conifer
Canopy
Understory
Forest floor
Deciduous

Directions for Lesson 1
Layers of the Forest
BioAction Lab

Please read information on forest fires at
www.fs.fed.us/r4/boise/field_trip/forest/forlayer.html

1. Using all of the BioAction carts (orange, green and blue), find at least one animal, insect, or item that lives or comes from each layer of the forest.
2. Take that item back to your group and examine it using the BioAction Lab manual.
3. Try to relate this animal, insect or item to a layer of the forest. Describe how it eats, where it lives, and what it looks like.
4. Take your item and look at it under the Mantis microscope. Document your findings.
5. Remember that the recorder of your group will document the findings of your exam. The reporter will create either a verbal or written report to be given at the end of today's lesson. This will be very brief.

Layers of the Forest
Crossword Puzzle
Lesson 1

Down

1. Organisms that break down cells of dead plants and animals to simpler substances.
2. The bottom layer of the forest is called the _____.
3. An animal that lives on the forest floor.
4. An example of a decomposer found in the soil of the forest.
5. _____ helps in the process of decomposition.
6. Another name for a mushroom.
7. An example of an animal found mainly in the canopy layer of the forest.
8. What is found on the bottom layer of the forest.

Across

1. Large _____ make up the tallest layer of the forest.
2. The tallest layer of the forest.
3. The tallest trees in the forests that have pine cones and make up the canopy layer of the forest.
4. The conifer ____ tree is an example of the tallest tree in the North American forest.
5. An example of an animal that lives in the understory of the forest.
6. A _____ can be either helpful or harmful to a forest.
7. Types of trees whose leaves fall to the ground each year.
8. A place where humans, animals or plants live.
9. The second layer of the forest.
10. One of the reasons that the canopy is always changing is because of _____.
11. When fire, disease or lightning attack the forest canopy, this allows _____ to show through helping the smaller plants of the forest.

WORD BANK

Habitat	Decomposers	Trees	Soil
Conifer	Snakes	Pine	Canopy
Insects	Sunlight	Understory	Earthworms
Disease	Forest floor	Bacteria	Fire
Deciduous	Fungi	Birds	

Layers of the Forest
Crossword Puzzle Answer Sheet
Lesson 1

Forest Restaurant

Lesson 2

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Understand the connection among all living things by examining food consumption.
- Create a food chain using at least six items from the BioAction carts, and from each layer of the forest to create a connection.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Define the following terms: producers, consumers, decomposers, food web, plant eaters and animal eaters.

Materials

Lab manuals
Pencils
Colored pencils
Yarn
3" x 5" cards
Specimens from the BioAction Lab
Computers
Mantis microscope

Set up

The students will be broken into six groups; five of the groups will have four students and one group will have three students. In this activity the students will move between two stations, the computer and the BioAction Lab. The groups using the computer will be instructed to research key words such as food chain, forest food chain, food web, and layers of the forest. The other group will be using the BioAction Lab. They will be instructed to examine a specimen from the BioAction cart. They will try to match a specimen from the cart to each layer of the forest and in that process create a food chain across the layers. The science teacher and the museum educator will be assisting the students in the BioAction Lab. The classroom teacher will assist the students on the computers. After 15 minutes the students will switch stations. Both groups will create food chains, compare them, and display them on the bulletin board.

Staffing needs

Classroom teacher
Museum educator
Science teacher

Background student information

Food chains are the pathways along which energy is transferred from one organism to another. Animals need energy and rely on getting it from plants and animals. Each transfer from one animal to the next is considered a link in the chain. With energy from the sun and through photosynthesis, producers such as plants get what they need to grow. Animals eat the plants for energy, until they get eaten by a larger animal, and so on. Carnivores and omnivores consume herbivores. Decomposers break down dead plants and animals, and these remains nourish the soil to continue the cycle. This example of a simple food chain rarely occurs in nature because few organisms eat just one kind of organism. A food web is an interconnected food chain in an ecosystem.

Vocabulary

Producer An organism that can produce organic substances from inorganic substances; examples of producers are plants.
Consumer An organism that feeds on other plants or animals.
Food web The sequence defined by who eats whom, starting with producers and progressing through various levels of consumers, including decomposers and predators.
Many organisms may be more than one level of consumer, depending on whether they eat a plant, a microorganism that has consumed a plant, or an animal that ate the microorganism that ate the plant. A food web describes more complex linkages and interrelationships than a food chain.
Food Chain The sequence defined by who eats whom, starting with a producer (green plant).
Herbivore Plant-eating animal.
Carnivore Meat-eating animal.
Omnivore An animal that eats both plants and animals.
Decomposer An organism, such as an earthworm, that breaks down cells of dead plants and animals into simpler substances.

Set induction

The students will have participated in the previous BioAction lesson about the layers of the forest. They will have drawn or colored in the detail pictures of various forest animals and now they must discover who eats whom.

Lesson procedure

1. Students assigned to use the BioAction carts will gather specimens from each layer of the forest and create a food chain or food web connecting all the forest layers. The lab students will be encouraged to use the Mantis microscope to enhance their inquiry.
2. The students will be given 3" x 5" cards on which to write the animal or plant name and then draw a picture of it.
3. The students will connect their food chain with the food chains of the other groups to make a food web to be displayed on the board.
4. The students assigned to the computers will be asked to research key words such as forest food webs and forest food chains. They will make a journal entry as to what animals live in which layer.
5. After 15 minutes each group will change stations, and do the activity for that station.
6. Ten minutes before the end of the class, the groups will clean up their area, and make a journal entry. The reporter from the group will report to the class their group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

Closure

The students will sit with their group and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Lab directions
Forest Restaurant
Lesson 2

Remember and review what you learned from Lesson 1, Layers of the Forest. Now your group will create a food chain using the animals, insects or items from each layer.

From your previous information, draw a picture of an animal from each layer of the forest on the 3" x 5" card. Then connect the card with yarn to another card, indicating what animal or plant is eaten by or eats the previous animal. If you need some help to remember which animals are from what layer, use the BioAction carts to see the specimens.

If your group used five animals from one layer of the forest, then connect your food chain with another group's food chain on a different layer of the forest. When the groups are done, their food chains should all connect and be interrelated, or dependent on each other.

Computer directions
Forest Restaurant
Lesson 2

Find web sites by entering the following key words in an internet search.

Food chains
Food webs
Decomposers

In your biodiversity manual please define the following words:

Producer
Consumer
Food web
Food chain
Herbivore
Carnivore
Decomposer

Wildfires and Controlled Burns

Lesson 3

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Identify three criteria for fire to burn.
- Identify the difference between a wildfire and a controlled burn.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Define the following terms: controlled burn, wildfire, fuel load, crown fire and fire ecology.

Materials

Lab manuals
Pencils
3 birthday candles for each group
12 jars (6 medium, 6 large) with lids
6 jar lids only
Matches
Small bowl of water for each group
Nontoxic modeling clay
Watch with a second hand, or stop clock
Computers
Mantis microscope

Set up

The students will be broken into six groups; five of the groups will have four students and one group will have three students. In this activity the students will move between two stations, the computer and the BioAction Lab.

