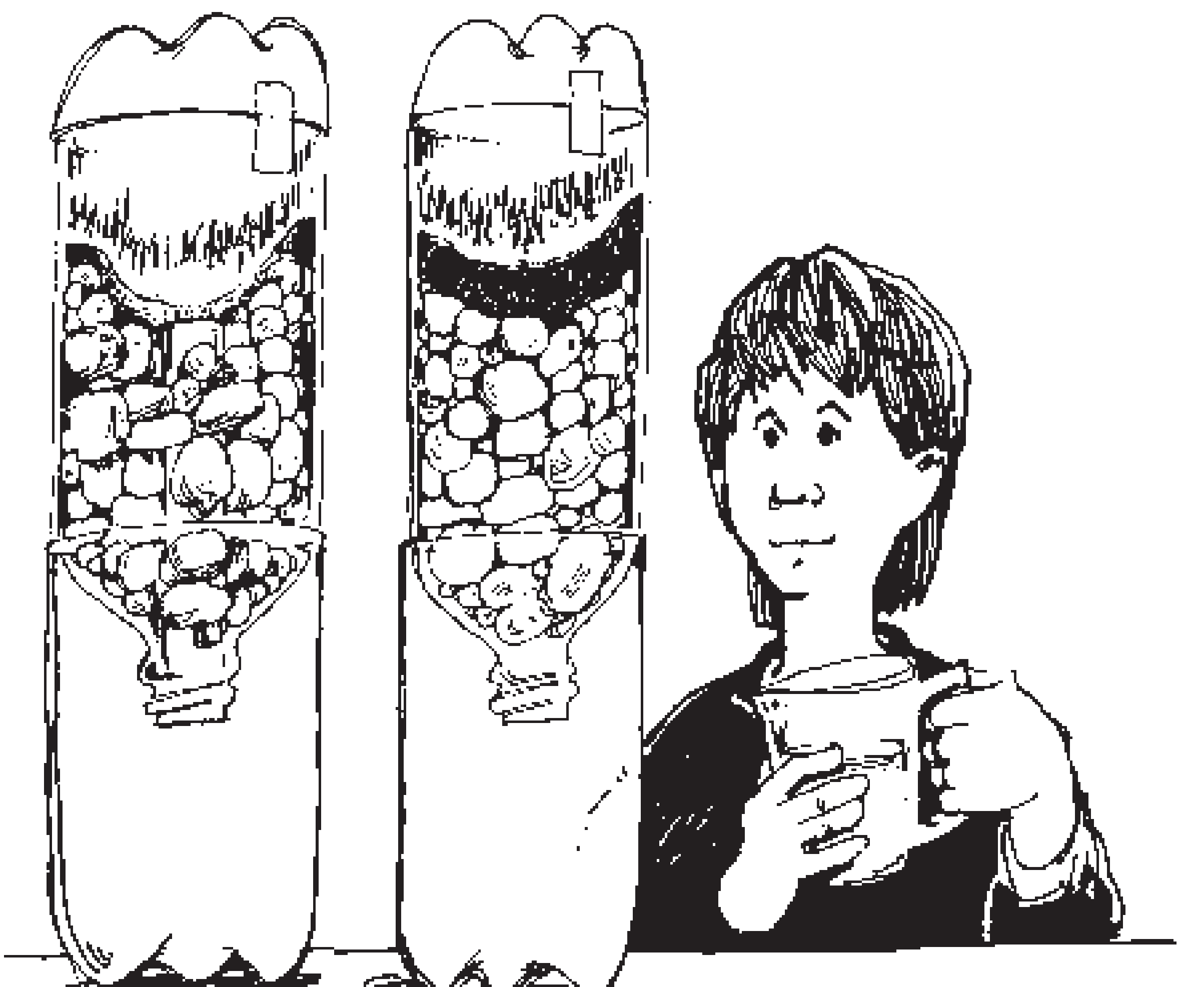
MAKING CONNECTIONS

A curriculum and activity guide to Mammoth Cave National Park

Gr 6-8



CONTENTS

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6TH GRADE PROGRAM OF STUDIES

	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin) to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
Social Studies [Grade 6]										
Historical Perspective										
Students Will										
• Examine how human and physical geography influence past decisions and events.	X			X						
• Analyze the influence of geographic factors on past decisions and events.	X			X						
• Evaluate past, current, and future issues of land use (e.g., preservation, development, modification) from geographic perspectives.	X		X	X						
Geography										
Students Will										
• Examine patterns on Earth's surface, using geographic tools (e.g., maps, globes) to identify where things (e.g., people, places, landmarks) are, how they are arranged, and why they are in particular locations.			X		X					
• Analyze the physical and human characteristics of places and regions.		X	X	X	X				X	X
• Evaluate the impact of human settlement and the interaction of humans with their environments.	X	X	X	X	X				X	
• Use the five themes of geography (location, place, regions, movement, and relationships within places) to organize information about various regions in the modern world.					X					
Science [Grade 6]										
Scientific Ways of Thinking & Working										
Students Will										
• Identify and refine questions that can be answered through scientific investigations combined with scientific information.	X	X	X				X			X
• Use appropriate equipment (e.g., binoculars), tools (e.g., beakers), techniques (e.g., ordering), technology (e.g., calculators), and mathematics in scientific investigations.	X	X		X			X			
• Use evidence (e.g., orderings, organizations), logic, and scientific knowledge to develop scientific explanations.	X	X	X				X			
• Design and conduct different kinds of scientific investigations to answer different kinds of questions.		X	X	X			X			
• Communicate (e.g., speak, write) designs, procedures, and results of scientific investigations.	X	X	X				X			
• Review and analyze scientific investigations and explanations of other students.	X	X	X				X	X		

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	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's all Greek (& Latin) to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
Earth/Space Science [Grade 6]										
Earth in the Solar System										
Students Will										
• Identify phenomena (e.g., growth of plants, winds, water cycle, ocean currents) on the Earth caused by the sun's energy.							X			X
Life Science [Grade 6]										
Regulation and Behavior										
Students Will										
• Investigate how organisms obtain and use resources, grow, reproduce, and maintain stable internal conditions. Examine the regulation of an organism's internal environment.								X		X
• Analyze internal or environmental stimuli and organisms' behavioral responses. Explore how organisms' behavior changes through adaptation.							X	X		X
Populations and Ecosystems										
Students Will										
• Observe populations and determine the functions (e.g., decomposers, producers, consumers,) they serve in an ecosystem.							X	X	X	X
• Investigate energy flow in ecosystems.							X	X		X
• Investigate factors (e.g., resources, light, water) that affect the number of organisms an ecosystem can support.	X	X	X	X						X
Applications/connections										
Students Will										
• Recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.	X	X	X	X			X	X		X
Arts & Humanities [Grade 6]										
Visual Arts										
Elements of Art & Principles of Design										
Students Will										
• Produce visual products which illustrate elements of art and principles of design.		X	X		X		X			
• Apply elements of art and principles of design in producing two- and three-dimensional artwork involving a variety of subject matter.		X	X		X		X			
• Use a variety of media and art processes to produce two- and three-dimensional works of art.		X	X		X		X			

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	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin) to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
English/Language Arts [Grade 6]										
Reading										
Students Will										
• Identify meaning of a variety of reading materials, making connections to students' lives, to real world issues, and/or to current events.	X			X	X	X		X	X	
• Respond to transactive reading materials (informational, practical/workplace, and persuasive) supporting ideas through summarizing and through identifying main ideas, details, and examples.	X				X	X		X	X	
• Interpret text features (e.g., layout, boldface print, bullets, diagrams) of transactive reading materials to understand passages and complete authentic tasks.	X						X		X	
• Identify and apply logical sequence in reading materials to complete tasks or procedures.					X				X	
• Employ reading strategies (e.g., skimming, scanning) to locate and apply information in varied print and nonprint (e.g., computers, electronic media, interviews) sources for inquiry projects and other authentic tasks.	X				X				X	
• Use vocabulary and comprehension strategies, as well as technology, to understand text.	X					X				
Writing										
Students Will										
• Respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as graphic organizers, notetaking, journals, and logs and writing-to-demonstrate-learning strategies in situations such as graphic organizers, open-response questions, and summaries.	X	X	X	X	X	X	X	X	X	
• Write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) based on personal experience, reading, listening, observing, and/or inquiry (additional supporting Academic Expectation 6.3).	X				X				X	
Speaking/Listening/Observing										
Students Will										
• Interpret meaning from verbal/nonverbal cues by applying appropriate listening and observing strategies.					X		X			
Inquiry										
Students Will										
• Develop questions to obtain ideas and information for authentic tasks (additional supporting Academic Expectation 6.3).					X		X	X	X	

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Health [Grade 6]										
Individual Well-Being										
Students Will										
• Recognize that rights and responsibilities are interrelated.	X								X	
Consumer Decision										
Students Will										
• Analyze environmental impacts when making consumer decisions.	X	X	X						X	
Community Services										
Students Will										
• Identify services provided by environmental protection agencies.	X			X					X	X
Math [Grade 6]										
Number and Computation										
Students Will										
• Extend understanding of operations (+,-,x,÷) to include fractions and decimals.	X			X	X					
Probability and Statistics										
Students Will										
• Make predictions, draw conclusions, and verify results from statistical data and probability experiments.	X			X						
• Select an appropriate graph to represent given data.				X						
• Compare data from various types of graphs.				X						
Algebraic Ideas										
Students Will										
• Recognize, create, and continue patterns (given an informal description for the continuance of the pattern and/or generalize patterns through a verbal rule).	X			X						
Represent, interpret, and describe function relationships through tables, graphs, and verbal rules.	X			X						
Physical Education [Grade 6]										
Lifetime Activity										
Students Will										
• Use rules and fair play in games and sports.						X				X
• Apply techniques to achieve consistency for games and sports.	X					X				X

7TH GRADE PROGRAM OF STUDIES

	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
Social Studies [Grade 7]										
Historical Perspective										
Students Will										
• Use a variety of tools (e.g., primary and secondary sources, data, artifacts) to understand the interpretive nature (how perceptions of people and passing of time influence accounts of historical events) of world history from early civilizations prior to 1500A.D.	X	X	X			X			X	
Geography										
Students Will										
• Recognize the importance of physical environment (e.g., natural resources, natural disasters, natural barriers) in the settlement and development of early world civilizations.	X		X		X				X	
• Examine how technology influences modifications of the physical environment.					X				X	
• Explore migration and settlement patterns in early world civilizations.					X				X	
Economics										
Students Will										
• Recognize that all societies must address the questions of production, distribution, and consumption.			X	X						X
• Explain how resources were used in early world civilizations to produce goods and services and explore ways productivity was increased.			X							
Government and Civics										
Students Will										
• Examine the essential roles of government in early civilizations (establishing order, providing security, achieving common goals).	X			X		X			X	
Culture and Society										
Students Will										
• Investigate the emergence of social institutions and how they responded to human needs.	X		X							
Science [Grade 7]										
Scientific Inquiry										
Students Will										
• Identify and refine questions that can be answered through scientific investigations combined with scientific information.	X	X	X				X			X
• Use appropriate equipment (e.g., spring scales), tools (e.g., spatulas), techniques (e.g., measuring), technology (e.g., computers), and mathematics in scientific investigations.	X	X		X			X			

7th Grade Program of Studies

	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
• Use evidence (e.g., measurements), logic, and scientific knowledge to develop scientific explanations.	X	X	X				X			
• Design and conduct different kinds of scientific investigations to answer different kinds of questions.		X	X	X			X			
• Communicate (e.g., write) designs, procedures, and results of scientific investigations.							X			
• Review and analyze scientific investigations and explanations of other students.	X	X	X				X	X		
Life Science [Grade 7]										
Diversity & Adaptation of Organisms										
Students Will										
• Investigate unity among organisms.								X		X
• Investigate biological adaptation and extinction.								X	X	X
Arts & Humanities [Grade 7]										
Visual Arts										
Elements of Art & Principles of Design										
Students Will										
• Make art for specific purposes using elements of art and principles of design.		X	X		X		X			
Processes and Media										
Students Will										
• Use a variety of art media, processes, and subject matter to communicate ideas, feelings, and experiences.		X	X		X		X			
English/Language Arts [Grade 7]										
Reading										
Students Will										
• Identify the meaning of a variety of reading materials, making connections to students' lives, to the real world, and/or to current events.	X			X	X			X	X	
• Respond to and analyze meaning, literary techniques (e.g., figurative language, foreshadowing, characterization), and elements (e.g., character, setting, conflict/resolution, theme, point of view) of different literary genres (e.g., novels, essays, short stories, poetry, drama.	X					X			X	
• Respond to and analyze transactive reading materials (informational, practical/workplace, and persuasive) through raising and addressing questions, making predictions, drawing conclusions, solving problems, and summarizing information (additional supporting Academic Expectation 5.1).	X			X				X	X	
• Interpret and apply information in a variety of transactive reading materials to complete authentic tasks.	X			X				X	X	
• Identify authors' positions, main ideas, and techniques of support in persuasive materials.	X								X	
• Employ reading strategies (e.g., skimming, scanning) to locate and apply information in varied print and nonprint (e.g., computers, media, interviews) resources for inquiry projects and other authentic tasks.	X				X			X	X	
• Use vocabulary and comprehension strategies, as well as technology, to understand text.	X				X	X			X	

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	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin) to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
Writing										
Students Will										
• Respond to reading, listening, observing, and inquiry through applying writing-to-learn strategies in situations such as graphic organizers, notetaking, journals, and logs and writing-to-demonstrate-learning strategies in situations such as graphic organizers, open-response questions, and summaries.	X	X	X	X	X		X	X	X	
• Write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning), based on inquiry and/or personal experience that show independent thinking and incorporate ideas and information from reading, listening, observing, and inquiry.	X				X				X	
Speaking/Listening/Observing										
Students Will										
• Adjust listening and observing strategies for specific situations and purposes (e.g., to follow directions, to acquire information, for entertainment, to complete a task).		X	X		X	X	X		X	X
• Apply listening, speaking, and observing skills to conduct authentic inquiry tasks and to create products (additional supporting Academic Expectation 5.1).			X				X			
Inquiry										
Students Will										
• Develop effective questions to obtain ideas and information and access resources to address those questions.	X			X	X		X	X		X
Health [Grade 7]										
Individual Well-Being										
Students Will										
• Examine how respect, rules, communication, and cooperation enable groups to function effectively.	X		X	X	X	X	X		X	X
Community Services										
Students Will										
• Suggest solutions to community environmental problems.	X		X						X	
Mathematics [Grade 7]										
Number and Computation										
Students Will										
• Extend understanding of operations (=,-,x,÷) to include integers.				X	X					
Probability and Statistics										
Students Will										
• Collect, organize, analyze, and interpret data in a variety of graphical methods, including circle graphs, multiple line graphs, double bar graphs, and double stem and leaf plots.	X			X						
• Make predictions, draw conclusions, and verify results from statistical data and probability experiments.	X			X						
• Select an appropriate graph to represent given data and justify its use.				X						
• Compare data from various types of graphs.				X						

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Algebraic Ideas										
Students Will										
• Recognize, create, and continue patterns and generalize the pattern by giving the rule for any term.	X			X						
• Represent, interpret, and describe functional relationships through tables, graphs, and verbal rules (input/output).				X						
• Understand the concept of equations and inequalities using variables as they relate to everyday situations.	X			X						
• Use a variety of methods and representations to create and solve single-variable equations that may be applied to everyday situations.	X			X						
• Organize data into tables and plot points onto all four quadrants of a coordinate (Cartesian) system/grid and interpret resulting patterns or trends.				X						
• Interpret relationships between tables, graphs, verbal rules, and equations.				X						
Physical Education [Grade 7]										
Lifetime Activity										
Students Will										
• Apply rules and fair play in games and sports.						X				X
• Practice to achieve consistency in games and sports.	X					X				X

8TH GRADE PROGRAM OF STUDIES

	Protect and Provide	Soda Sink	Secret Sink	Mammoth Math	Back to the Past	It's All Greek (& Latin) to Me!	That's My Tree!	Do or Die	Making Headlines	Sum(it)-Up
Social Studies [Grade 8]										
Historical Perspective										
Students Will										
• Use a variety of tools (e.g., primary and secondary sources, data, artifacts) to explore the interpretive nature (how perceptions of people and passing of time influence accounts of historical events) of United States history.	X		X		X				X	
• Develop a chronological understanding of the early history of the United States (early inhabitants to Reconstruction).					X					
• Analyze the social, political, and economic characteristics of eras in American history to Reconstruction (Land and People before Columbus, Age of Exploration, Colonization, War for Independence, Young Republic, Westward Expansion, Industrialism, Civil War).					X					
• Recognize the significance of geographical settings and natural resources on historical perspectives and events in early United States history.	X		X		X					
Geography										
Students Will										
• Explore reasons behind patterns of human settlement across the United States that resulted in the diverse cultures of the United States.					X					
• Examine how early United States history was influenced by the physical environment (e.g., natural barriers, natural disasters, natural resources).			X		X					
• Investigate how Americans used technology, especially in early American history, to modify the environment.					X					
Economics										
Students Will										
• Recognize that government regulation impacts the economy in decisions about productive resources (e.g., natural, human, human-made).	X								X	
Science [Grade 8]										
Scientific Ways of Thinking & Working										
Students Will										
• Identify and refine questions that can be answered through scientific investigations combined with scientific information.	X	X	X				X			
• Use appropriate equipment (e.g., barometers), tools (e.g., meter sticks), techniques (e.g., computer skills), technology (e.g., computers), and mathematics in scientific investigations.	X	X		X			X			
• Use evidence (e.g., computer models), logic, and scientific knowledge to develop scientific explanations.	X	X	X				X			
• Design and conduct different kinds of scientific investigations to answer different kinds of questions.		X	X	X			X			
• Communicate (e.g., write, graph) designs, procedures, and results of scientific investigations.	X	X	X				X			
• Review and analyze scientific investigations and explanations of other students.	X	X	X				X	X		