The groups using the computer will be instructed to research key words such as wildfires and controlled burns, and to visit specific web sites such as *www.firewise.org, www.smokeybear.com* and *www.windowsintowonderland.org.*

The other groups will be using the BioAction Lab. Each lab group (3) will need an adult to supervise this activity. The students will be using a small (4 inches or less) birthday candle placed in modeling clay on the jar lid. One candle will be left on the lid, the other two candles will be covered by two different-sized jars. The students will have to observe how long each candle burns.
The next experiment will show how oxygen is consumed and air pressure changes.

In this experiment, the students will place the small jar lid and attached candle in a bowl of water. The jar will be placed over the lighted candle and the students will note what happens to the water. The science teacher and the museum educator will be assisting the students in the BioAction Lab. The classroom teacher will assist the students on the computers.

Staffing needs

Classroom teacher
Museum educator
Science teacher or Museum volunteer

Background student information

Fire is a chemical reaction, and needs three things to burn: fuel, oxygen, and heat. During a fire, energy is released as heat and light, which is why fires are so hot and so bright. When a fire is over, there is nothing left but ash. Ash is the form the fuel takes after the chemical reaction of fire is over.

Fires not only release heat, but are also caused by heat. A burning match, a flash of lightning, or a glowing ember in a dying campfire can cause a fire. Once a fire starts, the heat from the fire can cause other fires to start in nearby materials.

Fires also need oxygen to burn. Oxygen is an invisible gas in the air we breathe. One of the reasons wet wood rarely burns is that the water prevents air from getting to the fire.
When heat, fuel and
oxygen are brought together in the proper proportions, a fire ignites. If any of the three known collectively as the fire triangle fall below a certain proportion, a fire cannot burn.

Fire is one of the important natural agents of change. Fire has helped shape North American's open spaces for thousand of years and has been essential for the survival of many plants and animals.

Vocabulary

Controlled or prescribed burn Controlled application of fire to a grassland or forest area, which allows the fire to be confined to a predetermined area.
Fuel load The excessive twigs, leaves and brush of the understory or litter layer of a forest that act as fuel for a fire.
Wildfire Any fire occurring in a forest area, often caused by arson, campfires or lightning.
Crown fire A fire that affects only the tops of trees or shrubs, independent of the ground.
Fire ecology Study of wildfires, fire management.

Set induction

In preparation for this lesson, the student will become familiar with fire and the different types of fires by reading *Wildfires* by Seymour Simon, and *Fire: Friend or Foe* by Dorothy Patent.

Lesson procedure

1. Students assigned to use the BioAction carts will be in small groups of three or four students.
2. Each group will have three jar lids, three candles, modeling clay, two jars (one medium and one large), a small bowl of water, and the lab manual.
3. Each candle needs to have its wick cut to the same length.
4. Each candle needs to be fastened to the lid top with clay.
5. With adult supervision, carefully position the candles and their lids on a flat sturdy surface and light each candle.
6. Place two jars firmly over two of the burning candles on their respective jar lids. Leave one candle burning in the open.
7. Each student will include in their journal entry a discussion of which candle burns the longest time and which burns the shortest time and why. They should include how the fire triangle was broken.
8. For the second part of this experiment, the students will place the small jar lid with the candle attached in a bowl of water two or three inches deep.
9. Next place the jar on the lid in the water, and mark the water level height on the jar.
10. Remove the jar, leaving the lid and candle in the water.
11. Light the candle and again place the jar over the candle but loosely enough that water can flow into the jar and around the base of the candle.
12. Students will include in their journal entry the rise of the water in the jar and the observation of the creation of ash, smoke and carbon dioxide.
13. After 15 minutes each group will change stations, and do the activity at that station.
14. Ten minutes before the end of the class, the groups will clean up their area, and make a journal entry. The reporter from the group will report to the class their group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

The students assigned to the computers will do a search on controlled burns, wildfires, and visit *www.firewise.org, www.smokeybear.com* and *www.windowsintowonderland.org.* They will include in their journal entry one item they learned about how wildfires are started and the positive and negative effects of a controlled burn.

Closure

The students will sit with their group and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries. The students will be asked to complete a small conceptual map on fires.

Extension activity

Students will be asked to research how fire creates its own winds and spreads across a large area. Students could contact a forest park ranger and interview him about wildfires, or they could contact a forest ranger through the *www.windowsintowonderland.org* web site.

Lab directions
Wildfires and Controlled Burns
Lesson 3

1. Students assigned to use the BioAction carts will be in their small groups of three or four students.
2. Each group will have three jar lids, three candles, modeling clay, two jars (one medium and one large), a small bowl of water, and the lab manual.
3. Each candle needs to have its wick cut to the same length.
4. Each candle needs to be fastened to the lid top with clay.
5. With adult supervision, carefully position the candles and their lids on a flat sturdy surface and light each candle.
6. Place two jars firmly over two of the burning candles on their respective jar lids. Leave one candle burning in the open.
7. Each student will include in their journal entry a discussion of which candle burns the longest time and which burns the shortest time and why. They should include how the fire triangle was broken.
8. For the second part of this experiment, the students will place the small jar lid with the candle attached in a bowl of water two or three inches deep.
9. Next place the jar on the lid in the water, and mark the water level height on the jar.
10. Remove the jar, leaving the lid and candle in the water.
11. Light the candle and again place the jar over the candle but loosely enough that water can flow into the jar and around the base of the candle.
12. Students will include in their journal entry the rise of the water in the jar and the observation of the creation of ash, smoke and carbon dioxide.

Computer directions
Wildfires and Controlled Burns
Lesson 3

For this lesson you may search using key words such as:
Wildfires
Prescribed burns
Controlled burns
Forest fires

or visit the following web sites:

www.firewise.org
*www.smokeybear.com**
www.windowsintowonderland.org

* If there is time try playing some of the games on this web site.

From your search please define the following:

Controlled burn
Fuel load
Wildfire
Crown fire
Fire ecology

Handout for Lesson 3 Wildfires and Controlled Burns

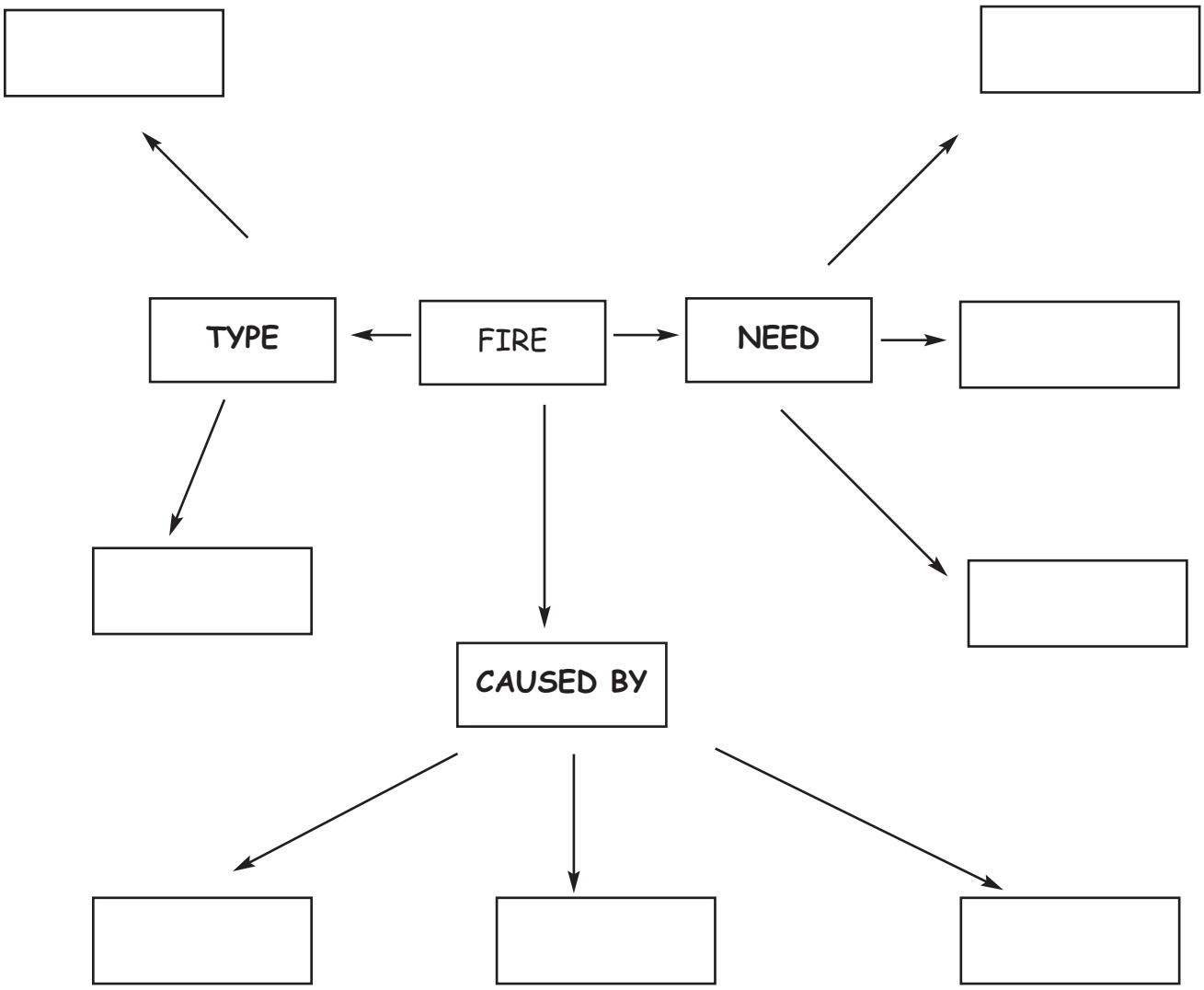
Wildfires are an important part of nature in many areas of the world. Those areas most likely to have a wildfire usually have a wet season followed by a dry season. Plants that grow and accumulate during the wet season dry out enough during the dry season to create a fuel load, which burns easily. If lightning hits the area, the ground litter quickly ignites and a fire can spread through a large area of forest.

At one time forest rangers thought that any forest fire had to be put out. Today we allow many fires to burn themselves out as long as they are not near any homes. Research has shown that if the forest has not burned in many years, forest litter builds up, trees overtake the area and make it difficult for other plants to grow, and the food supply for some animals diminishes.

Prescribed burns are designed to reduce the fuel load in a given area. Reducing the fuel load in a forested area can prevent fires from becoming so hot that they burn the soil and damage all plant life. A controlled burn every five to ten years can clear the heavy understory without harming the larger trees in the forest. Accumulation of brush and understory can cause intensely hot and destructive fires. Intense and uncontrolled wildfires risk damage to soil, watersheds and air quality. Prescribed burns are planned and started by forest rangers who are trained in using fire to manage forests. After the burn, ash is left behind to provide nutrients in the soil for seeds and new plant growth. Some trees can only reproduce after a fire, which opens their seeds to allow a new tree to grow.

Fire is a chemical reaction that needs three things to burn: heat, fuel and oxygen. During a fire, energy is released as heat and light, which is why fires are so hot and so bright. When a fire is done, there is nothing left but ash. Ash is the form the fuel takes after the chemical reaction of fire is over. Fire makes heat, which can cause other fires to start in nearby materials. A burning leaf can set fire to a nearby leaf without touching it, just from the intense heat. The flaming leaves can then set fire to a branch, which can set fire to the whole tree. In a short while, a fire can leap to another tree, and then another and another. A whole forest can be set ablaze from a tiny fire no bigger than the flame from a match.

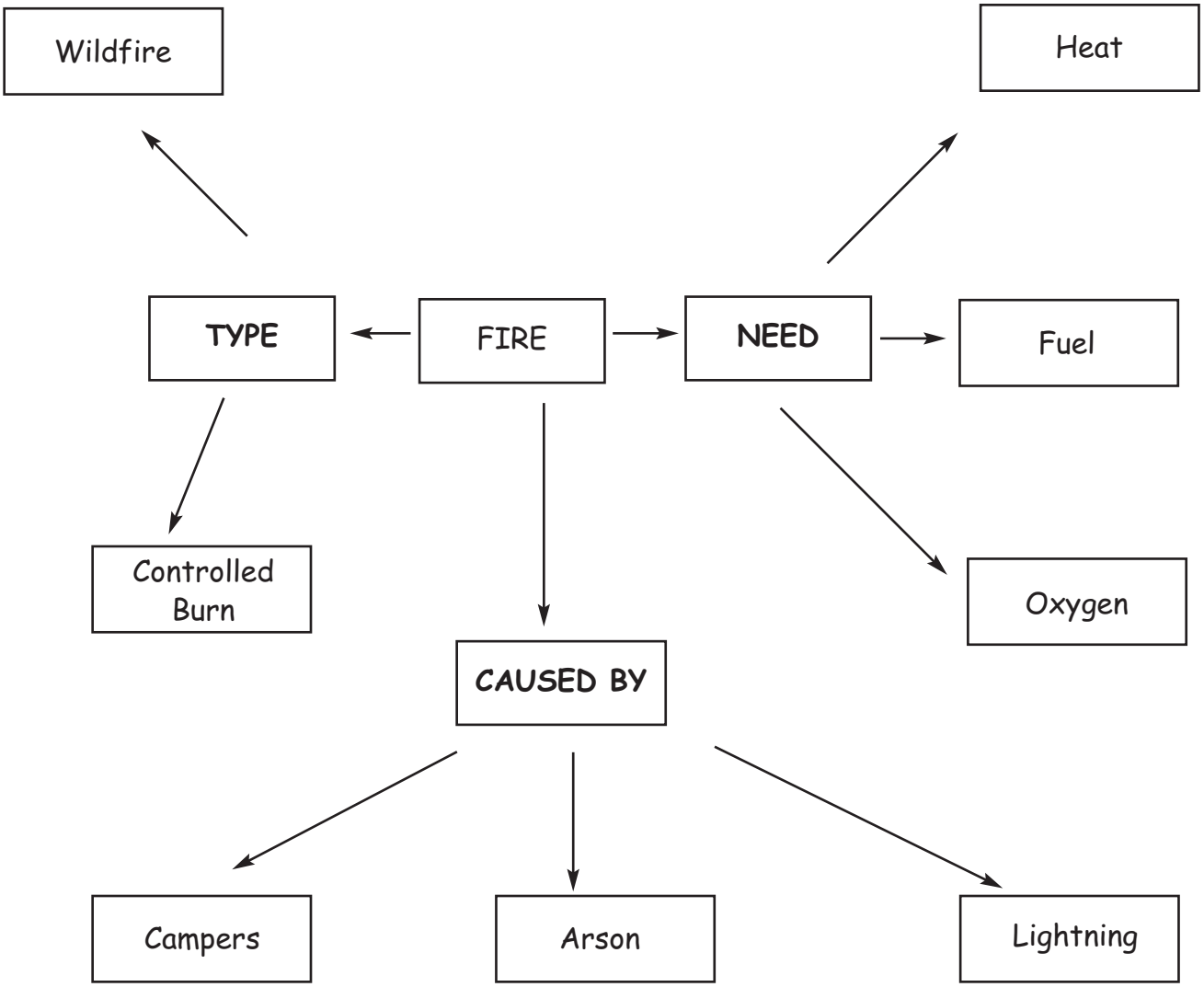
Wildfires and Controlled Burns
Conceptual Map