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Earth/Space Science										
Students Will										
• Investigate the structure of the Earth system (e.g., lithosphere, rock cycle, water cycle, weather, climate).		X	X							X
Life Science										
Students Will										
• Analyze regulation (changing physiological activities) and behavior (a set of responses).								X		X
• Investigate and analyze populations and ecosystems.	X	X	X				X	X		X
• Analyze diversity and adaptations (e.g., changes in structure, behaviors, or physiology).							X	X		X
Applications/Connections										
Students Will										
• Recognize how science is used to understand changes in populations, issues related to resources, and changes in environments.		X	X	X			X	X		X
• Examine the role of science in explaining and predicting natural events (e.g., floods, earthquakes, volcanoes).	X	X	X					X		X
• Use science to evaluate the risks and benefits to society for common activities (e.g., riding on airplanes, choice of habitation).	X	X	X	X						X
• Demonstrate the role science plays in everyday life and explore different careers in science.	X		X			X			X	
Arts & Humanities [Grade 8]										
Visual Arts										
Elements of Art & Principles of Design										
Students Will										
• Refine use of elements of art and principles of design when producing two- and three-dimensional artwork.		X	X		X		X			
English/Language Arts [Grade 8]										
Reading										
Students Will										
• Read and understand a variety of materials, making connections to students' lives, to real-world issues, and/or to current events.	X			X	X	X		X	X	
• Analyze transactive reading material (informational, practical/workplace, and persuasive) to create responses through addressing issues, confirming predictions, paraphrasing information to support ideas, and formulating/supporting opinions.	X			X	X	X		X	X	
• Evaluate the effectiveness of techniques and organizational aids (e.g., bullets, lists, layout, embedded visuals) in transactive reading materials to enhance understanding and to complete tasks.									X	
• Identify and analyze authors' positions, main ideas, and techniques of support in persuasive materials.									X	
• Employ reading strategies to locate and apply information in varied print and nonprint (e.g., computers, electronic media, interviews) resources for inquiry projects and other authentic tasks.	X				X	X		X	X	

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Writing										
Students Will										
• Respond to materials read and concerns relevant to students' lives and the lives of others in society through applying writing-to-learn strategies and writing-to-demonstrate-learning strategies (additional supporting Academic Expectations 1.10, 5.1, 6.3).	X	X	X	X	X		X	X	X	
• Write transactive pieces (writing produced for authentic purposes and audiences beyond completing an assignment to demonstrate learning) that demonstrate independent thinking about literature, issues, and events relevant to students' lives.	X				X				X	
Speaking/Listening/Observing										
Students Will										
• Collaborate to gather and interpret information from observing, speaking, and listening and to prepare and deliver messages and products.		X	X				X		X	
• Apply listening, speaking, and observing skills to conduct authentic independent inquiry tasks in order to create products (additional supporting Academic Expectation 5.1).		X	X				X		X	
Inquiry										
Students Will										
• Follow a logical, organized plan of inquiry to learn and to complete tasks (additional supporting Academic Expectation 5.5).		X	X		X		X	X	X	
• Evaluate the appropriateness of resources and of ideas and information gained through inquiry.									X	
Health [Grade 8]										
Individual Well-Being										
Students Will										
• Practice group processing strategies (e.g., collaboration).	X	X	X	X	X	X	X	X	X	X
• Practice conflict resolution strategies.	X		X						X	
Consumer Decisions										
Students Will										
• Consider environmental issues when making consumer decisions.	X	X	X	X						
Community Services										
Students Will										
• Evaluate agency and government standards (e.g., restaurant inspections, OSHA, water quality) and the part they play in the reduction of health risks.	X	X	X						X	
• Describe the role of individuals and society in conserving resources.	X	X	X	X					X	
• Implement strategies to help reduce community environmental problems.	X	X	X						X	

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Mathematics [Grade 8]										
Probability and Statistics										
Students Will										
• Collect, organize, analyze, and interpret data in a variety of graphical methods (e.g., circle graphs, scatterplots, box and whisker plots, histograms).	X			X						
• Make predictions, draw conclusions, and verify results from statistical data and probability experiments.	X			X						
• Select an appropriate graph to represent given data and justify its use.				X						
• Compare data from various types of graphs.				X						
Algebraic Ideas										
Students Will										
• Recognize, create, and continue patterns (generalize the pattern by giving the rule for the *nth* term and defend the generalization).	X			X						
• Represent, interpret, and describe functional relationships through tables, graphs, and symbolic rules (input/output).	X			X						
• Explain how a change in one variable affects change in another variable (e.g., in distance equals rate times time, increasing time increases distance).	X			X						
• Organize data into tables, plot points onto all four quadrants of a coordinate (Cartesian) system/grid, interpret resulting patterns or trends.				X						
• Interpret and explain relationships between tables, graphs, verbal rules, and equations.				X						
• Graph linear functions in a four-quadrant (Cartesian) system/grid and interpret the results.				X						
Physical Education [Grade 8]										
Lifetime Activity										
Students Will										
• Demonstrate sportsmanship (e.g., fair play, following rules, accepting officials' decisions, controlling responses) as it applies to participants and spectators.						X				X
• Develop techniques and refine skills related to performance in games and sports.	X					X				X

PROTECT AND PROVIDE

SUBJECTS: Science, Social Studies, Math, English/ Language Arts, Health, Consumerism

GRADES: 6-8

DURATION: One class period of 40 to 60 minutes

GROUP SIZE: One or two classes of 10-30 students

SETTING: Indoors

KEY VOCABULARY: Balance, protect, provide, Organic Act, mission

ANTICIPATORY SET: Trying to organize issues and ideas can be challenging. Trying to keep issues in balance can be even more difficult.

OBJECTIVES: The students will be able to: 1) work productively in small groups to create a balance and demonstrate the complexity of keeping the environment in order; 2) make observations demonstrating the complex situations that occur in making decisions that affect the environment.

MATERIALS: Each group will need the following items: two small paper cups, a yardstick, masking tape, stapler or similar object (to create a fulcrum), 30 objects of equal weight (such as pennies or 1 gram cubes), a pencil, three Situation Cards, a copy of the Protect and Provide Activity Sheet.

BACKGROUND: On August 25, 1916, legislation creating the National Park Service was adopted. This legislation, referred to by National Park Service employees as the Organic Act, is the basis for determining how the service manages its natural and cultural resources. A section of the law reads:

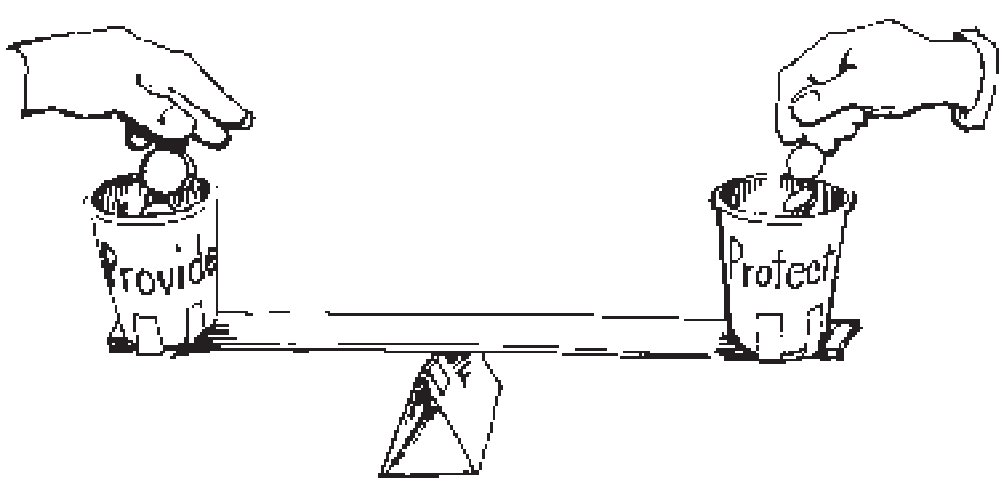
"The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations, as provided by law, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

This law states that the National Park Service is to accomplish two things:

1. To conserve (**protect**) the scenery, natural and historical objects, and the wildlife.

2. To **provide** enjoyment of these same resources.

It is not an easy task to keep both areas in balance. A great deal of complex decision making goes into determining how to handle a situation to meet both missions.



PROCEDURE:

1. The teacher passes out a copy of the Protect and Provide Activity Sheet to each student. The students read the portion of the Organic Act at the top of the page. The teacher explains that there are two major goals stated in the law and asks the students to identify and list them on the activity sheet.

2. The class should be able to respond with conserving (**protecting**) the scenery, natural and historical objects, and the wildlife; and **providing** for the enjoyment of these resources.

3. The teacher asks if the class thinks it would be an easy task to follow both missions and be fair and equal in meeting each goal. The teacher then explains that they will do an experiment to demonstrate how to keep everything in balance.

4. The teacher divides the class into groups of three or four students and explains that each group will create their own balance and make decisions affecting whether the balance stays level.

5. The teacher distributes cups, yardsticks, and masking tape to be used to create the balances. The next section of the activity sheet, entitled "Keeping the Mission in Balance", describes how to do this. Each group follows the instructions to create their model.

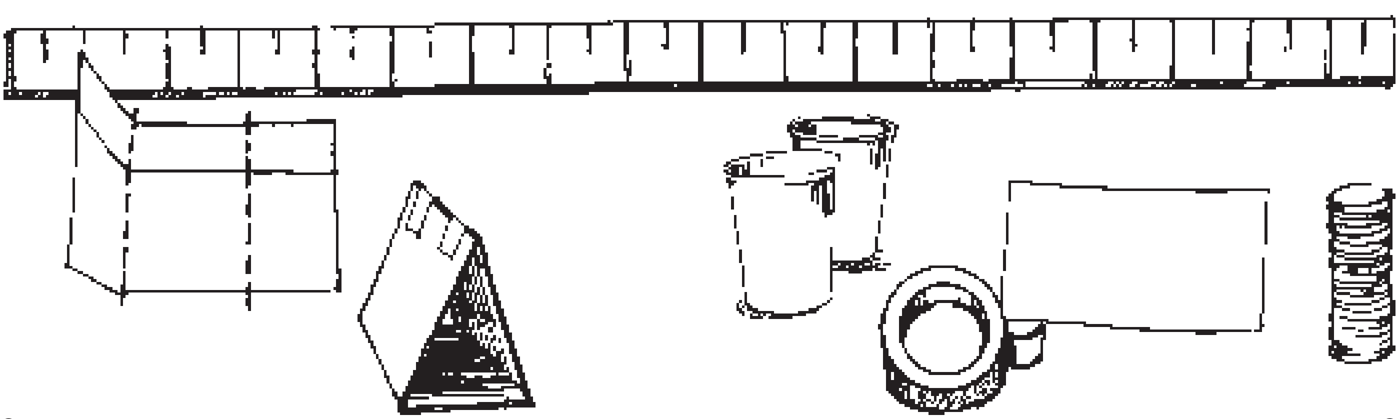
6. After building their balance, the students place ten pennies or similar items in each cup. Once each group places the items in their cup they then balance the yardstick on the fulcrum (stapler or other similar item).

7. Each group receives any three of the Situation Cards. The group can read them in any order. After reading, discussing, and filling in the Setting the Scene Work Sheet for the first Situation Card, the students adjust their balance accordingly by adding to or removing objects from the cups. For each beneficial change, add one penny (or other object) to the appropriate cup. For each harmful change, take one penny (or other object) out of the appropriate cup. Do not add or subtract if the situation is unchanged.

8. After adjusting their balance for the first Situation Card, the group brainstorms ways to rectify the situation to bring it back into balance, thus maintaining the "protect" and "provide" goals of the Organic Act.

9. The students follow the same procedure for the second Situation Card; and again for the third.

10. The teacher asks if any students would like to share their situations and how it affected their balance. The class discusses whether it was easy to keep their scale in balance. The teacher asks questions such as, "What could be done to assure all is in balance? Is there one part of your situation you see as more of a problem than another? Why? Does everyone in your group agree?"



CLOSURE: We have taken a look at the mission of the National Park Service and how easily outside factors can make this mission difficult to achieve. When choices are made about what can be done in a situation, many viewpoints need to be considered before a decision is made. People making these decisions also have to stay within the limits of laws such as the Organic Act.

EVALUATION: The teacher is able to evaluate the students as they work in groups, through class discussion, and by reviewing their activity sheets.

EXTENSIONS:

1. The students can choose a “situation” to research and then provide an oral or written report on their findings.

2. A speaker from a conservation agency could be invited to speak to the class about various issues that impact their job and/or their organization’s mission. They could address an issue that is a challenge in meeting the mission/missions of their agency.

3. The students could choose an environmental issue related to their community and brainstorm various ways this issue could both positively and negatively affect the community.

PROTECT AND PROVIDE ACTIVITY SHEET

Please read the following paragraph taken from the "Organic Act" of 1916.

"The service thus established shall promote and regulate the use of the Federal areas known as national parks, monuments, and reservations, as provided by law, which purpose is to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

This act is the law that must be obeyed whenever the National Park Service makes decisions.

List the two main ideas or missions in the Organic Act.

1. ____

2. ____

Keeping the Mission in Balance:

Materials: two small paper cups, tape, a pencil, a yardstick, a stapler or other heavy object (to serve as the fulcrum for the balance), and 30 objects of equal weight (pennies, cubes, etc.).

1. Place the fulcrum (stapler or other heavy object) on a level area.
2. Tape one cup to each end of the yardstick. Write "Protect" on one cup and "Provide" on the second cup.
3. Place 10 items (pennies, cubes, etc.) in each cup. Then place the yardstick on the fulcrum so that it is balanced and the yardstick is level.
4. As a group, read your situation cards one at a time and fill out the Setting the Scene Work Sheet for each card.

SITUATION CARDS

Situation Card A

It is a warm spring day. Many people have come to enjoy the great outdoors in their favorite national park. There are so many people, that cars are parking in an open field.

Situation Card B

There is a family on a trail in a national park. They are having a wonderful time identifying and picking wildflowers to press later.

Situation Card C

A carload of friends pulls up to the entrance gate to visit a national park. They are welcomed and told they will have to wait for a car to exit the park before they can enter.

Situation Card D

There is a group hiking along a trail in a national park. They discover arrowheads and pottery. The group looks at the artifacts without touching them. As everyone walks away the last person figures it won't hurt if they take just one.

Situation Card E

There are deer gathered along a roadside in a national park feeding on nuts and plants. Three cars pull over to take pictures. One person takes out an apple and starts over to feed the deer.

Situation Card F

A couple is out walking on a nature trail in a national park. They come to a tree and see that others have left initials on the tree. The couple decides to add their initials and a heart. They begin to carve into the bark.

PROTECT AND PROVIDE

SETTING THE SCENE WORKSHEET

Choose one of the situation cards and read it aloud to your group.

As a group decide:

1. Does this situation affect the Protect mission, the Provide mission, or both?
2. Is it beneficial, harmful or leave things unchanged? (Check or circle your answer.) Why?
3. How can the situation be corrected?

Answer the questions in the boxes below for each of the three situations.

CARD	PROTECT	PROVIDE
	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:
	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:
	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:	❏ Beneficial ❏ Unchanged ❏ Harmful Why: Corrective Measure:

For each situation, adjust your balance by adding to or by removing objects from the appropriate cup.

Is it easy to keep the balance level?

Is the job of upholding the missions of the Organic Act easily done?

PROTECT AND PROVIDE

CORE CONTENT

MA-M-4.3.2	How the change in one variable affects the change in another variable (e.g., if rate remains constant, an increase in time results in an increase in distance).
MA-M-4.3.1	How everyday situations, tables, graphs, patterns, verbal rules, and equations relate to each other.
MA-M-4.2.6	Write and solve equations that represent everyday situations.
MA-M-4.2.3	Model equations and inequalities concretely (e.g., algebra tiles or blocks), pictorially (e.g., graphs, tables), and abstractly (e.g., equations).
MA-M-3.2.5	Make predictions and draw conclusions from statistical data and probability experiments.
MA-M-3.2.1	Organize, represent, analyze, and interpret sets of data.
MA-M-1.2.1	Add, subtract, multiply, and divide rational numbers (fractions, decimals, percents, integers) to solve problems.
PL-M-3.3.2	Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.
PL-M-3.3.1	A range of resources and services are provided by community agencies such as: public health department, fire department, police department, family resource centers, hospitals, and nonprofit organizations (e.g., American Heart Association, American Red Cross, American Cancer Society).
PL-M-3.1.5	Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).
PL-M-1.8.4	Using appropriate coping strategies (e.g., realistic goal-setting, effective time management, decision-making processes) promotes mental and emotional health.
PL-M-1.8.1	The use of appropriate strategies (e.g., assertiveness, refusal skills, decision-making techniques) are positive ways to cope with peer pressure.
RD-H-x.0.7	Formulate opinions in response to a reading passage.
RD-H-x.0.1	Locate, evaluate, and apply information for a realistic purpose.
RD-H-4.0.8	Identify essential information needed to accomplish a task.
RD-H-2.0.13	Analyze the content as it applies to students' lives and/or real world issues.
RD-H-2.0.12	Make predictions and draw conclusions based on what is read.
RD-M-x.0.10	Connect information from a passage to students' lives and/or real world issues.
RD-M-x.0.9	Reflect on and evaluate what is read.
RD-M-x.0.8	Make predictions, draw conclusions, and make generalizations about what is read.
RD-M-x.0.7	Skim to get the general meaning of a passage.
RD-M-4.0.14	Interpret the meaning of specialized vocabulary.
RD-M-4.0.11	Locate and apply information for a specific purpose (e.g., following directions, completing a task).
RD-M-3.0.15	Identify the argument and supporting evidence.
RD-M-2.0.14	Summarize information from a passage.

PROTECT AND PROVIDE

CORE CONTENT

RD-M-2.0.13	Identify supporting details and explain their importance in a passage.
RD-M-2.0.12	Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.
SC-M-3.5.4	The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.
SC-M-3.5.2	Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.
SC-M-3.5.1	A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.
SC-M-3.4.1	Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
SS-M-4.4.4	Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper).
SS-M-4.4.3	The natural resources of a place or region impact its political, social, and economic development.
SS-M-4.4.2	The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).
SS-M-4.2.2	Places and regions change over time as new technologies, resources, and knowledge become available.
SS-M-4.2.1	Places can be made distinctive by human activities (e.g., building houses, stores, roads, railroads, irrigation) that alter physical features.

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

SODA SINK

SUBJECTS: Science, Social Studies, English/Language Arts, Arts and Humanities, Health, Physical Education, Consumerism

GRADES: 6-8

DURATION: One 20-30 minute period

GROUP SIZE: One classroom of 25-35 students (or less)

SETTING: Indoors or outside at a table or flat surface

KEY VOCABULARY: Sinkholes, pollution, groundwater, karst, watershed, water table

ANTICIPATORY SET: We are going to look at a karst area and a non-karst area. Does anyone know the features of a karst area? How does a karst area differ from a non-karst area?

OBJECTIVES: The students will be able to: 1) conceptualize the differences between a karst area and a non-karst area after watching the demonstration; 2) make decisions and solve problems related to a karst area and its threats of pollution.

MATERIALS: Four plastic 2-liter bottles, two pieces of ½" PVC pipe (7" long), soil, gravel, pickle relish (rinsed), red food coloring, spoon, Soda Sink Activity Sheet.

SODA SINK

BACKGROUND: Karst is a geologic term that describes special areas with unique concerns. Karst areas are noted for their abundance of relatively pure layers of limestone rock. These limestone layers are protected by a cap rock that can repel water and protect the more soluble underlying limestone layers. This cap rock must be thick enough to prevent water from reaching and dissolving all the softer limestone layers, but must be thin enough to form cracks and fissions as the earth's crust shifts and moves. In south-central Kentucky, the cap rock is 50-60 feet thick and is formed of sandstone and shale.

A watershed is an area of land that collects rainwater and melted snow. Following the properties of gravity, water that falls on a hill or plateau will drain downward to the lowest point. Water collects at the lowest point as a river, lake, or ocean. This is the water table. In the Mammoth Cave area the lowest point is the Green River Valley. The water table is at the level of the Green River.

In a non-karst area, water travels as a surface river or stream for long distances until it eventually empties into a larger river, lake, or ocean found at the water table. However, in a karst area this water more frequently disappears into the earth by flowing into depressions called sinkholes. Sinkholes are landforms that develop when underlying rock layers collapse inward, causing the upper layers to develop cracks and collapse. These cracks and newly formed holes will speed the drainage of the surrounding area. Thus, karst areas are noted for having a dramatic lack of surface water.

Falling rainwater absorbs carbon dioxide from decaying surface vegetation. The absorbed carbon dioxide produces an acidic water (carbonic acid) that can dissolve limestone. This acidic water flows across the earth's surface until it finds a crack or a sinkhole. The water then drains vertically until it reaches the water table. On its downward journey through the layers of rock, the water can begin to seep into cracks located between layers of limestone rock. As the water begins to flow horizontally it dissolves holes in the limestone. These horizontal holes are referred to as caves. The vertical holes are called vertical shafts, or domes and pits.

Water that flows underground must eventually have an outlet. In a karst area, groundwater sometimes travels many miles before exiting as a spring that then flows into a surface river or lake.

All land uses can dramatically affect an area. This is particularly true in a karst area where the abundance of sinkholes can funnel not only surface water but also all types of pollution into the groundwater. A rainstorm within a karst region can swiftly wash soils, agricultural chemicals (fertilizers, insecticides, etc.), oil and gas from roads and railways, animal waste from farms, and sewage from poorly performing sewer/septic systems into the underlying water table. On the way to its outlet, this underground water can be intercepted by residential wells where the waters are collected and consumed without any filtration or cleansing. In a karst area, rainwater is often available for re-use within a matter of hours.

In a non-karst area, the same types of pollution can also be carried by surface streams to the controlling waterways, but water that seeps underground does not have the benefit of caves and cracks to speed it along. In a non-karst area water particles must seep around the molecules making up the soil and solid rock on its way to an underground stream or aquifer. Under normal conditions, this groundwater becomes naturally filtered and emerges in a cleansed state. It takes a long time for water to travel through solid rock layers and it is not unusual for groundwater to take 300 years or more to reach the water table.

In a karst area, groundwater movement is measured in miles per hour. In a non-karst area, groundwater movement is measured in centimeters per year!

PROCEDURE:

1. A few days before teaching this exercise the teacher will need to make the karst and non-karst watersheds by following directions found in this lesson. The teacher will also need to prepare the "pollution". To make the "pollution", rinse the oils off 1/8 cup of pickle relish. Add several drops of red food coloring and 1/8 cup water to the rinsed pickle relish. Refrigerate until ready to use.

2. The teacher shows the students the model karst watershed and model non-karst watershed, identifying the ground, rock, and water table. After looking at the models the teacher asks the students to predict what will happen when it rains.

3. The teacher then simulates rain by pouring an equal amount of water on the karst watershed and the non-karst watershed, (about 1/4 cup of water on each). After the "rain" is poured over each model the class discusses what happened.

4. After talking about how quickly water traveled to the water table in the karst model the teacher asks what other things may get into the groundwater. The teacher gets out the "pollution" (the colored pickle relish) and puts about 1 tablespoon of "pollution" on the "ground" of each of the two models. The teacher asks the students to predict what will happen during the next rainstorm. The teacher may also ask questions like, "Will the karst watershed or the non-karst watershed become more polluted?"

5. The teacher makes it rain again. The students observe what happens. The class discusses what happened after the second rain.

6. The students now break up into small groups with their activity sheets. After they have answered their questions, the class gathers together to discuss their answers.

CLOSURE: We have seen how easy it is for water or pollution to get into the groundwater in a karst area. We might think about things we can do to help protect groundwater, since it is the water all of us use every day.

EVALUATION: The teacher is able to evaluate the students during the class discussions and from information written on their activity sheets.

EXTENSIONS:

1. Find newspaper articles that address water pollution in your area. How is the water becoming polluted and what can be done to correct the problem?

2. Plan a class trip to a sinkhole. View it and clean up any pollution you might find in the sink.

3. Discuss sinkholes in your area. Are they polluted? What would be an "action plan" to protect your groundwater?

Note: The plans to create the karst watershed and non-karst watershed were taken from Waste: a Hidden Resource in Kentucky *written for the Kentucky Department of Environmental Protection, 1992.*

SODA SINK

ACTIVITY SHEET

Name:____
Date:________________

1. Draw and label the major features of a karst watershed.

2. Draw and label the major features of a non-karst watershed.

3. What are the differences between a karst and non-karst watershed?

4. List at least four sources of groundwater pollution.

(1.) ____

(2.) ____

(3.) ____

(4.) ____

5. For each type of pollution listed in question four, give a way to either clean up the groundwater or prevent it from becoming polluted.

(1.) ____

(2.)____

(3.)____

(4.)____

SODA SINK

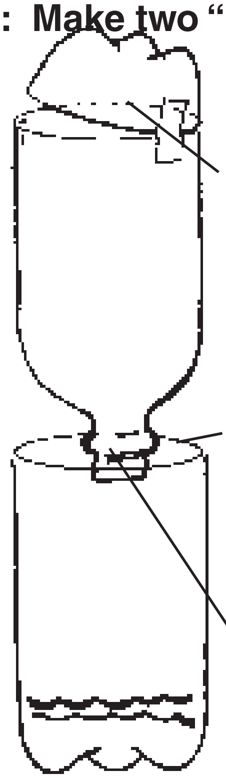
ASSEMBLY INSTRUCTIONS

For “Soda Sink” you will need to construct two simulated environments as demonstration columns.

Materials:

- 4 plastic 2-liter bottles, empty, caps removed
- Two ½” PVC pipes (7 inches long)
- Sod
- Soil
- Gravel

Step 1: Make two “columns.”



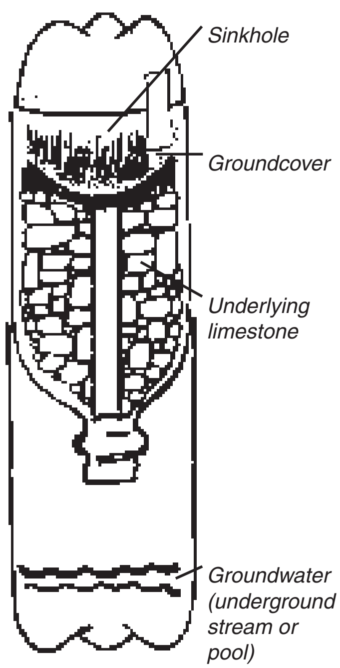
Step 2: Prepare Karst Watershed

Insert 7-inch PVC pipe into the neck of Bottle 1.

Pack stones around the pipe, higher at the edges and lower in the center.

Lay sod on top, as shown. Make a hole in the sod to expose the top of the PVC pipe.

Insert Bottle 1 into Bottle 2 as illustrated.



Step 3: Prepare Non-Karst Watershed

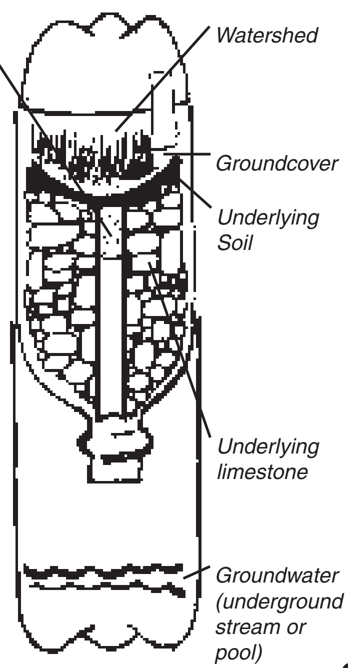
Insert 7-inch PVC pipe into the neck of bottle 1, then plug the top of the pipe with clay or cover with a flat stone.

Pack stones into Bottle 1 as shown, higher at the edges and lower in the center.

Add a layer of soil, slightly packed down, higher at the edges and lower in the center.

Lay sod on top, as shown.

Insert Bottle 1 into Bottle 2 as illustrated.



SODA SINK

CORE CONTENT

AH-M-4.1.41 Create art for specific purposes using the elements of art and principles of design to communicate ideas. [PE] (1.13, 2.22)

PL-M-1.8.4 Using appropriate coping strategies (e.g., realistic goal-setting, effective time management, decision-making processes) promotes mental and emotional health.

PL-M-1.1.1 Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams).

PL-M-2.3.2 Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one's own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.

PL-M-3.3.2 Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.

PL-M-3.1.5 Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).

SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.

SS-M-4.4.4 Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper).

SS-M-4.4.2 The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

SECRET SINK

SUBJECTS: Science, Social Studies, English/Language Arts, Health, Physical Education, Consumerism

GRADES: 6-8

DURATION: One to three 45-60 minute periods

GROUP SIZE: 20-30 students working in small groups

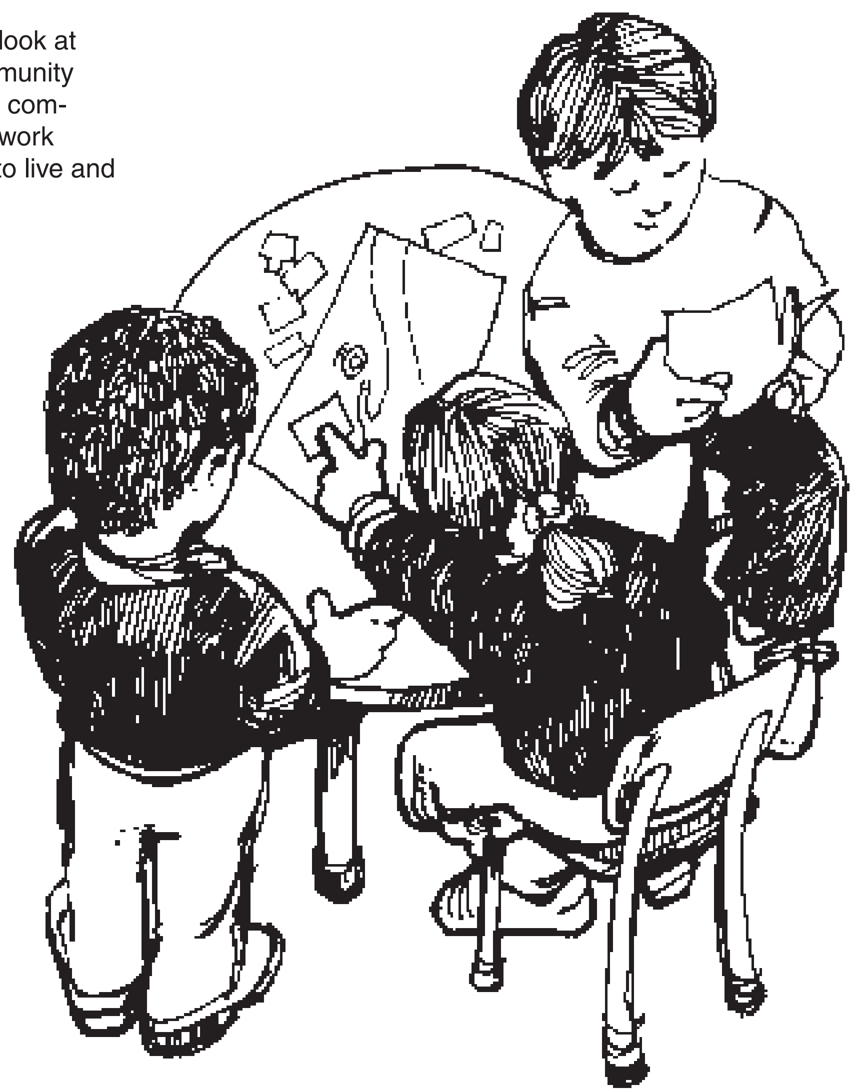
SETTING: Indoors or outside at tables

KEY VOCABULARY: Karst, sinkholes, groundwater, spring, run-off, pollution, community

ANTICIPATORY SET: Today we are going to look at a place called Secret Sink and develop a community around it. What kinds of things do we find in a community? How can all aspects of a community work together to create a healthy, productive place to live and work?

OBJECTIVES: The students will be able to: 1) develop and express rights and responsibilities for themselves and others; 2) investigate alternative perspectives; 3) work together in a decision making and problem solving situation by applying multiple perspectives.

MATERIALS: Scissors; masking tape; glue; surface map that includes a river, spring, and sinkhole (one per group); Secret Sink Community Sheet (one per group).



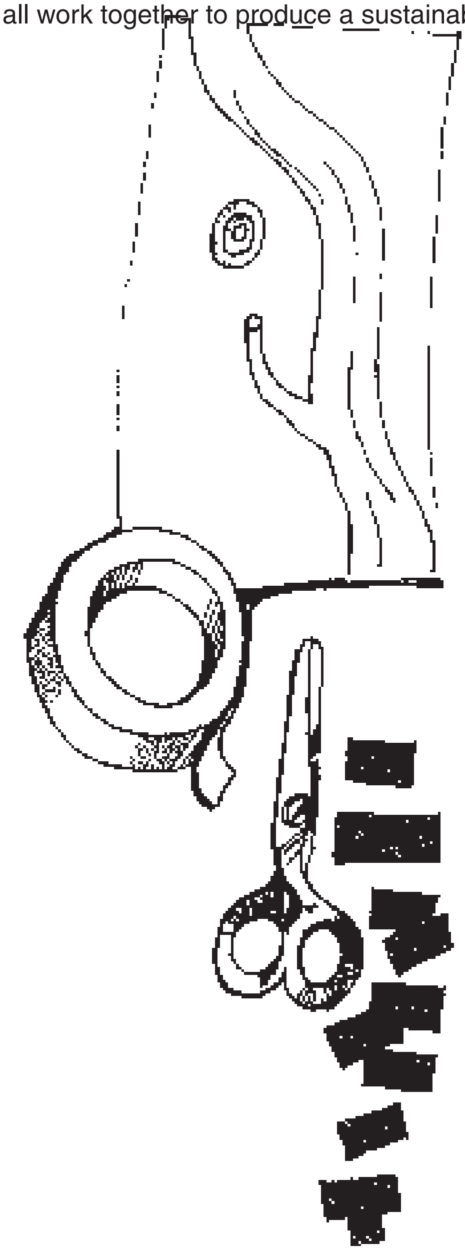
SECRET SINK

BACKGROUND: All land use can dramatically affect an area. This is particularly true in a karst area. A karst area is distinguishable by the lack of surface streams and an abundance of sinkholes and springs. Following the properties of gravity, water consistently travels to the lowest point, the water table. In most areas of the United States the water travels along the surface as a stream or river. But in a karst area the water is more likely to sink underground to form sub-surface streams or rivers. Underground water may travel many miles before exiting as a spring near or along a surface river.