Word Bank

Controlled burn	Campers	Heat
Wildfire	Arson	Fuel
Lightning	Oxygen	

Wildfires and Controlled Burns
Conceptual Map Answer Key



Adaptation to Forest Fires

Lesson 4

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Count the rings on a tree "cookie" sample from the BioAction carts.
- Identify the tree bark sample from the BioAction cart.
- Dissect seed samples and identify the parts of the seed.
- Examine a soil sample and water sample from the classroom terrarium and report their findings.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Be able to define the following terms: serotinous pine cones, Lodgepole pine tree, Yellowstone National Park, annual rings, pyrophytes, seed dispersal, horizons.

Materials

Lab manuals
Pencils
Soil and water samples from classroom terrarium
Specimens from the BioAction Lab (tree rings, bark samples)
Various seeds
Serotinous pine cones
Plastic wrap
Microwave in School-Based Health Clinic (SBHC)
Dissection kit for seeds
Computers
Mantis microscope
Activity sheets in *Life Science* by T. Heyworth

Set up

The students will be broken into six groups of four students. In this activity the students will move between two stations: the computer and the BioAction Lab. The groups using the computer will be instructed to research key concepts such as adaptation to fire and fire ecology, and to visit specific sites such as *www.firewise.org* and *www.windowsintowonderland.org.* The other groups, stationed at the BioAction Lab, will be instructed to examine a specimen from the BioAction cart. After 15 minutes, the groups will switch locations. The science teacher and the museum educator will be assisting the students in the BioAction Lab. The classroom teacher will assist the students on the computers.

Staffing needs

Classroom teacher
Museum educator
Science teacher or Museum volunteer

Background student information

To survive a wildland fire, most plants have adaptive traits or abilities that allow them to reproduce or regenerate after the fire. Such plants are called pyrophytes. To survive a fire, a plant must be able to insulate itself from the heat of the flames. Bark thickness is one of the most important factors determining fire resistance of trees. The Ponderosa pine, longleaf pine, slash pine, burr oak, and the giant sequoia are examples of trees in the United States with thick bark that acts as insulation.

Small woody plants use the soil as an insulating layer to protect themselves. Some trees retain their seeds until there is enough heat from a forest fire to open and re-seed them. Animals have developed many different strategies to escape fires. Some are able to outrun the fire, while others burrow underground.

Vocabulary

Serotinous pine cones Seeds from the Lodgepole pine tree, which require heat to burn off the sticky resin that holds the pine cone shut.
Lodgepole pine A tree, found mostly in the western United States, that produces two kinds of pine cones, one that opens by itself and contains seeds that sprout without fire, and the fire-resistant serotinous cones.
Yellowstone National Park A federally protected natural area located in the western United States in the states of Idaho, Wyoming and Montana.
Annual rings The rings of a tree showing growth of the tree, and how old the tree is.
Pyrophytes Plants that have adapted to the heat of a fire.
Seed dispersal The method of the seeds of plants and trees getting around and eventually in the soil.
Horizons Layers of soil.

Set induction

In preparation for this lesson, the students will become familiar with the background material on fire adaptations. They will have read various articles available to them, such as *Fire and the Natural History of Giant Sequoias* by Mecham, Ueckert and Lindauer, and *Wildfire Awareness* by Glenda Wallace.

Lesson procedure

1. Students assigned to the BioAction Lab will gather specimens from drawer #4 from the green cart.
2. The students will be asked to examine the tree rings and bark. Their journal entry will include information on how old the "cookie" is, the thickness of the bark and what tree it comes from. They should look for changes in the thickness of the tree rings. Make a rubbing of various samples of tree bark from the BioAction carts (using the "Barkprints!" activity sheet in *Life Science*).
3. Next, the students will examine numerous seed samples. They will dissect the seeds and identify the parts. Each group of students will wrap a pine cone in plastic wrap and place in the SBHC microwave for one minute. The heat will cause the pine cone to open. The students will count the seeds and plant some in the classroom terrarium.
4. If time permits, the students will examine a small soil sample and water sample from the classroom terrarium. They will examine the samples under the microscope for microscopic animals and insects.
5. The students assigned to the computers will be asked to research key words such as fire adaptations, trees, evergreen trees, conifers and serotinous pine cones, and to visit forest web sites. They will be required to make a journal entry with observations of this lesson.
6. After 15 minutes each group will change stations, and do the activity at the opposite station.
7. Ten minutes before the end of the class, the groups will clean up their area, and make a journal entry. The reporter from the group will report to the class their group's observations and thoughts that they learned from this activity. The journals will be collected at the end of the class.

Closure

The students will sit with their group and after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Extension activity

Students can find a tree ring sample, identify the type of tree and draw it, labeling all the parts of the tree layers. Or they can draw their favorite tree, making it as old as they are themselves.

Directions for Lesson 4
Adaptation to Forest Fires
Soil samples

You learned in Lesson 1 that the forest is made up of three major layers, one of which is the litter layer or soil layer. There are many different types of soil in North America. One way to classify the soil is by feel (texture).

Clay soil is smooth, sticky and dense. It holds water so well that it is not available for plants to use. Sandy soil is gritty, loose and crumbly. It holds little water for plants to use. *Loamy soil* is a mixture of the above soils. It is loose, crumbly, and holds water well for use with plants.

Soils can also be classified by color: *Dark* black, dark gray, or dark brown; *medium* brown to yellow; or *light* pale brown to yellow. The darker the color, the more organic material is in the soil. In general, the darker the soil, the more easily water sinks in, and the better it is for growing.