In a karst landscape, water drains underground by flowing into depressions called sinkholes. Sinkholes are areas where underlying rock layers have given way, causing the upper layers of rock to develop cracks and collapse. Karst terrain is very susceptible to groundwater pollution due to the many sinkholes on the surface that quickly drain water into underground rivers.

When discussing land development in a karst region numerous issues should be addressed. All uses for land can dramatically affect an area, but the problems of groundwater pollution and an increasing human population have the most dramatic impacts on a given area. This is particularly true in a karst area where the abundance of sinkholes can funnel not only surface water but also all types of pollution into the groundwater. This run-off, or drainage of water and water carried pollution, can create major community problems. Because of its numerous surface cracks and holes, a rainstorm within a karst terrain can swiftly wash soils, farming chemicals (including fertilizers, insecticides, pesticides, etc.), or animal waste from adjacent farm land into the underground waterways. Oil and gas residues can wash off area roadways or railway lines. Broken sewage or septic lines can carry human wastes into the underlying water table. If a residential well intercepts these underground streams, the polluted waters can be brought into area homes without the necessary filtration or cleansing. This affects the health and well being of the community.

A community's greatest challenge is to develop a relationship with its surroundings so both can thrive. Planning is the key to a successful partnership with the land. By understanding the workings of a karst terrain and the vital role that water plays in this environment people can make informed decisions to insure that pre-existing plant and animal communities are not greatly disturbed. In the Secret Sink Community industry, agriculture, and general services must all work together to produce a sustainable environment.



PROCEDURE:

1. Tell the students that they are responsible for planning a new community in the Secret Sink region. All components of the community must be arranged so that it maximizes the usefulness of this region. The teacher reviews what needs to be developed and the importance of not leaving out any aspects of the community.

2. Divide the class into groups of three to five students. Each group represents a town planning committee. Working together as a team, their job is to plan the "perfect" community -- a community which provides a clean, healthy environment for all its residents as well as the pre-existing plant and animal life.

3. Review the components of the community*:

Residents – live in the area
Farmers – use the land to raise tobacco and livestock
Industry – uses the land for economic growth and trade
Small Businesses – provide local services
National Park – preserves and protects the unique environment
Transportation Department – insures appropriate transportation throughout the community. This can include highways, railroads and/or water transportation
Environmental Groups – protect the sinkholes under any circumstances

*Other groups can be added.

4. Before the students cut out the materials, "brainstorm" the pros and cons of land use in the Secret Sink community. Record the pros and cons on the board. The table below shows a few examples:

5. Pass out the surface maps, scissors, glue, and the Secret Sink Community Sheets. The surface maps will serve as a base for each group's community. Explain that the group will need to use all the building cutouts provided. These cutouts can be made smaller or they can include more land, but all pieces must be used. The students may also develop other land uses. **Do not paste items down at this time.**

6. Have students work in their groups and begin to develop their ideal community. While doing this, keep in mind the priorities of each community group. Remember no land use is to be excluded, all community buildings must be used, plant and animal habitats need to be preserved, and everyone in your group should agree. Once all community members agree to the best layout, the pieces should be pasted or taped in place.

7. After each land use plan has been completed, each group now shares their "ideal" community with the rest of the class. During each presentation, community members should explain why they chose the placement of each component of their community. They should also explain how the placement of individual components helps protect, preserve, and maintain the health and well being of other community components.

8. As each presentation is completed, the teacher should tape or hang each completed community along the board or wall of the classroom. Place communities side by side until each group has completed their presentations. Next, have the class focus on the string of communities found along the river. Point out that each represents a town, city, or farming community found along the Green River. Individual components of any one community may protect other components within its town limits, but how do they affect the next community downstream? Did the individual planning committees think about other communities while working on the layout of their own town? Are there different choices that would have made a difference to neighboring communities?

   NOTE: There is no "perfect" community. Every community will affect the plant and animal habitats around it, but proper planning can help to alleviate many environmental consequences.

9. To show that our Secret Sink community is not isolated, the teacher uses a U.S. map to show that the Green River flows into the Ohio River which flows into the Mississippi River which flows into the Gulf of Mexico. Now, as we look at our community, how are we affecting other communities down river and around the world?

CLOSURE: Secret Sink is a special community. All communities have differences that make them unique. As community planners we need to take these special attributes into consideration. No community is an island. Each has its impact on many environments.

EVALUATION: The teacher is able to evaluate the students by observing how the students interact with each other in their groups. Through the students' presentations and discussions the teacher will be able to evaluate their problem solving skills and how well they adapt to different perspectives.

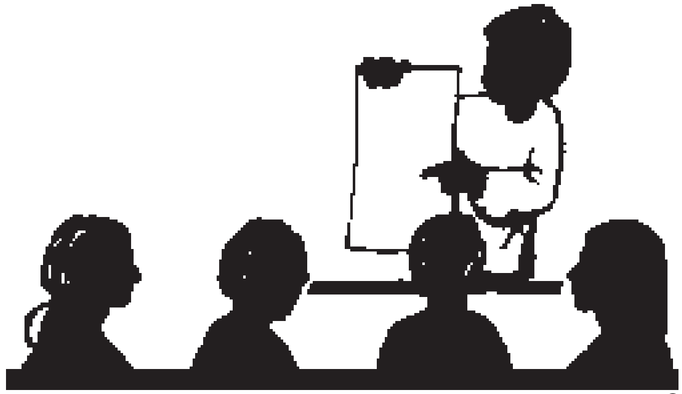
EXTENSIONS:

1. Relate Secret Sink to a sinkhole or other potentially hazardous area in or near your community. How is it being used? What kinds of connections can you make?

2. Find articles in local newspapers relating to sinkholes. What problems, concerns, and/or solutions are being discussed?

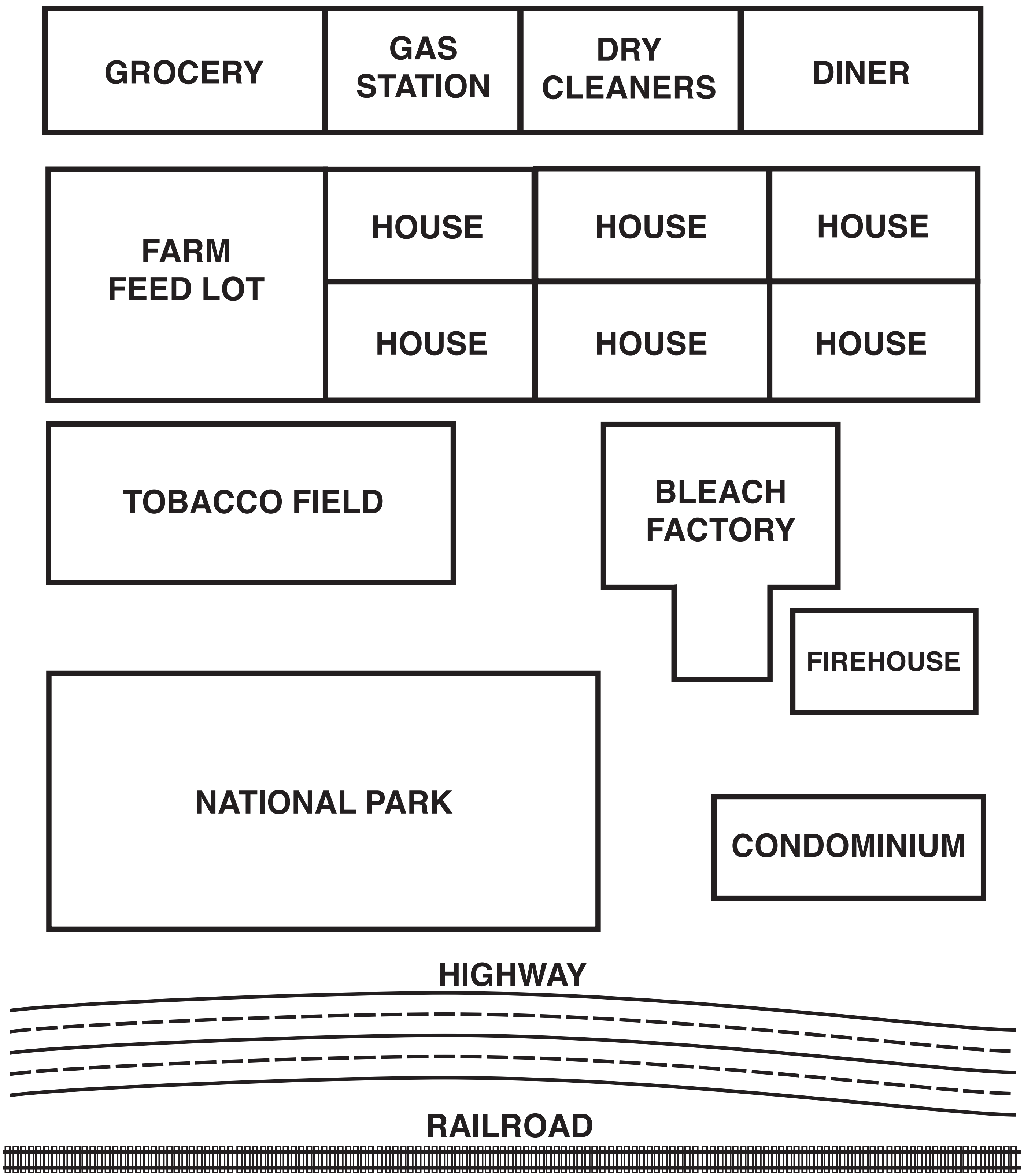
3. Attend a town meeting to see how your community discusses and plans for your area's development.

4. Brainstorm some changes that could be made within your school community. Prepare your ideas and present then to your school's student council.



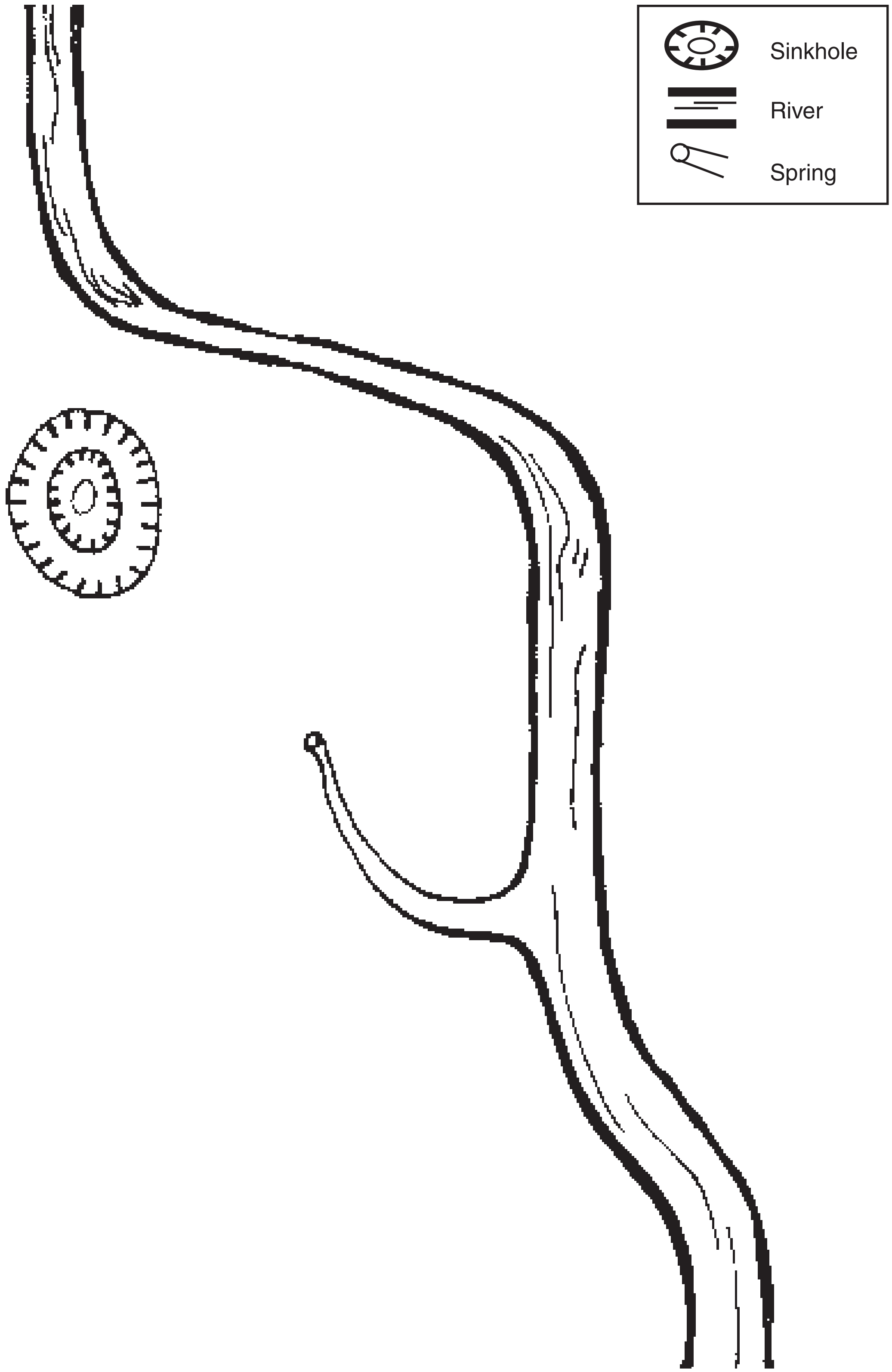
SECRET SINK

COMMUNITY SHEET



SECRET SINK

MAP



CORE CONTENT

PL-M-3.3.2 Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.

PL-M-3.3.1 A range of resources and services are provided by community agencies such as: public health department, fire department, police department, family resource centers, hospitals, and nonprofit organizations (e.g., American Heart Association, American Red Cross, American Cancer Society).

PL-M-3.1.5 Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).

PL-M-2.3.2 Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one's own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.

PL-M-1.8.4 Using appropriate coping strategies (e.g., realistic goal-setting, effective time management, decision-making processes) promotes mental and emotional health.

PL-M-1.8.3 Strategies (e.g., walking away, communication skills, conflict resolution) for preventing violence vary with the situation.

PL-M-1.8.1 The use of appropriate strategies (e.g., assertiveness, refusal skills, decision-making techniques) are positive ways to cope with peer pressure.

PL-M-1.1.1 Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams).

SC-M-3.5.4 The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

SC-M-3.5.2 Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

SC-M-3.5.1 A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.

SECRET SINK

CORE CONTENT

SS-M-4.4.4 Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper).

SS-M-4.4.3 The natural resources of a place or region impact its political, social, and economic development.

SS-M-4.4.2 The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).

SS-M-4.2.2 Places and regions change over time as new technologies, resources, and knowledge become available.

SS-M-4.2.1 Places can be made distinctive by human activities (e.g., building houses, stores, roads, railroads, irrigation) that alter physical features.

SS-M-4.1.2 Different factors (e.g., rivers, dams, developments) affect where human activities are located and how land is used in urban, rural, and suburban areas.

SS-M-2.4.2 Compromise and cooperation are possible choices for positive social interaction and resolution of conflict.

SS-M-2.3.1 Various human needs are met through interaction in and among social institutions and groups (e.g., family, schools, teams, clubs, religious groups, governments).

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
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- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

This activity was adapted from Aquatic Project Wild

MAMMOTH MATH

SUBJECTS: Social Studies, Government, Math

GRADES: 6-8

DURATION: One class period of 40-60 minutes

GROUP SIZE: One or two classrooms (15-60 students)

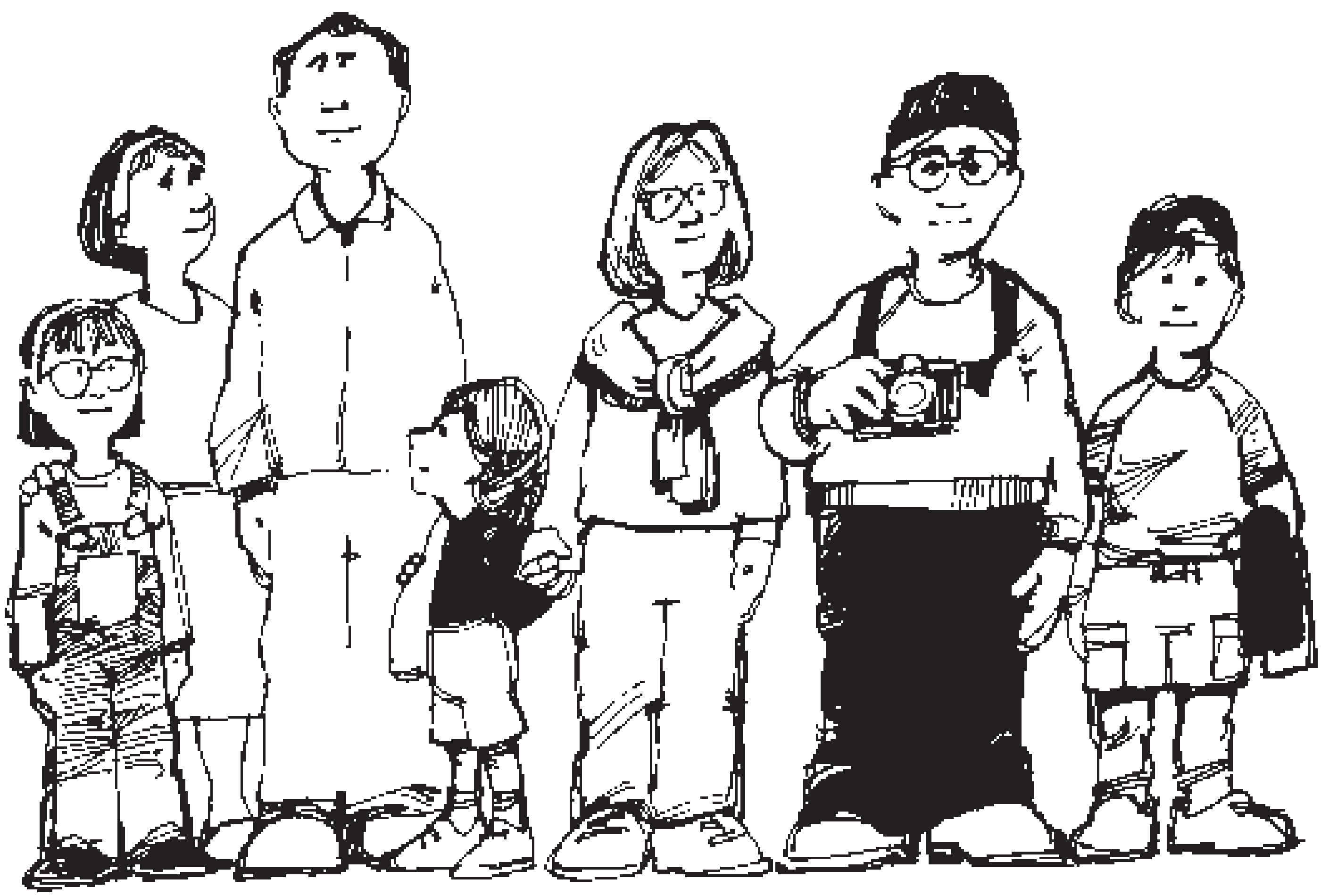
SETTING: Indoors

KEY VOCABULARY: Visitation, line graph, x-axis, y-axis, fiscal year, calendar year, peak season, capacity

ANTICIPATORY SET: Can someone explain the word capacity? How can this word be applied to the number of visitors to an area?

OBJECTIVE: The students will be able to: 1) develop and graph visitation statistics over a fifty-five year period; 2) interpret other line graphs to gather information; 3) read graphs and draw conclusions about visitation trends.

MATERIALS: One copy per student of the Mammoth Math Visitation Graph; Park And Cave Visitation Statistics (for 1941-1997); Mammoth Math Worksheets; pencils; rulers.



BACKGROUND: For years statistics have been kept on the number of people visiting Mammoth Cave National Park. These statistics include the number of visitors to the park and the number of people who tour the cave. The number of park visitors is an estimate based on the number of cars that pass over a traffic counter. That number is then multiplied by what is known as a multiplier, or the average number of people per vehicle. This number has changed over the years. The number of people that go into the cave is based on the total number of cave tour tickets sold.

National events brought about some drastic changes in visitation numbers. In the early 1940's visitation dropped dramatically. This was due to the United States' involvement in World War II. During the war years almost everything was rationed (gas, tires, food items), men were off fighting the war, women were working in defense factories or on the family farm, and there was little time to travel. Even if people had time to travel during the World War II era they could not buy gas or tires, making travel extremely difficult. In the mid-1970's visitors flocked to national parks to experience their heritage and roots during our nation's bicentennial. In the early-1980's visitation dropped off due to a fuel crisis, which included a gas shortage, high gasoline prices, and in many areas the inability to purchase gas on certain days of the week. These national influences had a dramatic effect on the number of people visiting Mammoth Cave National Park.

Capacity is the total number an object or resource can accommodate. For example, a bus only has 24 seats and can only carry a designated number of passengers safely and comfortably. That bus has a total capacity, or number, of passengers it can carry. In a cave the capacity is the total number of people that a cave tour can accommodate. For safety, a quality visitor experience, and resource protection only a pre-determined number of visitors are allowed on a tour. The average limit on tours in Mammoth Cave is one hundred people. On some cave tours, such as the Wild Cave tour and the Introduction to Caving tour, the capacity is much lower. On the graphs provided in this lesson you will notice the visitation exceeds the capacity. This can happen because of the addition of a half-mile Discovery tour. On the Discovery tour visitors walk the cave passage at their own pace and stop and talk to the rangers stationed in various areas versus being guided through the cave. On very busy days and holiday weekends this tour is offered to provide visitors a chance to view a portion of Mammoth Cave when the other guided tours are sold out-- or have reached capacity!

One question on the worksheet asks which time of year the students would like to visit and why. They will need to remember these graphs do not give the full story. While some might choose to come in the winter when there are not as many visitors, there is the trade-off of not having the variety of cave tours that are available in the summer. Some years the park has had the luxury of adding specialty tours to the Fall schedule. These tours have smaller tour limits and go into parts of the cave that are not visited as often. Although graphs give us some information, they can not tell the entire story.

PROCEDURES:

1. The teacher passes out copies of an information sheet entitled Park and Cave Visitation Statistics. The teacher asks the students what the difference between park visitation and cave visitation might be? The teacher then explains that the class is going to look at the cave visitation statistics and plot them to create a line graph.

2. The teacher passes out a blank Mammoth Math Visitation Graph. The teacher explains that the y-axis is on the left side of the graph. It is read from bottom to top. Starting at zero, students are to label this section in thousands, from 0 to 750,000 in increments of 25,000. The first line will be worth 0, the next 25,000, then 50,000 and so forth. Since the margin has the word "thousands" students can leave off the zeros and label the graph 25, 50, 75 and so forth.

3. The teacher explains that the x-axis moves from left to right across the bottom of the graph. The x-axis will be your time line (or years) starting in 1941 and moving across until 1996. It is to be labeled in 5-year increments, 1941, 1946, 1951, etc.

4. Once the graph is labeled the teacher will have the students plot the number of cave visitors for each year. After the years are plotted a line is drawn from dot to dot to connect the years.

5. After plotting the points the teacher asks the class to discuss the possible reasons for the highs and lows. The students will then locate the year with the highest visitation and the year with the lowest. Then the teacher asks the students: What was happening nationally around 1973 that would cause that year to have higher numbers of visitors? What about our lowest years, 1942-45 and 1983? What was happening in the nation at that time?

6. Work Sheet # 1 includes cave visitation for three fiscal years. (Fiscal year is abbreviated as FY). The teacher asks the students what fiscal year means. In this case the calendar for the National Park Service begins in October and ends in September. October through September is the government's financial, or fiscal, year. The students review the graph and then answer the questions. The class discusses the answers. Notice that question number five is a matter of opinion. (Remember, information that is not seen in the graph could alter this answer!)

7. The teacher asks the students the meaning of the word capacity. Can the longest cave system in the world have a capacity? Yes! The capacity is the number of people that can go on the scheduled guided cave tours.

8. Using Work Sheet # 2 the class will now look at monthly cave visitation for two fiscal years (FY'92 and FY'93). The teacher asks the students if they notice anything unusual about these graphs. How can visitation be higher than capacity? The class discusses some possibilities.

9. The students review the graphs and answer the accompanying questions. The class discusses the answers.

CLOSURE: Today we have looked at graphs as a way to compare information, determine trends, and draw conclusions from the information given. Graphs are a way to organize and present information in a visual display. We were able to visualize the visitation at Mammoth Cave National Park for over fifty years.

EVALUATION: The teacher is able to evaluate the students through class participation, their graphs, and the answers found on their worksheets.

EXTENSIONS:

1. Students could interview people in their community who lived during the hardships of World War II and/or the gas crisis of 1983. These community members could be invited to class to talk about what is was like to live during these difficult times.

2. The class could graph the attendance record for several months from their school. They could then review the dates to answer various question such as: Are there certain months when more students are absent? Why?

3. The class could research various ways to graph information, such as pie charts and bar graphs. How do these differ? The data from this activity could be converted to another type of graph to help illustrate the relationship of capacity and visitation or to show monthly and yearly trends.

MAMMOTH MATH

PARK AND CAVE VISITATION STATISTICS

Year	Park Visitation		Cave Visitation
1997	2,089,911		467,239
1996	1,989,082		480,177
1995	1,935,700		517,129
1994	2,101,188	(change in multiplier)	526,247
1993	2,569,300	(1,937,089 by new multiplier)	531,769
1992	2,565,946		563,811
1991	2,331,283		547,035
1990	2,097,626		500,745
1989	1,845,928		495,500
1988	1,908,698		504,413
1987	1,809,428		463,025
1986	1,819,761		443,965
1985	1,681,027		426,086
1984	1,674,538		416,576
1983	1,671,591		402,383
1982	1,699,764		450,747
1981	1,577,405		447,371
1980	1,668,875		434,905
1979	1,557,998		411,538
1978	1,813,776		514,396
1977	1,979,351		575,829
1976	1,922,010		606,273
1975	1,853,770		615,838
1974	1,739,957		596,268
1973	1,927,547		675,167
1972	1,872,870		661,136
1971	1,745,016		625,364
1970	1,726,494		610,964
1969	1,299,695		541,168
1968	1,540,191		527,036
1967	1,282,754		479,130
1966	1,143,794		464,444
1965	872,210		388,015
1964	793,424		348,895
1963	636,094		303,996
1962	569,319		284,025
1961	519,274		258,850
1960	519,144		248,411
1959	490,268		232,491
1958	479,530		209,538
1957	450,181		215,380
1956	466,126		208,283
1955	447,828		194,570
1954	439,752		196,889
1953	499,362		220,634
1952	438,030		217,615
1951	364,216		229,876
1950	254,187		198,827
1949	211,792		171,542
1948	180,621		163,262
1947	192,803		143,720
1946	180,081		133,248
1945	84,335		63,883
1944	50,862		45,687
1943	46,812		45,687
1942	87,155		78,874
1941	165,966		70,382

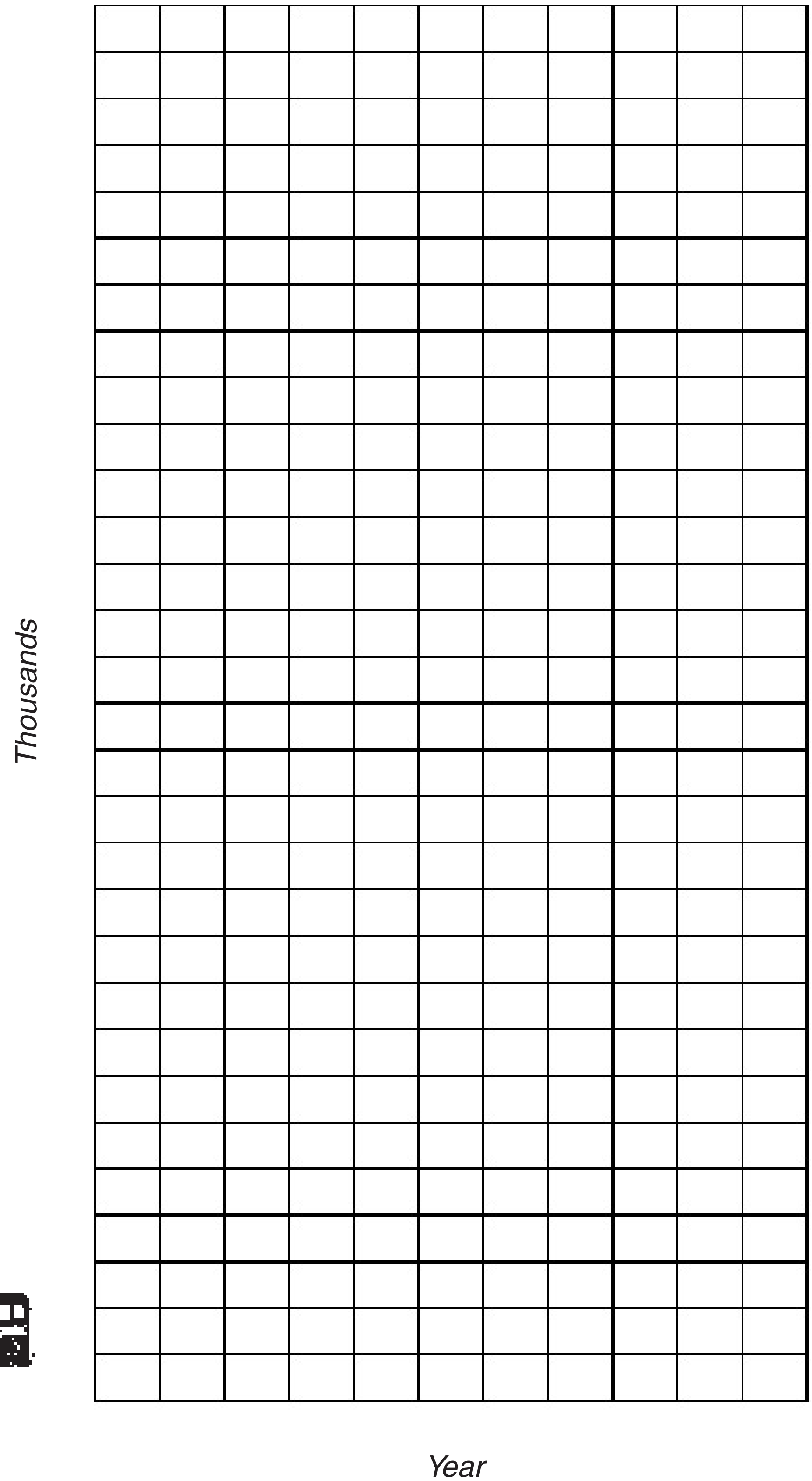
Name:____Date:________________________

MAMMOTH MATH

VISITATION GRAPH

Number the x-axis in 5-year intervals starting with 1941 when Mammoth Cave became a National Park.

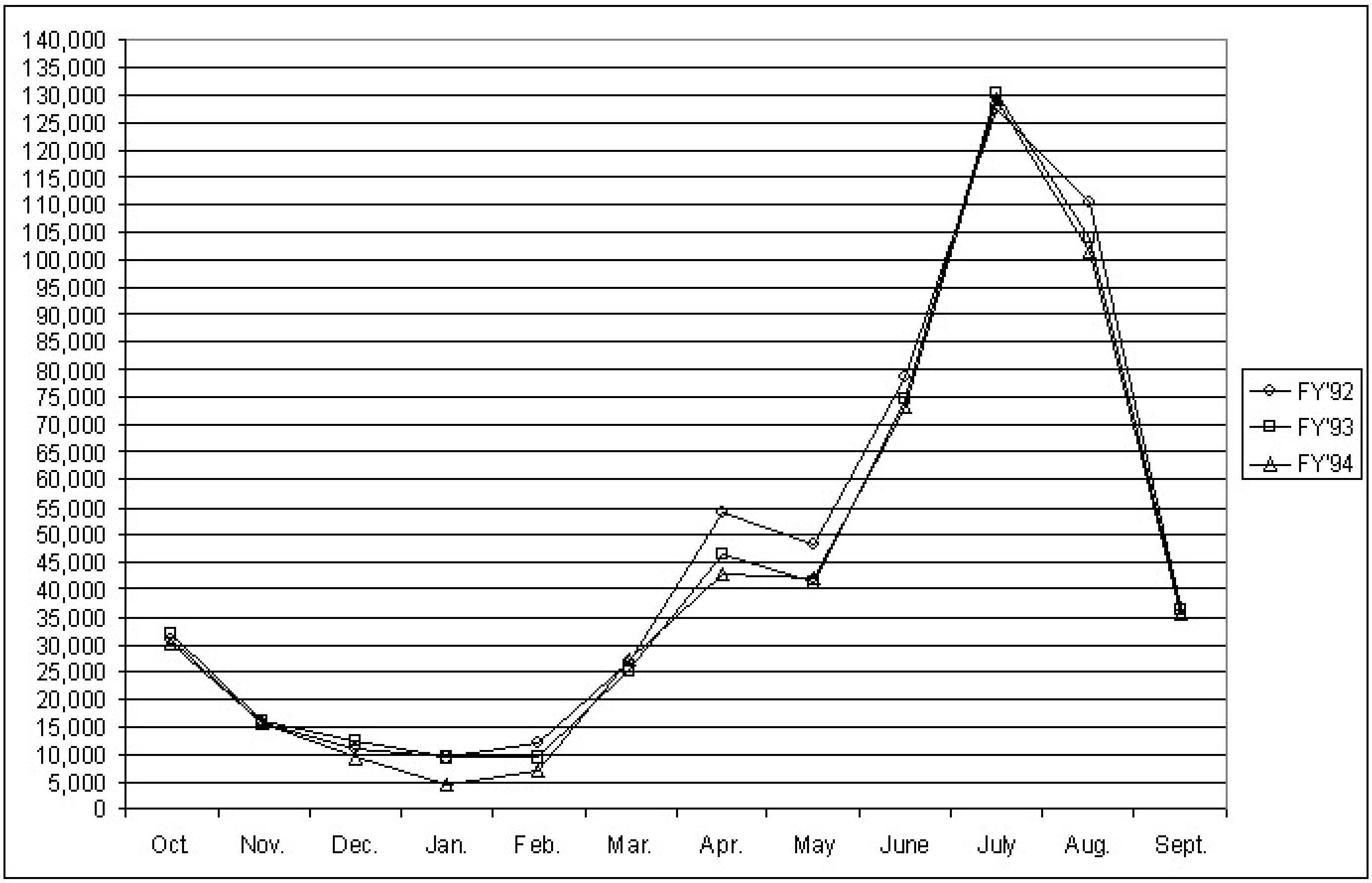
Number the y-axis, starting with 0 in intervals of 25,000 (0; 25,000; 50,000; 75,000; 100,000) etc., up to 750,000



MAMMOTH MATH

WORK SHEET NO. 1

Monthly Cave Visitation: FY '92 vs FY '93 vs FY '94



1. Which year has the highest total visitation? ________ Explain how you came to this determination.

____

2. For all three years, when is the peak season? ___________________________________

3. Looking at all three years, which month has the greatest difference in visitation? __________

4. Which month has the least visitation in FY'94? ___________________________

5. As a visitor, what time of year would you most like to visit and why?

____

MAMMOTH MATH

WORK SHEET NO. 2

Using Monthly Cave Visitation Graphs for FY'92 and FY'93 answer the following questions:

1. In each year visitation is higher than capacity from March to September. In which year is visitation closer to capacity during this period?