Directions

1. Examine your soil sample. Include in your report the soil's color, texture and smell.
2. Decide what type of soil you have, and if it would be good for growing plants.
3. Try using some litmus paper to test whether your soil's pH is acid or base. If the strip turns pink, then the sample is acid; if it turns blue, then the sample is base. If there is no color change, then the sample is neutral.
4. Take your soil sample to the Mantis microscope and look for microscopic animals, insects, worms, or bacteria. Describe what you find.

When this project is done, your group can examine the tree rings or seeds from the other groups.

Directions for Lesson 4
Adaptation to Forest Fires
Seed dispersal

1. You have in front of you many types of seeds found in the forest.
2. Take the maple seed, dissect it, and label its parts. Use our reference books with pictures to help you label the parts. Draw a picture of the seed in your journal. Count the number of seeds found. Using a microscope may help you with all of the following dissections.
3. Next take a pine cone, dissect it, and label its parts. Use our reference books to help you label the parts. Draw a picture of the seed in your journal. Count the number of seeds found.
4. Finally, take the serotinous pine cone, and wrap it in plastic wrap. This pine cone is in the white paper envelope.
5. Bring the serotinous pine cone wrapped in plastic to the school-based clinic's microwave and heat the pine cone for 1 to 1½ minutes.
6. Open the pine cone, dissect it, label the parts, and count the seeds.

Answer the following questions in your science journal. You may use reference books to help you or the handouts given to you.

- How do you think the seeds from the maple tree and the pine cones leave the tree and form a new tree?
- What could happen to the seed to prevent it from becoming a tree.
- On the pine or conifer tree, both the male and female pine cone live on the same tree. How does the female pine cone get fertilized?
- What are the three main parts to the pine cone?

If your group finishes this activity, they can choose to examine the tree rings or examine soil samples using the Mantis microscope.

Directions for Lesson 4
Adaptation to Forest Fires
Counting annual rings

1. Gather tree and bark samples from the BioAction carts. Look in drawer #4 of the green cart for tree and bark samples.
2. Record in your science journal how many rings you were able to count on your sample. If one ring is formed for every year the tree was alive, then how old is your sample?
3. How big around was the tree when you were born?
4. How big was the tree when it was as old as you are now?
5. You may notice that some of the layers of the tree sample are uneven. Can you tell where a tree limb may have been or what might have caused the tree to not grow so well some years?
6. Now examine some bark samples. Can you tell what type of bark you are looking at? Find some pictures in our resource books to help you decide.
7. Using the handout "Barkprints" (in *Life Science* by T. Heyworth), follow the directions and create a rubbing or tracing of the bark.

If your group finishes this project early, you may look at some soil samples using the Mantis microscope. Ask an adult to help you.

Handout for Lesson 4
Fire Adaptations

To survive a wildland fire, most plants have adaptive traits or abilities that allow them to reproduce or regenerate after the fire. Such plants are called pyrophytes. To survive a fire a plant must be able to insulate itself from the heat of the flames. Bark thickness is one of the most important factors determining fire resistance of trees. Ponderosa pine, longleaf pine, slash pine, burr oak and giant sequoia in the United States, and the cork oak on the Iberian Peninsula, are examples of trees with thick bark that acts as insulation.

Small woody plants and shrubs, which normally have thin bark, tend to use the soil as an insulating layer. Individual plants recover from fires by producing new growth (shoots) from underground organs or roots. Some plants protect their buds by locating them within the main stem and roots. A few species of poplar trees in several parts of the world possess this trait.

Retention of seeds by plants until a fire does occur and stimulation of seed dispersal by fire are other examples of fire adaptation. Several pine species around the world have pine cones that open only as the result of heat from a fire. These are called serotinous species. Their cones are held closed by a resin that is sensitive to high temperatures generated by wildland fires. Serotinous cones will not open to release their seeds until the critical temperature is reached. Lodgepole pine cones vary from serotinous to free opening. When these trees grow in areas that have frequent fires, the cones are serotinous. But if the Lodgepole tree is growing in an area that does not have frequent fires, the pine cones open and release their seeds more often without fire. While fire may kill individual plants, the species survives because of its adaptations.

Wildlife species have developed different methods or strategies to escape fires. Animals such as deer, bear and kangaroo, which are accomplished runners and jumpers, use their skills to escape the flames. Other animals such as mice, shrews, snakes, lizards and turtles use burrows to escape fire.

Plants and animals that have structural and behavioral adaptations to survive in habitats frequented by fire are said to live in a fire-dependent community. Plants that are highly adapted to fire are called pyrophytes. Today, people are beginning to recognize that fire is not always destructive. Fire is merely a means of change in ecosystems.

Anatomy of Lungs

Lesson 5

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

The Students will:

- Become familiar with the anatomy of the lungs.
- Be able to locate on a diagram the bronchial tubes and the air sacs.
- Make a moving model of a lung.
- Observe the exhalation of smoker's lungs.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Be able to define the following terms: bronchial tubes, alveoli, trachea, diaphragm.

Materials

Lab manuals
Pencils
1 quart empty soda bottle for each group, with bottom cut off
2 balloons (one large, one small) for each group
1 straw per group
Smoker's lungs model with bellows
Clay
Tape
Computers
Mantis microscope

Set up

The students will be broken into six groups; five of the groups will have four students and one group will have three students. In this activity the students will move between two stations, the computer and the BioAction Lab. The groups using the computer will be instructed to research key words such as "how do lungs work," American Lung Association, and to visit web sites about the lungs. The other group will be using the BioAction Lab. They will be instructed to observe the smoker's lung with bellows, and make a lung model. After 15 minutes the two groups will switch stations and assignments. The science teacher and the museum educator will be assisting the students in the BioAction Lab. The classroom teacher will assist the students on the computers.

Staffing needs

Classroom teacher
Museum educator
Science teacher or Museum volunteer

Background student information

The lungs, which are located in our chest, perform two functions: breathing in (inspiration) to deliver oxygen to the blood, and breathing out (expiration) to rid the body of carbon dioxide received from the cells throughout the body. The lower respiratory tract begins with the trachea (windpipe), which is divided at the end into two bronchial tubes that subdivide into smaller tubes and finally into the tiny air sacs where oxygen is exchanged into the blood stream. The diaphragm (a thin muscle wall) helps with breathing. When the diaphragm contracts, it creates a vacuum, which allows the air to rush in and fill the trachea. When the diaphragm relaxes, air is forced out of the lungs making the air sacs contract.

Vocabulary

Bronchial tubes Structures located at the end of the windpipe that provide a pathway for air to get into the lungs.
Alveoli Tiny air sacs in the lungs where oxygen is exchanged into the blood.
Trachea The windpipe or breathing tube at the lower end of the respiratory tract.
Diaphragm Thin muscle wall under the lungs, which helps in breathing.

Set induction

In preparation for this lesson, the students will become familiar with the background material on the respiratory system in their science textbooks.

Lesson procedure

1. Students assigned to use the BioAction carts begin by making a lung model from a plastic bottle.
2. First cut off the neck of a large balloon. Have a group member hold a plastic bottle that has the bottom cut off. Stretch the balloon over the cut end of the bottle. Secure the balloon with tape or an elastic band.
3. Insert the straw into the neck of the other balloon. Tie the balloon to the straw with tape or an elastic band. Hold the balloon and part of the straw in place by wrapping a blob of clay around it. Make sure the clay covers the mouth of the bottle completely.