____

2. Why do you think visitation is so high in April?

____

____

____

3. What does capacity mean?

____

____

____

4. What can you suggest managers do when visitation is higher than capacity?

____

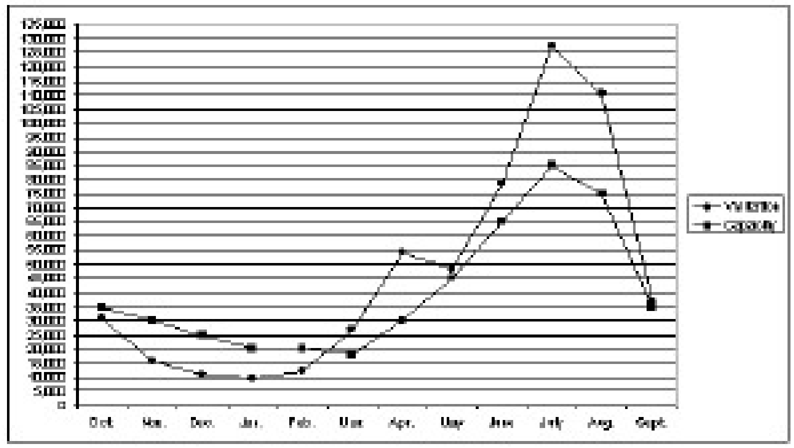
____

____

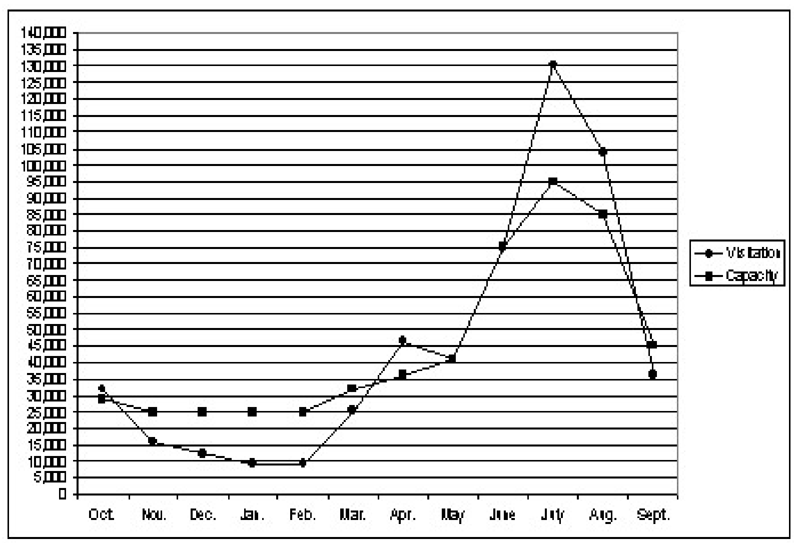
____

____

FY'92



FY'93



MAMMOTH MATH

CORE CONTENT

MA-M-4.3.1 How everyday situations, tables, graphs, patterns, verbal rules, and equations relate to each other.

MA-M-4.2.3 Model equations and inequalities concretely (e.g., algebra tiles or blocks), pictorially (e.g., graphs, tables), and abstractly (e.g., equations).

MA-M-4.1.3 Rectangular (Cartesian) coordinate system/grid and ordered pairs.

MA-M-3.3.4 How probability and statistics are used to make predictions and/or draw conclusions.

MA-M-3.3.3 How data gathering, bias issues, faulty data analysis, and misleading representations affect interpretations and conclusions about data (e.g., changing the scale on a graph, polling only a specific group of people, using limited or extremely small sample size).

MA-M-3.3.1 How different representations of data (e.g., tables, graphs, diagrams, plots) are related.

MA-M-3.2.2 Construct and interpret displays of data (e.g., table, circle graph, line plot, stem-and-leaf plot, box-and-whiskers plot).

MA-M-3.2.1 Organize, represent, analyze, and interpret sets of data.

MA-M-3.1.3 Characteristics and appropriateness of graphs (e.g., bar, line, circle), and plots (e.g., line, stem-and-leaf, box-and-whiskers, scatter).

MA-M-1.2.2 Compute (e.g., estimate, use pencil and paper, use calculator, round, use mental math) large and small quantities and check for reasonable and appropriate computational results.

MA-M-1.2.1 Add, subtract, multiply, and divide rational numbers (fractions, decimals, percents, integers) to solve problems.

PL-M-1.8.4 Using appropriate coping strategies (e.g., realistic goal-setting, effective time management, decision-making processes) promotes mental and emotional health.

PL-M-1.1.1 Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams).

SS-M-4.4.3 The natural resources of a place or region impact its political, social, and economic development.

SS-M-4.4.2 The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

BACK TO THE PAST

SUBJECTS: Social Studies, Math, English/Language Arts, Arts and Humanities, Health, Physical Education

GRADES: 6-8

DURATION: One 3 to 3 1/2 hour time period

GROUP SIZE: One classroom of 25-35 students (or less)

SETTING: Outdoors

KEY VOCABULARY: Community, headstones, footstones, tombstones, epitaph, veteran

ANTICIPATORY SET: Today we are going to explore one of the cemeteries located in Mammoth Cave National Park. What information can we collect from a cemetery? Note: This lesson could also take place in a cemetery located in the community where your school is located.

OBJECTIVES: The students will be able to: 1) work productively in small groups to survey tombstones; 2) analyze the data collected from the tombstones and draw conclusions about the people who once lived in the community.

MATERIALS: Cemetery Survey Activity Sheets, clipboards, pencils/pens.

BACKGROUND: Within the park boundaries, there are over 100 cemeteries scattered across the land. Today these cemeteries hold valuable information about the communities and families who lived on the land that is now Mammoth Cave National Park. When we think of a cemetery we usually picture it near a church or in a specific place in a community. But if there are over 100 cemeteries, obviously they could not all be connected to a church or a community. Many of these graveyards are small family cemeteries ranging from as few as two graves to a hundred or more grave sites.

There are three church buildings that still exist within the park boundaries. The three churches are Joppa Missionary Baptist Church established in 1862, Mammoth Cave Baptist Church established in 1827, and Good Spring United Baptist Church established in 1842. These churches were the center of community life until the 1930's when several thousand acres of land was acquired to form Mammoth Cave National Park. Today, these churches are still used on occasion by local citizens for celebrations including weddings, funerals, family reunions, and Decoration Day*. All three churches are on the National Register of Historic Places and are maintained by the National Park Service and church members. There are still burials in these cemeteries on a regular basis.

** Decoration Day is usually on or near the Sunday of Memorial Day weekend. On this Sunday relatives of the deceased place flowers on graves to decorate the graves of ancestors, family members, or friends.*

PROCEDURE:

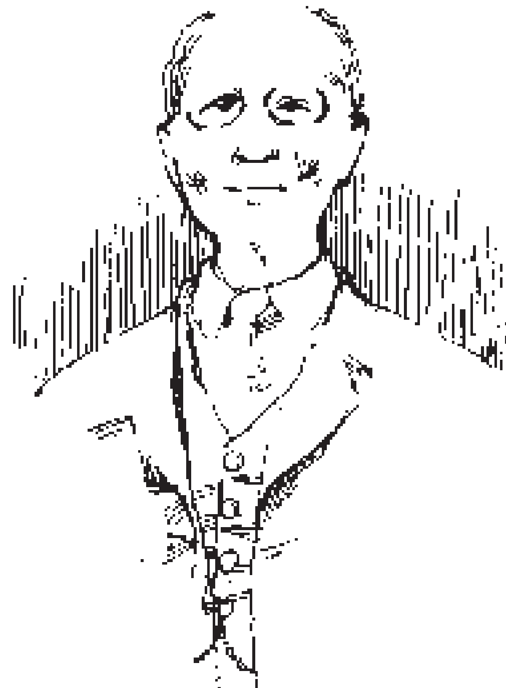
1. The class reviews and discusses proper behavior when entering a cemetery. The teacher reminds the students that they are in a special place. They need to show respect for the people buried and for the families represented in the cemetery.
2. The class travels to one of the cemeteries in the park or to a cemetery located within their school community.
3. The teacher places the students in small groups (2-4 students). Each group is given a Cemetery Survey Activity Sheet.
4. The groups are given five to ten minutes to locate a gravesite that catches their interest.
5. After completing the Cemetery Survey Activity Sheet, the groups gather and discuss their answers.

CLOSURE: We have visited a cemetery and collected information about people who once made up a community. This lesson has given us clues to the past. We also have a greater understanding of the hardships that some of our ancestors had to endure to survive the harsh conditions of early settlements in this part of Kentucky.

EVALUATION: The teacher is able to evaluate the students during the activity, class discussions, and by reading their activity sheets.

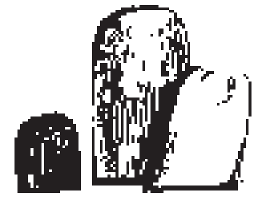
EXTENSIONS:

1. Have students write a story about the life of the person buried at the site they visited.
2. Invite someone from your local historical society to visit your classroom and talk to the students about the early settlement of your community.
3. Have students investigate their own family tree or visit where their ancestors are buried.



BACK TO THE PAST

CEMETERY SURVEY ACTIVITY



Name of Cemetery:

Headstone Information

First Name: ______________ Middle Name: _____________ Last Name: ______________________________________

Date Born: _____________________

Date of Death: __________________

Epitaph(s) or Inscription(s) on Headstone:

If more than one inscription please number each one.

Is there a symbol or etching on the headstone?
Describe and/or draw the symbol or etching here:

BACK TO THE PAST

CEMETERY SURVEY ACTIVITY (PAGE 2)

Age at death: ____________

Is this person still alive? Yes❑ No❑

Were they a veteran? Yes❑ No❑
Can you tell from the tombstone if they were in the military during a war? Yes❑ No❑
If so, which war?

Is their military rank evident and if so what was it?

Was this person married? Yes❑ No❑
Does the inscription indicate how long the person was married and/or when they were married?

Did they or their spouse die first?

Did they have children? Yes❑ No❑ If so, can you distinguish how many?

Did they or their child (children) die first?

Can you tell from the inscription or etching anything about their occupation or hobbies?

Are there other interesting facts? If so, please describe below.

Do their families still visit the grave site? Yes❑ No❑ How can you tell?

____

From the information on this headstone, what do you know about this person's life? Tell how you came to the conclusion you did about this person.

BACK TO THE PAST

CORE CONTENT

MA-M-1.3.3 How operations (addition and subtraction; multiplication and division; squaring and taking the square root of a number) are inversely related.

MA-M-1.2.2 Compute (e.g., estimate, use pencil and paper, use calculator, round, use mental math) large and small quantities and check for reasonable and appropriate computational results.

MA-M-1.2.1 Add, subtract, multiply, and divide rational numbers (fractions, decimals, percents, integers) to solve problems.

PL-M-2.3.2 Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one's own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.

SS-M-4.4.3 The natural resources of a place or region impact its political, social, and economic development.

SS-M-4.3.2 Human populations may change and/or migrate because of factors such as war, famine, disease, economic opportunity, and technology.

SS-M-4.3.1 Human settlement develops in different ways based on the culture and needs of settlers.

SS-M-4.2.2 Places and regions change over time as new technologies, resources, and knowledge become available.

SS-M-4.2.1 Places can be made distinctive by human activities (e.g., building houses, stores, roads, railroads, irrigation) that alter physical features.

SS-M-4.1.2 Different factors (e.g., rivers, dams, developments) affect where human activities are located and how land is used in urban, rural, and suburban areas.

SS-M-2.3.1 Various human needs are met through interaction in and among social institutions and groups (e.g., family, schools, teams, clubs, religious groups, governments).

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- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

IT'S ALL GREEK (AND LATIN) TO ME!

SUBJECTS: English/Language Arts, Science, Health, Foreign Languages

GRADES: 6-8

DURATION: One class period

GROUP SIZE: One classroom of 25-30 students

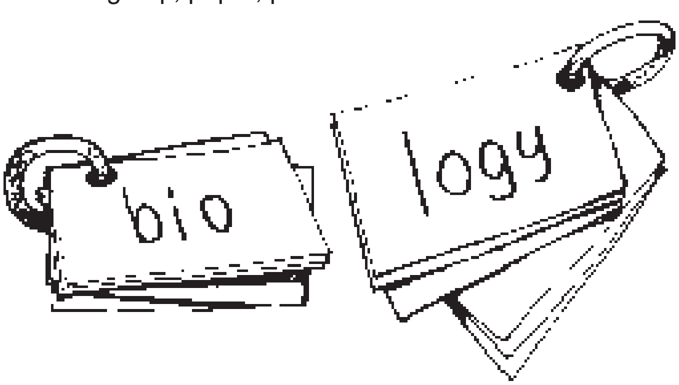
SETTING: Indoors

KEY VOCABULARY: Greek, Latin, prefix, suffix, root word, etymology

ANTICIPATORY SET: When learning new words are you ever curious about what they mean and where they originated? Today we will learn how to decode the meaning of words without looking in a dictionary.

OBJECTIVES: Students will be able to use Latin root words, suffixes and prefixes in order to: 1) match word parts with their meanings; 2) combine word parts to create scientific terms; 3) create new words by using learned root words, suffixes, and prefixes; and 4) use scientific and newly invented words in creative writing situations.

MATERIALS: One set of Memory Cards for each group of 2-4 students, one Key to Roots, Prefixes and Suffixes for each group, paper, pencil.



BACKGROUND: Many Mammoth Cave organisms are described using scientific terms. These terms are usually derived from Greek or Latin root words, prefixes, or suffixes. Latin and Greek words are used predominantly in science and medicine because the words and their meanings do not change. If you are familiar with the meanings of these root words, you can easily decode new and old scientific terms.

At different times, Greece and Rome were world powers with the Romans eventually conquering the Greeks. Roman rule spread, extending far outside Italy -- into Asia to the East and westward to the British Isles. Conquered peoples had to become familiar with the language of their rulers. As a result, Greek and Latin were at different times considered universal languages.

As languages are used, they constantly change and evolve. The Romans "borrowed" many Greek words. Roman words were absorbed into other local languages. Like Greece, Rome eventually lost its position as a world power and the Roman language, Latin, was no longer spoken. This meant that Latin, as a language, stopped evolving or changing. Today, many English words are derived, or borrowed, from original Greek and Latin vocabularies.

In the mid-1800's scientists began using a two-word descriptor to name new species of plants and animals. By this time, Latin was no longer in daily usage. Because the meanings of its words were no longer changing, scientists decided to use early Greek and Latin prefixes, root words, and suffixes to provide these new descriptive (scientific) names. Today, scientists can understand a great deal about a species by simply translating its name! By agreeing to use this system of a common scientific language, scientists from around the world can now share their knowledge and discoveries without the need to translate from or into many individual languages.

PROCEDURE:

1. The teacher explains the difference between a root word, a prefix and a suffix. The teacher further explains that these word parts can be combined to form scientific words that are regularly used at Mammoth Cave National Park and by scientists in other locations around the world. For example, "herba" is a root word meaning "grass" (or plants). A prefix or suffix can be added to "herba" in order to change the meaning. For example the suffix "cida" means "killer". Combining herba and cida gives you the new word "herbicide", or plant killer. The suffix "vorus" means "eating". Combining herba and vorus gives you the new word "herbivore", or plant eater. You can see this root (herba) used in other words such as herbs, herbarium, or herbaceous. Point out that while the connecting vowel is often changed to make the word easier to pronounce, it is still fairly easy to see the various root words being used!

2. Divide the class into small groups of 2-4 students each. Give each group a set of Memory Cards and one copy of Key to Roots, Prefixes, and Suffixes.

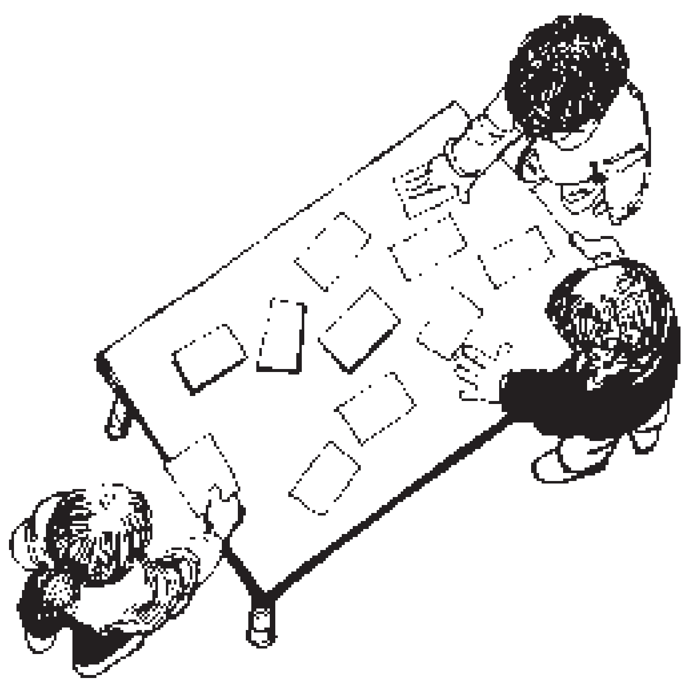
3. The teacher tells the students that they will be using Greek and Latin words to play a basic "Memory" game in which they memorize the location of matching cards.

4. The teacher instructs each group to shuffle their cards and lay them face down on a flat surface (table or floor). Students take turns turning the cards over to match a word with its correct definition. If the definition is not found, they turn the cards back facedown. The next student uses his/her memory to locate the correct cards. Students pick up and keep any matching cards they find. Play continues until there are no cards left on the table. The winner is the student with the most matching cards. Students may use the Key to Roots, Prefixes, and Suffixes to check their choices.

5. The teacher tells the students they will now be using the Greek and Latin words from their memory game to form scientific terms that could be used by scientists at Mammoth Cave National Park. Each group should record all the words they were able to make by combining their Latin/Greek prefixes, root words and suffixes in various ways, grouping all real terms together and all newly created terms together. Students should provide the meaning of each word created.

CLOSURE: Etymology is the study of the history and origin of words. Today you have learned to break apart a word in order to understand its meaning. You learned to use prefixes, root words, and suffixes to create new words that describe new ideas, species, objects or discoveries.

EVALUATION: The teacher is able to evaluate the students through their group participation and their list of scientific words and definitions.



EXTENSIONS:

1. Have students collect scientific terms and names found in their school literature -- from their science books, literature books, or library readings. Each student could keep a journal or notebook of new terms they find.

2. Using the Key to Roots, Prefixes, and Suffixes, instruct students to create a list of as many descriptive words as they can by combining prefixes, suffixes and root words found in the list. Have each student write a story about a cave creature using as many of the real terms and new terms as possible from their list. "Real" terms (such as subterranean or microscopic) should be underlined. "New" terms (such as transterranean or terreaneanphile) should be circled.

3. Can students identify the various Greek/Latin stems found within words? Have students use a dictionary to look up the identifying root, prefix, or suffix within the following list of words. The first two have been done for you. Add new words to this list.

   Can you find the origins of: school, bisect, insect, botanical, zoologist, cave, mammal, geology, gypsum, river, student, or science? (choose any 8)

4. Give each student a copy of the Key to Roots, Prefixes, and Suffixes. The teacher writes one of the word segments on the board. Students are given three minutes to form as many words as possible using the indicated word segment. For example, if the teacher writes the prefix "un-", students attach root words and suffixes to "un-" to form new words. If the teacher writes the root word "locate", students can use prefixes and suffixes to form words such as "echolocation" and "relocated". Students may use the word segments found in the Key to Roots, Prefixes, and Suffixes or they may use others. When time is up, students take turns reading their list of words. As a word is read, any students with the same word should cross out or place a checkmark next to that word to show it is a duplicate. Students score one point for each unique word left on their list. In case of doubt, the unique words 1) must be found in the dictionary or 2) if the teacher is willing to accept creativity, the author must be able to offer a logical definition. The winner gets to choose and write the next word segment on the board. How many unique words were created by class members?

5. Have students print root words, prefixes, and suffixes on 3"x5" index cards, one word or word segment per card. Put the root words on one pile and punch a hole through the top of the cards. Secure the cards with a book ring. Follow the same procedure for the prefixes and for the suffixes. Lay the card piles in order (prefix-root word-suffix). Students work individually to form as many words as they can by flipping prefixes, root words and/or suffixes. The student records the words they have formed. After each student has had time to record their lists, they exchange lists and check the words in a dictionary to be certain the words are correct.

IT'S ALL GREEK (AND LATIN) TO ME!

KEY TO GREEK AND LATIN – ROOTS, PREFIXES AND SUFFIXES

BASE WORD	WORD ORIGIN	ORIGINAL MEANING OF THE BASE WORD
-al	from Latin *-alis*	of, relating to, characterized by, process
anthrop-	from Latin *anthropo-*	human being
aqua	from Latin *aqua*	water
arte	from Latin *arte*	by skill (human)
arthr- (or arthro-)	from Greek *arthron*	joint
aut- (or auto-)	from Greek *autos*	same, -self, self
bi-	from Latin *bi-*	two
bi- (or bio-)	from Greek *bios*	mode of life, life
carn-	from Latin *carn-*	flesh
centi-	from Latin *centi-* (or *centum*)	hundred, hundredth part
-cidal	from Latin *-cidalis* (or *-cida*)	killing, having the power to kill
-cide	from Latin *-cida* (or *caedere*)	to cut, to kill
de-	from Latin *de-* (or *dis-*)	to remove, away, from
deca- (dec-, deka- or dek)	from Latin *deka-*	ten
-dyte	from Greek *-dutai* (or *dyein*)	enter, to enter
echo-	from Greek *eche-* (or *echo-*)	sound
-er	from Latin *-arius*	added to verbs to form a noun (ie, baker from bake)
-fact	from Latin *factum* (or *factus*)	to do (made)
fauna	from Latin *Fauna*, sister of *Faunus*, the Roman god of animals	animal life
flora	from Latin *flor-* (or *flos*) meaning flowers; and *Flora*, the Roman goddess of flowers	plant life
herb	from Latin *herba*	grass
hyper-	from Latin and Greek *hyper-*	over, to exceed, surpass, more than normal
hypo- (or hyp-)	from Latin and Greek *hypo-*	under, beneath, below or less than normal
icthy- (or ichtyo-)	from Latin *ichthys*	fish
is- (or iso-)	from Latin and Greek *isos*	equal, uniform
-ist	from Latin *-ista* (or *-istes*)	someone who performs, makes, or specializes in
locate	from Latin *locatus* (or *locare*)	to find or fix the place
-logy	from Latin *-logia* (or *-logy*)	collecting, to gather, the study of
lucent	from Latin *lucere*	to shine through
micr- (or micro-)	from Latin and Greek *mikr-* (or *mikro-*)	small, short, minute
milli-	from Latin *milli-*	thousand, one thousandth
meter	from Latin *metrum*	measure, meter
-nomous (or -nomy)	from Greek *nomos*	law (govern, rule)
-onta (or -onto-)	from Greek *onta*	existing things
paleo- (or pale-, palae-, palaeo-)	from Greek *palai-* (*palaio-*)	ancient, long ago

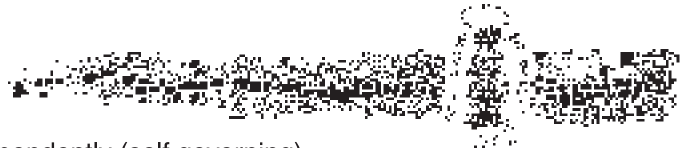
IT'S ALL GREEK (AND LATIN) TO ME!

KEY TO GREEK AND LATIN – ROOTS, PREFIXES AND SUFFIXES

BASE WORD	WORD ORIGIN	ORIGINAL MEANING OF THE BASE WORD
pest	from Latin *pestis*	a plant or animal detrimental to man, to pester or annoy
phil- (or philo-)	from Greek *philos*	dear, friendly, loving
-phil (or -phile)	From Greek *-philos*	lover, loving
photo-	from Greek *phot-* (or *phos*)	light
-pod	from Greek *pod-* (or *podos*)	foot
prot- (or proto-)	from Latin *proto-* and Greek *prot-* (proto- or *pro*)	before, for, ahead, forward
-scope	from Latin *-scopium* and Greek *-skopion* (or *-scopos*)	to watch, look at, spy
-sect	from Latin *sectus*	to cut, to divide
spele-	from Latin *speleum* (or *spelunca*) and Greek *spelynx* (or *spelaion*)	cave
stalactite	from Latin *stalactites* and from Greek *stalaktos* (or *stalassein*)	dripping, to let drip
stalagmite	from Latin *stalagmites* and from Greek *stalagma* (or *stalagmos*)	drop, dripping
sub-	from Latin *sub*	under, close to
sui-	from Latin *sui* (or *suus*)	of oneself; one's own
syn- (or sym-)	from Latin or Greek *syn*	with, together with
synthesis	from Greek *syntithenai*	to put together
terra	from Latin *terra* (*terrestris* or *terrenum*)	land, earth, ground
-them	from Greek *therma*	deposit
therm- (or thermo-)	from Greek *therme* (or *thermos*)	heat, hot
-theses	from Greek *tithenai*	to put, to place
trans-	from Latin *trans-* (or *tra-*)	Across, beyond, through, so as to change, cross over
troglo-	from Greek *trogle*	hole, cave
-vore (or -vour)	from Latin *vorac-* (*-vorus*, *-vorous*, or *vorare*)	to devour, to eat
xen (xene or xeno)	from Greek *xenos*	stranger, guest, host, foreigner
-zoa	from Latin *-zoa* or Greek *zoia*	animals

IT'S ALL GREEK (AND LATIN) TO ME!

COMMON TERMS IN MAMMOTH CAVE LITERATURE



Anthropologist	one who studies human beings
Arthropod	jointed foot
Artifact	made by human skill
Aquatic	water living
Autonomy	existing, or capable of existing, independently (self governing)
Bisect	divide into two (usually) equal parts; intersect
Carnivore	a flesh-eating animal
Centimeter	one hundredth of a meter
Centipede	a many-segmented arthropod. Each body segment contains one set of legs.
Decapod	ten footed
Echolocation	a process of locating distant or invisible objects by means of sound waves reflected back to the emitter by the object(s)
Florist	one who sells, or grows for sale, flowers and ornamental plants
Herbicide	an agent used to destroy or inhibit plant growth (Note: Herbicides cannot be used in a national park)
Herbivore	eating on plants
Ichthyologist	someone who studies fish
Isopod	small sessile-eyed crustacean with a body composed of seven free thoracic segments. Each segment contains a pair of similar legs.
Microfauna	small, minute animals invisible to the naked eye
Microscopic	invisible or indistinguishable without the aid of a microscope
Millimeter	one thousandth of a meter
Millipede	one thousand feet
Paleontologist	someone who studies fossils to learn about past geological periods
Pesticide	an agent used to destroy pests (Note: Pesticides cannot be used in a national park)
Photosynthesis	formation of carbohydrates in the chlorophyll-containing tissues (usually leaves) of plants
Protozoans	minute protoplasmic acellular or unicellular animals which have varied morphology and physiology, and often complex life cycles, which are represented in almost every kind of habitat. Some are serious parasites of man and domestic animals.
Speleology	the scientific study or exploration of caves
Speleothem	a cave formation
Spelunker	someone who makes a hobby of exploring or studying caves
Stalactite	a deposit of calcium carbonate resembling an icicle hanging from the roof or sides of caves
Stalagmite	a deposit of calcium carbonate, which looks like an inverted stalactite, formed on the floor of a cave by the drip of calcareous water
Subterranean	being, lying, or operating under the surface of the earth
Suicide	the act of taking ones own life voluntarily and intentionally
Terrestrial	of or relating to the earth; living on or growing from land
Thermal	of, relating to, or caused by heat
Translucent	clear; transparent; permitting the passage of light
Troglobite	"cave dwellers." Animals that spend their entire life in a cave and can live nowhere else. (Example: a blind cavefish or an eyeless crayfish)
Troglodyte	a member of a primitive people dwelling in caves
Troglophile	"cave lovers." Animals that can complete their entire life cycle in caves or in places outside of the cave if the habitat is dark and damp like a cave (Example: cave salamanders, a cave springfish, or sculpins)
Trogloxene	"cave visitors." Animals that live only a part of their life in a cave. These creatures must periodically return to the surface for part of their living requirements - usually for food. (Example: bats or cave crickets)

MEMORY CARDS

BI	TWO (LATIN)
CENTI	HUNDRED, HUNDREDTH (LATIN)
FAUNA	ANIMAL LIFE (LATIN)
FLORA	PLANT LIFE (LATIN)

HERB	GRASS, PLANT (LATIN)
-IST	SOMEONE WHO PERFORMS, MAKES, OR SPECIALIZES IN (LATIN)
MILLI	THOUSAND, THOUSANDTH (LATIN)
-LOGY	COLLECTING, TO GATHER, THE STUDY OF (LATIN)

MEMORY CARDS

SUB	UNDER, CLOSE TO (LATIN)
TERRA	LAND (LATIN)
THERM	HEAT, HOT (GREEK)
TROGLO	HOLE, CAVE (GREEK)

IT'S ALL GREEK (AND LATIN) TO ME!

CORE CONTENT

PL-M-1.1.3	Communication, cooperation, rules, and respect are important to the effective functioning of groups.
PL-M-1.1.1	Individuals have personal rights and responsibilities (e.g., cooperation, communication, patience) when dealing with others (e.g., families, classmates, teams).
RD-H-4.0.12	Interpret the meaning of specialized vocabulary.
RD-M-x.0.4	Know the meanings of common prefixes and suffixes to comprehend unfamiliar words.
RD-M-x.0.3	Identify words that have multiple meanings and select the appropriate meaning for the context.
RD-M-4.0.14	Interpret the meaning of specialized vocabulary.

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

THAT'S MY TREE!

SUBJECTS: Science, Math, English/Language Arts, Health, Consumerism

GRADES: 6-8

DURATION: Two one-hour class periods

GROUP SIZE: One classroom of 20-25 students (or less)

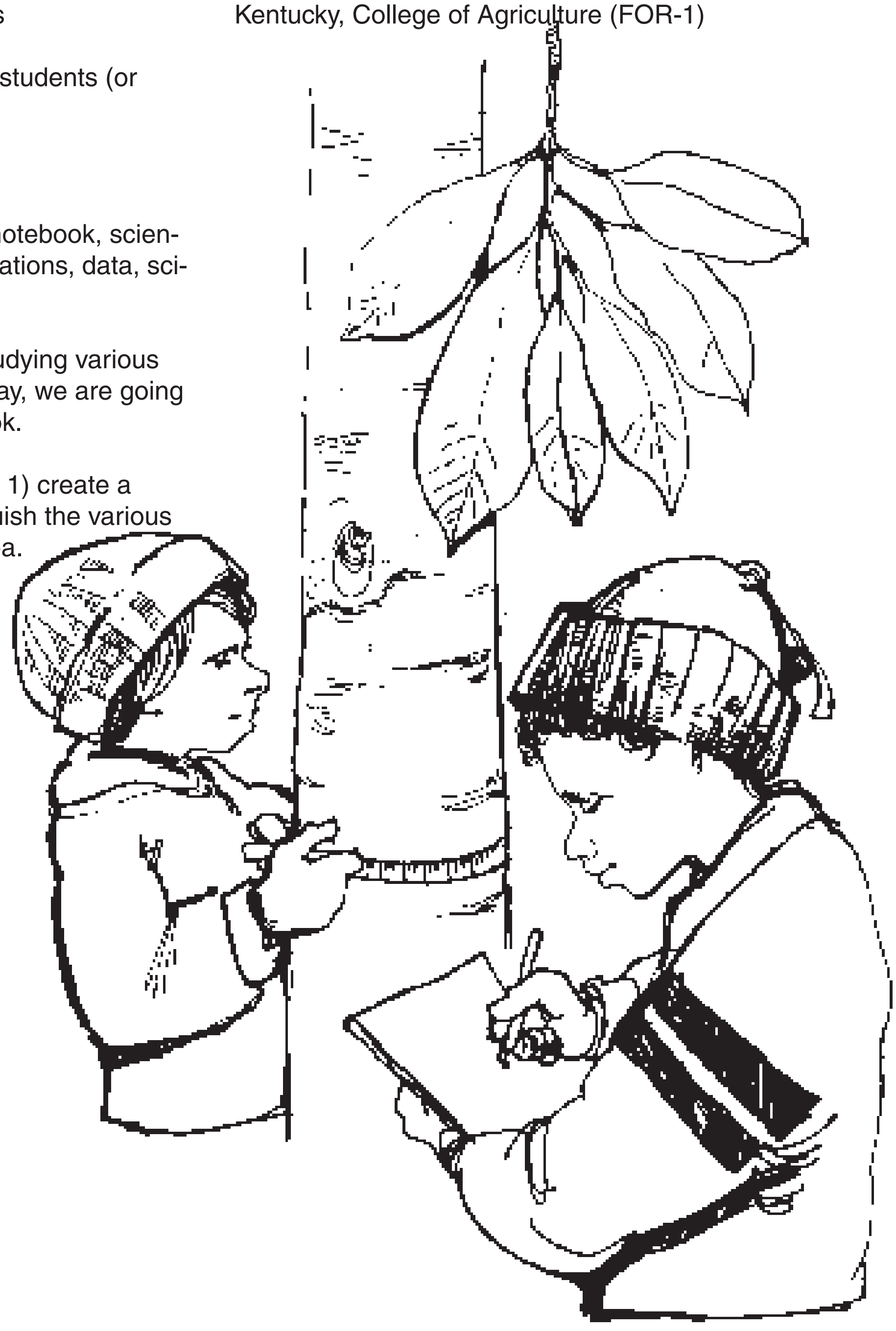
SETTING: Outdoors and indoors

KEY VOCABULARY: Field guide, field notebook, scientific notebook, scientific research, observations, data, science conference

ANTICIPATORY SET: We have been studying various aspects of Mammoth Cave recently. Today, we are going to be scientists and make a field notebook.

OBJECTIVES: Students will be able to: 1) create a field notebook; 2) recognize and distinguish the various characteristics of trees within a study area.