4. The students will predict what will happen to the small balloon when you pull down and push up on the big balloon. They will record their findings in their journal.
5. Then observe what happens when you pull down and then push up on the large balloon. Relate this to human breathing.
6. Next the students will use the bellows to make the smoker's lungs exhale. Observe what happens and record in journal.
7. The students assigned to the computers will be asked to research key words such as "how do lungs work," American Lung Association, and other web sites. They will make a journal entry as to what they learned.
8. After 15 minutes each group will change stations, and do the activity at that station.
9. Ten minutes before the end of the class, the groups will clean up their area, and make a journal entry. The reporter from the group will report to the class his or her group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

Closure

The students will sit with their group and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Extension activity

The students will complete the exercises from *Life Science* called "How Cells Get Oxygen" and "How Cells Use Oxygen." The students could also do "Exploring Your Breathing Rates" and then graph the results of the group.

Directions for Lesson 5
Anatomy of Lungs
Making a Model of the Lungs

1. Take a one-liter soda bottle with the bottom of the bottle cut off.
2. Cut off the neck of the large balloon with a scissors and stretch it over the bottom of the bottle. Put a rubber band around it to hold it in place.
3. Insert a straw into the neck of the other balloon. Tie the balloon to the straw with the other rubber band.
4. Put the balloon and part of the straw into the bottle. Hold the straw in place by wrapping a blob of clay around it. Make sure the clay completely covers the mouth of the bottle.
5. Push up on the rubber at the bottom of the bottle. What happens?
6. Is this like breathing in or out?
7. Pull the rubber down. Which way would you be breathing now?

Questions (answer in your science journal working as a team or group)

- Draw a diagram of the respiratory system. Include the trachea, bronchial tubes, lungs and air sacs (alveoli).
- Using your lung model, describe what happens when you take in air and what happens when you breathe out?
- Define inhale.
- Define exhale.
- Describe what chemical we breathe in and what chemical we breathe out.
- Relate how our breathing may influence our environment.
- Describe how our air quality might affect our breathing.
- How does all this lung anatomy relate to forest fires?

Lung Volume and Vital Capacity

Lesson 6

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Measure their body height and the vital capacity of their lungs.
- Infer a relationship between height and vital capacity.
- Calculate how much air they breathe in a minute, hour and day.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Be able to define the following terms: lung volume, residual volume, respiration rate and vital capacity.

Materials

Lab manuals
Pencils
Small cardboard tube
One lung volume bag per group
Elastic bands
Ruler, yardstick or meter stick
Computers
Mantis microscope

Set up

The students will be broken into six groups of four students. In this activity the students will remain in their groups during the whole activity. The computer can be used if there is time. Each member in each group will be measured on the SBHC scale. After they are measured they will conduct a test to determine their vital capacity. They will record their results and calculate their average vital capacity and respiratory rate. They will make a graph for their group with the data collected.The science teacher, classroom teacher and the museum educator will be assisting the students for this activity.

Staffing needs

Classroom teacher
Museum educator
Science teacher or Museum volunteer

Background student information

An average adult with healthy lungs inhales, then exhales, about 0.5 liter (about 1 pint) of air per breath and has a respiration rate of about 15 to 20 breaths per minute. This comes out to about 15,000 liters of air breathed in one day and about 400 million liters breathed in a lifetime, enough air to fill two-and-a-half blimps.

When we breathe normally, we do not completely fill or completely empty our lungs. Lung volume is the total amount of air that a person can hold in his or her lungs. Vital capacity is the amount of air that a person can exhale in one long, continuous breath after having taken a deliberately deep breath. Lung volume is much greater than vital capacity because there is still air in the lungs even after a total, forcible exhale; the amount of air that remains is the residual volume.

Vocabulary

Lung volume The total amount of air that a person can hold in his or her lungs.
Vital capacity The amount of air that a person can exhale in one long, continuous breath after having taken a deliberately deep breath.
Residual volume The amount of air left in the lungs after a total forcible exhale.
Respiration rate The number of breaths per minute.

Set induction

In preparation for this lesson, the students will become familiar with lung capacity and lung volume by reading their science textbooks.

Lesson procedure

1. In each group, the students will predict if there is a relationship between their height and their lung capacity, and record their prediction in their journal.
2. Next the students will be measured by using the scale located in the SBHC. The scale will be moved into the library for this lesson.
3. Using an activity sheet, or journal, each student will record his or her height.
4. The students in each group will conduct a test to determine their vital capacity.
5. Using the lung volume bag and the disposable cardboard mouthpieces, each student will blow into the lung volume bag and record the results.
6. The student will open the bag about two inches, insert one end of the cardboard tube and attach the bag to the tube with the elastic band.
7. The student should take a long deep breath, exhale, take another deep breath

and exhale completely through the tube and into the volume bag. He or she should then immediately close the bag near the mouthpiece and push the trapped air to the far end of the bag by placing the bag over his or her thigh and pressing down on the bag while pulling it across the thigh.

8. The student should measure the volume of air by reading the number on the bag, and then record this number in their journal.
9. Empty the bag; each student should perform the test three times. Calculate the average of these tests.
10. Each group should create a graph with each member's average on it.
11. The student will calculate his or her respiratory rate for a minute, then for an hour, and finally for a day. Record these data in the journal.
12. Ten minutes before the end of the class, the groups will clean up their area and make a journal entry. The reporter from the group will report to the class his or her group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

Closure

Students will sit with their groups and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Extension activity

This activity could be performed the next day. Use a one-liter container of water and two sponges of different sizes to demonstrate that the larger sponge will absorb more water than the smaller sponge. Immerse the larger sponge in the water until it is completely saturated, then squeeze out the water into an empty one-liter container. Repeat the procedure with the smaller sponge and compare the amounts of water squeezed from the two sponges. The water that remains in the sponges after squeezing is similar to the residual volume of air in our lungs. The water squeezed out is similar to the vital capacity.

Handouts for this lesson will be the activity sheet "Lung Volume and Vital Capacity".

Lung Volume and Vital Capacity

Name: _____

Predictions:
Do you think there is a relationship between height and vital capacity?

_____

_____

_____

What do you think the relationship is?

_____

_____

_____

Results:
My Height is _____cm.

Trial 1: My vital capacity is _____L.

Trial 2: My vital capacity is _____L.

Trial 3: My vital capacity is _____L.

Average vital capacity: _____L.

Based on the class results, what is the relationship between height and vital capacity?

_____

_____

_____

_____

We Didn't Start the Fire!

Lesson 7

Lynn Peckham Grade 7
Sheridan Magnet School

Objectives

Students will:

- Perform an experiment that makes carbon dioxide and puts out a small candle flame.
- Play interactive wildfire computer games to learn how to put out a forest fire or a campfire.
- Use their lab manuals to make a journal entry about the subject and report their findings to the class.
- Be able to define the following terms: carbon dioxide, baking soda, vinegar.

Materials

Lab manuals
Pencils
1 small birthday size candle per group
Pan or plate to put the candle on
Clay
Pint jar
Baking soda
Vinegar
Balloons
Measuring cups
Computers
Mantis microscope

Set up

The students will be broken into six groups; five of the groups will have four students and one group will have three students. In this activity the students will move between two stations, the computer and the BioAction Lab. The groups using the computer will be instructed to visit Smokey Bear web sites and play the interactive games about putting out campfires. (The www.firewise.org web site has a fire simulator program.) The other groups using the BioAction Lab will be instructed to perform an experiment to make carbon dioxide. After 15 minutes the two groups will switch assignments. The science teacher and the museum educator will be assisting the students in the BioAction Lab. Provide a volunteer for each group when they are in the Lab area. The classroom teacher will assist the students on the computers.

Staffing needs

Classroom teacher
Museum educator
Science teacher
Museum volunteer(s)

Background student information

Since there are obviously no fire hydrants in a forest, it is more difficult to fight wildfires. Trucks can't be driven in because of a lack of roads. The trees, brush and leaves provide ideal fuel for the fire because they are so flammable. Firefighters have special equipment to fight forest fires such as a Pulaski, which is a combination ax and hoe used to dig a fireline. Smoke jumpers clear a large path in a big circle around the fire so the blaze is contained in an area of dirt. This area cleared of branches and dry wood is known as a fireline. When the fire reaches this area, it runs out of fuel and "starves". If the fire is too large, however, planes and helicopters drop special chemicals that smother the flames. Firefighters also use fire extinguishers filled with carbon dioxide for small fires.

Vocabulary

Baking soda A white powdery chemical used to bake cakes and breads.
Vinegar A sour liquid, acid based.
Carbon dioxide A heavy colorless gas that does not support fires.

Set induction

In preparation for this lesson, the students will become familiar with the background material when our local park ranger or firefighter comes to the classroom to demonstrate firefighting equipment.

Lesson procedure

1. Students assigned to BioAction carts will begin to create carbon dioxide.
2. First they will pour one-quarter cup of vinegar into a pint jar. Add one teaspoon of baking soda and quickly cover the jar with a flat piece of cardboard. Do not use a jar lid, do not screw a lid onto the jar.
3. Next stand a birthday candle in a pan; use clay to keep it in place.
4. Uncover the jar and immediately tilt it over (do not pour out the liquid or solid contents) the flame. Hold the jar so that its mouth is a little higher than the flame and a short distance away.

5. Next put some baking soda in a balloon. Add a small amount of vinegar and close the mouth to the balloon. Observe what happens.
6. Now aim the mouth of the balloon towards the candle and observe what happens next.
7. The students assigned to the computers will visit the Smokey Bear web site and play the interactive games for putting out the fires. If there is time, they can visit *www.firewise.org* and work with the fire simulator.
8. After 15 minutes each group will change stations, and do the activity at the opposite station.
9. Ten minutes before the end of the class, the groups will clean up their area and make a journal entry. The reporter from the group will report to the class his or her group's observations and thoughts learned from this activity. The journals will be collected at the end of the class.

Closure

The students will sit with their group and, after making a journal entry, will report to the class what they have discovered.

Assessment

The teacher will assess what the students have learned by their participation in the activity and their journal entries.

Extension activity

Students can make up a fire safety plan, rules for campfires, and plan an escape route out of their homes in case of a fire.

Directions for Lesson 7
Fighting fires

1. Pour one-quarter cup of vinegar into an empty bottle.
2. Take one Alka Seltzer® tablet, break it into smaller pieces and drop the tablet into the bottle; OR put one teaspoon of baking soda into the bottle.
3. Quickly put a balloon over the mouth of the bottle.
4. Observe what happens to the balloon.
5. Take the tea light candle and light it.
6. When the balloon reaches at least 11 inches in diameter quickly take the balloon off of the bottle, keeping the opening of the balloon closed.
7. Point the balloon towards the candle and gently let the gas out of it.
8. What happens to the candle?
9. What would happen to the candle if you blew up the balloon yourself and pointed that gas towards the candle?
10. What would happen to the candle if the balloon was filled with oxygen and we released that gas towards the candle very slowly?

Handout for Lesson 7
Fighting Fires

In many parts of the country it is normal for no rain to fall for several months. This dryness combined with extreme heat and winds, and a simple spark from a discarded cigarette, lightning or a careless camper can easily start a grassland fire.

Modern firefighters have many weapons for fighting fires: satellite communications, space age materials for protection, helicopters and airplanes that can drop water or fire-retardant chemicals, and smoke jumpers who parachute in to help put out the fires.

The first line of defense against a fire is to create a fuel break. The firefighters create a line that the fire can't cross by eliminating the fuel source with a heavy axe called a Pulaski. Sometimes the firefighters have to start a fire to stop the grassland fire. This method is called setting a backfire, which also deprives the wildfire of fuel. However, if the wind changes direction, the backfire can burn out of control.

Firefighters wear clothing made of Nomex®, a material that won't burn or melt even at 700 or 800°. Their gloves are made of flame-resistant leather and their chaps are made of nylon on the outside and Kevlar® on the inside. They also carry a fire shelter, which is made of aluminum foil and fiberglass.

When forest fires are far from any roads, airplanes are needed to dump a special fire-retardant chemical on the fire. This mixture consists of water, a chemical that helps put out the fire and later acts as a fertilizer for new growth, a thickening gum that makes the mixture thicker than molasses, and iron oxide, which gives it its red color so that the pilot can see where he has made his drop.

Smoke jumpers are highly trained firefighters. They carry heavy equipment, work long hours, and need to parachute into the forest to do their job. They must be educated in the science of fire fighting and have at least two years of experience as a firefighter in mountainous terrain.

Presentations

Lesson 8

Lynn Peckham Grade 7
Sheridan Magnet School

Background information for students

The seventh grade students at Sheridan Magnet School are also concerned with the effects of a controlled burn on their environment since most of the students live in the greater West Rock area. Mayor John DeStefano has asked the Sheridan students to prepare a presentation for WTNH News informing the public on the pros and cons of forest ecology. The presentation must discuss how the fire would affect the plants, animals, humans, soil and environment. The presentation needs to convince the public to either support or disapprove of the controlled burn in the West Rock Ridge area.

You will have four members on your team, each with a different role: Principal Investigator, Materials Manager, Recorder and Reporter. Remember that your presentation must be informative, creative and interesting. The BioAction Lab will be available for you to use as part of your demonstration.

Group A

Lessons 1 and 2: Layers of the Forest and the Forest Restaurant

Decide on a reporter for your group. This person will be responsible for telling the class what the group remembered from Lessons 1 and 2.

Include in your report:
1. The names of the layers of the forest.
2. The names of at least one animal or insect or plant from each layer.
3. A description of how the animal and layer are dependent on each other.
4. A discussion of how this relates to our unit about forest fires.
5. A defense of what your group thinks about having a controlled burn in the West Rock area.

Your presentation should not take more than 5 to 10 minutes.

Group B

Lesson 3: Wildfires and Controlled Burns

Decide on a reporter for your group. This person will be responsible for telling the class what your group most remembers about Lesson 3.

Please include in your report:
1. The components of what is needed to create a fire.
2. A description of a controlled burn.
3. A description of a wildfire.
4. A discussion of how this relates to your group's decision on whether or not there should be a controlled burn in the West Rock area.

Your presentation should not take more than 5 to 10 minutes.

Group C

Lesson 4: Adaptation to Forest Fires

Decide on a reporter for your group. This person will be responsible for telling the class about what your group remembers doing in Lesson 4 (looking at seeds, tree rings and soil).

Include in your report:
1. How seeds leave the trees and create new trees.
2. A description of the serotinous pine cones and how they need fire to reproduce.
3. How wildlife, tree bark and pine cones relate to a forest fire.
4. A discussion of how this relates to what your group has decided about having a controlled burn in the West Rock area.

Your presentation should not take more than 5 to 10 minutes.

Group D

Lesson 5: Anatomy of Lungs

Decide on a reporter for your group. This person will be responsible for telling the class what your group remembers about the anatomy of a lung from Lesson 5.

Include in your report:
1. A diagram of the respiratory system; include the trachea, lungs, bronchial tubes and the little air sacs called alveoli.
2. A definition of the word *inhale* and the primary chemical that we inhale.
3. A definition of the word *exhale* and the chemical that we exhale.
4. A description of how the air quality can affect our breathing.
5. A discussion relating this lesson to our unit about forest fires, and whether or not we should have a controlled burn in the West Rock area.

Your presentation should not take more than 5 to 10 minutes.

Group E

Lesson 6: Lung Volume and Vital Capacity

Decide on a reporter for your group. This person will be responsible for telling the class what your group remembers about this lesson.

Include in your report:
1. A definition of lung capacity.
2. A definition of lung volume.
3. A description of the difference between a tall person's lung capacity and a short person's lung capacity.
4. A discussion of how this relates to our unit on forest fires, and what your group has decided about whether or not there should be a controlled burn in the West Rock area.

Your presentation should not take more than 5 to 10 minutes.

Group F

Lesson 7: We Didn't Start the Fire!

Decide on a reporter for your group. This person will be responsible for telling the class what this group remembers about fighting fires from Lesson 7.

Your report should include:
1. The name of the chemical created in the activity.
2. A description of what happened to the candle when we released the contents of the balloon onto the candle.
3. A description of a Pulaski, smoke jumpers, and fuel break.
4. A discussion of how this lesson relates to our unit on forest fires. Tell the class what your group has decided as to whether we should have a controlled burn in the West Rock area.

Your presentation should take only 5 to 10 minutes.

Final Assessment

Lesson 9

Lynn Peckham Grade 7
Sheridan Magnet School

Post-test: Observational Drawing and Conceptual Maps

This is the last lesson of the curriculum. The students are asked to complete the observational drawing and the biodiversity conceptual map. After completing the assignment, time is given for feedback and the students' thoughts about the lessons. If there is time, play the fire spelling game again. It is a nice way to bring closure to the unit.

Biodiversity Observational Drawing
Post-test

Imagine your field trip to Edgewood Park. Remember your walk through the wooded area and how pretty it was with the trees beginning to change color. You saw some pine trees, hardwood trees and maple trees, and some animals, flowers and plants. Hopefully you noticed the layers of the forest and who might live in each layer. But what would this pretty area look like if it had caught fire? What would it look like one month later?

I would like you to draw for me what you think a forest looks like one month after a major forest fire.

Helpful Hints

- We divided our large classroom into groups of four students to work with the BioAction Lab. After the first class it became obvious that we needed an adult leader with each group of students.
- Even though we had seventh grade students, most of them were unwilling to read a list of directions, or read a handout given to them to enhance the lesson.
- We found that whatever directions we did write down needed to be very simple and easy to follow.
- None of the groups could work alone on a project. They needed a teacher or volunteer to help guide them through the activity.
- Although we were trying to instill the inquiry method in students, they responded best to a 10- to 15-minute explanation of what the lab was about, which brought together the information we had been talking about. The teacher needed to localize the information for them.
- Class time was definitely a factor. Having only 45 minutes to set up and complete the lab was often pushing it. It was most important to get into the lab 5 minutes before the kids to set up.
- It is helpful to have a classroom of your own when you lead the lesson. Seeing the students two or three times a week prevents the teacher from extending some of the lab time and activities with them. More time with students can also develop better classroom behavior.
- If possible, ask a guest speaker to come to the class to enhance the unit. This gives the students an opportunity to see job and career opportunities in this field.

Annotated bibliography

For teachers

Books

Allison, Linda. 1976. Blood and Guts: *A Working Guide to Your Own Insides.* Little, Brown & Company, Boston.
This book discusses the human body in a kid-friendly manner. It includes many experiments and activities to do with children about their bodies.

Appelhof, Mary. 1993. *Worms Eat Our Garbage*. Flower Press, Kalmazoo, MI.
This book has many activities centered around the earthworm, for the classroom. It includes teacher guidelines, resource materials and glossary.

Arbel, Ilil. 1992. *Medicinal Plants Coloring Book*. Dover Publications, New York.
Provides detailed pictures of plants and flowers for the student to color, and provides glossary terms.

Gaspas, Diane. 2001. *Forest Animals*. Coloring Book. Dover Publications, New York.
Provides detailed pictures with descriptions of animals in the forest for the student to color.

Heyworth, Thomasin. 1999. *Life Science*: *Grade Six*. Steck-Vaughn Science Series. Steck-Vaughn Company.

Houghton Mifflin. 2002. *Discovery Works*. Unit A. System in Living Things. Houghton Mifflin, Boston.
This workbook provides lesson plans and activities related to health and living things.

Articles

Mecham, Nancy, Catherine Ueckert and Ivo Lindauer. October 2002. "Fire and the Natural History of the Giant Sequoias." *The American Biology Teacher*. Vol. 64, No. 8, pp. 573-577.

Wallace, Glenda. Nov/Dec 2002. "Wildfire Awareness." *Science Scope*. pp. 40-45.

Time Magazine. August 5, 2002. "The Science of Wildfires." pp. 47-50.

For Students

Books

Patent, Dorothy Hinshaw. 1998. *Fire: Friend or Foe*. Clarion Books, New York.
Discusses forest fires and the effect that they have on both people and the

natural world. Beautiful photography; chapters include an explanation of firefighting equipment and techniques.

Simon, Seymour. 1996. *Wildfires*. HarperCollins Publishers, New York. Presents wildfires as neither good nor bad, but as part of the endless cycle of change in the forest and grasslands. Beautiful photography.

Videos

Fire and the Longleaf. Take a Closer Look Series. A Laurel Hill Press Natural History video story, 1999. Length: 12 minutes.

Web resources

http://www.smokeybear.com
This site has many activities and games; information is presented in a child-friendly way.

http://www.windowsintowonderland.org
This site has a virtual electronic field trip that explains fire histories in our national parks.

http://www.firewise.org
This site has some interactive games and activities for children, as well as a fire safety plan and forest fire information.