MATERIALS: Each student should have a field notebook and a pen. Each group should have a tape measure, and a tree field guide such as *Kentucky Forest Trees: How to Know Them,* produced by University of Kentucky, College of Agriculture (FOR-1)



THAT'S MY TREE!

BACKGROUND: A field notebook (also called a scientific notebook) is an essential component of every scientist's research life. Scientists use their notebooks every time they conduct research and each time they make observations in the laboratory or in the field.

Certain rules govern entries in a field notebook. A pen should always be used when writing in a field notebook, as pencil markings may become rubbed out or fade over time. Notes and observations are never erased or scratched out. If the written material is thought to be wrong, one line should be drawn through the word(s). (Ex: ~~Field Notebook~~). This allows the scientist to go back at a later date to take a second look at his or her thoughts and findings. What was thought to be wrong at one time – and therefore crossed out – may actually be correct. If only one line was drawn through the words it will still be legible for future references.

The students will use a field notebook to record information about trees. Oak and hickory trees primarily dominate the forests in and around Mammoth Cave National Park. Numerous other species can easily be found, including poplar, papaw, maple, sycamore, dogwood, and redbud trees. Variety is good in a forest. It helps to ensure that vegetation (and therefore habitat and food sources) will always be available. If only one species of tree is present, disease, blight, or fungus can wipe out acres of vegetation in a very short time. This could seriously affect a local ecosystem.

We don't have to look far for examples of widespread tree disease. The chestnut blight (*Endothia parasitica*) wiped out most of our American chestnut trees in the early 1900's. First noticed in the 1980's, a fungus disease called dogwood anthracnose attacked and killed flowering dogwood trees from New England south into the Appalachian Mountains. Butternut canker is an annual fungus introduced into the United States about 30 years ago. It inhibits the tree's reproduction and has affected butternut trees throughout the state of Kentucky. The balsam woolly adelgid was introduced from Europe and has impacted Fraser fir trees in the Great Smoky Mountains National Park and has spread into Eastern Kentucky. Dutch elm disease is another European import that has spread to American, slippery, and winged elms by the elm bark beetle as it feeds in the tree canopy. To protect itself, a healthy forest will have a variety of species.

Students will look at the forest variety found within Mammoth Cave National Park, or other selected study area, by recording observations in their field notebook. Students will be looking at and listing several different characteristics of trees observed. There are several ways to identify a tree. A tree can be categorized by its bark, twigs, leaves, the colors displayed during various seasons, its flowers, and its fruit. The leaves provide excellent clues as each tree has leaves of a distinctive size, venation, shape, and seasonal coloration. The fruit of a tree is a good indicator as each tree has its own unique fruit. Flowers are another factor in the identification of trees. Of course, flowers and fruits can only be used during the tree's flowering/fruiting seasons.

PROCEDURE:

1. The teacher gives, or has each student make, a field notebook. Notebooks should have several sheets of paper stapled or bound together. Cardboard covers can provide a firm writing surface. Each student should have a pen.

2. The teacher divides the class into groups of three or four students each. Give each group a tape measure and one copy of *Kentucky Forest Trees: How to Know Them (FOR-1), or any other tree field guide.

3. The students will go into a wooded area and choose one tree to observe and identify in their notebooks. The teacher should instruct students to stay within pre-selected boundaries. Indicate boundaries that allow the instructor to see and assist each group.

4. The students are to work as a group to collect their information and observations, but each student needs to record data individually. Instruct students to complete the following activities at their tree:

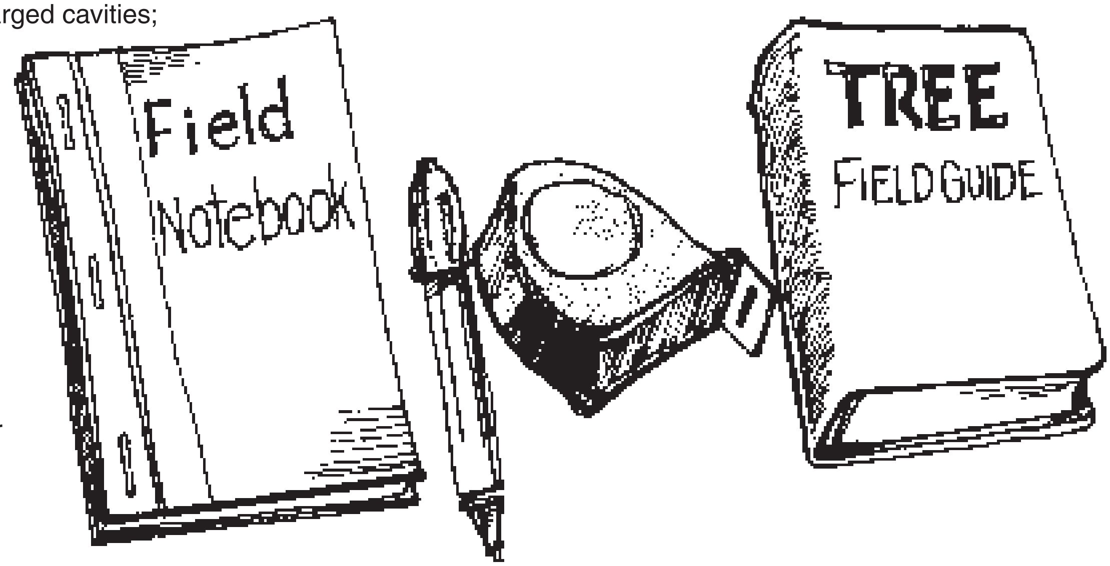
   • Make a bark rubbing
   • Draw the leaf
   • Draw the fruit (if present)
   • Draw the flower (if present)
   • Measure and record circumference of tree
   • Record evidence of and number of birds found in the tree
   • List animals seen or clues of animal activity discovered around the tree. (Clues may include nut remnants; footprints; guano piles; rubbed, drilled or eaten bark; enlarged cavities; oak galls; holes or leaf-miner designs on leaves; descriptions of old or new bird/squirrel nests; size and color of egg shells, etc.)
   • Write the scientific and common name of the tree obtained from their field guide book

5. After every student has completed their research and recorded their data into their field notebook, the teacher instructs each group to move to a new and different tree. Continue as before until the group has researched and recorded three different trees (or as many trees as time permits).

6. If sufficient field guides are not available in the forest, provide time in the classroom or library for students to use a field guide to identify their trees.

7. After identifying their trees, the teacher should explain that information has no value to the scientific community if it is kept secret. For this reason, scientists hold conferences to share their knowledge. The teacher tells the class they will now participate in a science conference.

8. Have each group present and discuss their findings to the class. The teacher explains that scientist like to really understand not only what was discovered but also how it was discovered. They like to ask questions. At their conferences, scientist will question each other about methodology, data collection techniques, and recording methods, as well as findings. Encourage questions during and after each presentation.



CLOSURE: Today we had a glimpse of what it is like to be a scientist. We used field guides and our senses to make accurate observations of selected trees. We learned how to keep a scientific notebook and how to share this knowledge with others. Through these methods we learned about some of the trees found in and around Mammoth Cave National Park.

EVALUATION: Teachers are able to evaluate each student's involvement and participation within their individual group and during the class science conference. Teachers are able to evaluate each student's ability to follow directions and complete all components of the assignment by looking at the completeness of their scientific notebooks.

EXTENSIONS:

1. Perform a forest density study.
2. Approximate the height of the trees studied.
3. Create a scientific notebook of trees found around your school or home.
4. Create a scientific notebook of plants found around your school or home.

**NOTE:* Kentucky Forest Trees: How to Know Them *(FOR-1) by Dr. Deborah B. Hill and Diana L. Olszowy can be obtained from the University of Kentucky, College of Agriculture, Cooperative Extension Service, Lexington, Kentucky for a nominal fee.*

THAT'S MY TREE!

CORE CONTENT

PL-M-3.3.2 Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.

PL-M-3.1.5 Environmental issues (e.g., pollution) should be considered when making consumer decisions (e.g., recycling, reducing, reusing).

SC-M-3.5.3 For most ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.

SC-M-3.5.2 Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

SC-M-3.5.1 A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

SC-M-3.2.1 All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.

WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
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- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

DO OR DIE

SUBJECTS: Science, English/Language Arts, Health

GRADES: 6-8

DURATION: 2-3 class periods

GROUP SIZE: One class of 25-30 students (or less)

SETTING: Indoors

KEY VOCABULARY: adaptation, trogloxene, troglobite, trolophile

ANTICIPATORY SET: Today we are going to learn how cave animals adapt to the environment in which they live.

OBJECTIVES: The students will be able to: 1) list what they already know about a specific cave animal; 2) list what they want to know about a specific cave animal; 3) list what they learned, after conducting research, about a specific cave animal.

MATERIALS: pen or pencil, KWL Chart Worksheet.

BACKGROUND: From the beginning, thousands of animals and plants have evolved, lived, reproduced and died. Species disappear if they are not able to adapt to our ever-changing world. Fire, flood, drought, earthquakes or changes in climate may alter an environment. If plants and animals are not able to adjust or flee the area in which the hazard is taking place they may eventually disappear or become extinct.

When change occurs in the environment, individual characteristics of a species may help or hinder the survival of an entire population. If a characteristic is beneficial, the species survives the changing situation and passes on the genetic code to assure the survival of its offspring. If the plant or animal is hindered by a particular characteristic, the species must either change or face possible extinction. The best known example of a species that was not able to adapt to a changing world is the dinosaur. Organisms able to cope with stress over time are the ones that tend to survive.

Adaptations to a changing environment can take varying amounts of time to occur. Some adaptations happen quickly. The immunity of insects to pesticides is one example. Other adaptations can take thousands of generations or even millions of years to occur. The loss of eyes by true cave dwellers (troglobites) is an example of a slow adaptation.

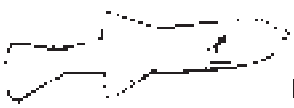
Cave animals are masters of adaptation. Some species living deep within a cave are often white or pink and blind or eyeless. These cave-adapted species have been isolated from the surface environment for many thousands of years. They have lost the ability to produce pigment in their skin or outer layer of the body, as well as the ability to produce eyes.

Cave animals often have intriguing differences in their biology. Sensory structures (other than eyes) often are more developed in true cave animals than in similar species that have never lived in a cave habitat. Often their antennae and legs are much longer than their above ground counterparts and their metabolism has slowed down considerably as an adaptation to the extremely nutrient-poor environment of a cave.

DO OR DIE

PROCEDURE:

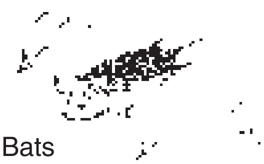
1. The teacher explains that there are three categories of animals that live in caves. They are troglobites, troglophiles, and trogloxenes.



Troglobites are true cave dwellers. These animals live their entire lives in caves. They are found nowhere else! They usually lack skin pigment and are blind or eyeless. In the Mammoth Cave area, troglobites include the eyeless crayfish (*Orconectes pellucidus*), the northern cavefish (*Amblyopsis spelaea*), the southern cavefish (*Typhlichthys subterraneus*), the Kentucky Cave Shrimp (*Palaemonias ganteri Hay*), an aquatic isopod (*Asellus stygius*), amphipods (like *Stygobromus exilis* or *S. vitreus*), blind cave beetles (*Neaphaenops tellkampfi*), and the blind cave harvestman (*Phalangodes armata*), among others.

Troglophiles are called cave lovers. These animals live in caves or in places on the surface that are dark and damp like caves. These animals are able to complete their entire life cycle in a cave or in suitable habitats on the surface. Examples include the cave salamander (*Eurycea lucifuga*), a surface crayfish (*Cambarus bartoni*), some amphipods (*Crangonyx sp.*), sculpins (*Cottus carolinae*), and the spring cavefish (*Chologaster agassizi*).

Trogloxenes are cave visitors. These animals live only a part of their lives in caves. Most trogloxenes leave the cave to find their food. All trogloxenes have eyes and use them to spot predators and to locate food. Bats (including the big and little brown bats, Indiana bat, gray bat, eastern pipistrelle), camel crickets (*Ceuthophilus gracilipes*), the common cave cricket (*Hadenoecus subterraneus*), and pack rats (*Neotoma pennsylvanica*), are found in Mammoth Cave National Park.



2. The teacher explains to the students that the class will be divided into three groups. Group one will investigate an animal from the troglobite classification, group two will investigate an animal from the troglophile classification and group three will investigate an animal from the trogloxene classification.

3. The investigation will begin by making a KWL chart. See example below for bats.

4. Each group of students will decide which animal in their classification they will investigate. Note: Teachers may want to divide the class into six groups instead of three if they feel the groups are too large.

5. Using the chart, each group will list what they know about their animal choice. One person will need to act as the recorder.

6. Using the chart, each group will make a list of questions about what they want to know about their animal choice.

7. Students will use various reference books, science text books, the internet and other reference tools to answer questions and gain knowledge with regard to their animal choice. Using the chart, information learned is recorded in the What We Learned column.

8. Each group will appoint a spokesperson (or persons) to report to the entire class what they learned about their chosen animal.

CLOSURE: Today we have taken a close look at cave animals and their ability to adapt to the harsh environment of the totally dark world of a cave. By conducting this investigation we have learned that if an animal is not able to change it stands a good chance of becoming extinct. Only those animals that are able to adapt or adjust to the ever-changing world are able to survive.

EVALUATION: The teacher is able to evaluate the students through participation within their small groups, by looking at their charts, and by listening to group discussions and reports.

EXTENSIONS:

1. Using information learned from this lesson students could create an imaginary animal that possessed the same or similar adaptations as cave animals.

2. Use the same KWL chart method to investigate other animals or plants.

DO OR DIE

KWL CHART WORKSHEET

K – What we know	W – What we want to know	L – What we learned

DO OR DIE

CORE CONTENT

SC-M-3.5.4	The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.
SC-M-3.5.3	For most ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.
SC-M-3.4.2	Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Extinction of species is common; most of the species that have lived on Earth no longer exist.
SC-M-3.4.1	Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.
RD-H-4.0.10	Follow the sequence of information.
RD-H-4.0.9	Apply the information contained in practical/workplace materials.
RD-H-4.0.8	Identify essential information needed to accomplish a task.
RD-H-2.0.13	Analyze the content as it applies to students' lives and/or real-world issues.
RD-H-x.0.6	Paraphrase important parts of a passage.
RD-H-x.0.1	Locate, evaluate, and apply information for a realistic purpose.
RD-M-4.0.13	Explain how organizational patterns and/or text features (e.g., pictures, charts, graphs, format) relate to the content of a practical/workplace passage.
RD-M-4.0.12	Identify the sequence of activities needed to carry out a procedure.
RD-M-4.0.11	Locate and apply information for a specific purpose (e.g., following directions, completing a task).
RD-M-2.0.14	Summarize information from a passage.
RD-M-2.0.13	Identify supporting details and explain their importance in a passage.
RD-M-2.0.12	Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.
RD-M-2.0.11	Use text features (e.g., lists, charts, graphs, tables of contents, indexes, glossaries, captions, diagrams, headings) to understand a passage.
RD-M-x.0.10	Connect information from a passage to students' lives and/or real-world issues.
RD-M-x.0.9	Reflect on and evaluate what is read.

DO OR DIE

CORE CONTENT

RD-M-x.0.7 Skim to get the general meaning of a passage.

RD-M-x.0.6 Scan to find key information.

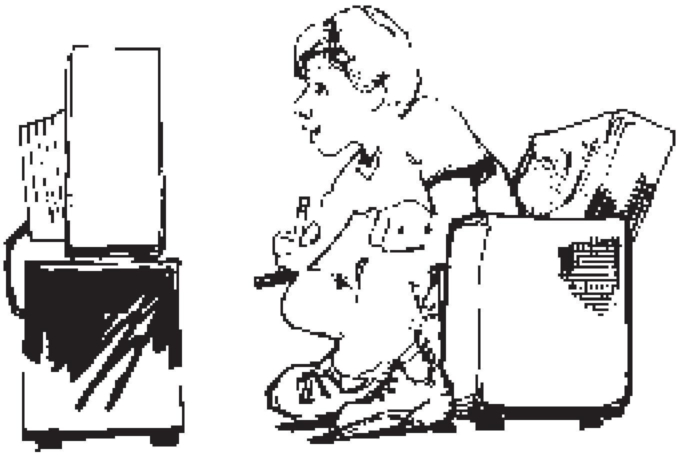
WR-M-1.4 Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms such as the following:

- letters
- speeches
- editorials
- articles in magazines, academic journals, newspapers
- proposals
- brochures
- other kinds of practical/workplace writing.

Characteristics of transactive writing may include :

- text and language features of the selected form
- information to engage/orient the reader to clarify and justify purposes
- ideas which communicate the specific purpose for the intended audience
- explanation and support to help the reader understand the author's purpose
- well-organized idea development and support (e.g., facts, examples, reasons, comparisons, anecdotes, descriptive detail, charts, diagrams, photos/pictures) to accomplish a specific purpose
- effective conclusions.

MAKING HEADLINES



SUBJECT: Science, Social Studies, Government, English/Language Arts, Health, Physical Education, Consumerism

GRADES: 6-8

DURATION: One class period of 40-60 minutes

GROUP SIZE: One class of 25-35 students

SETTING: Indoors

KEY VOCABULARY: Headline, fact, opinion, editorial, speleothem

ANTICIPATORY SET: Headlines are written to catch the reader's attention and to develop an interest in the article it is describing. Today we are going to review several articles and their headlines to determine what is fact and what is opinion!

OBJECTIVES: The students will be able to: 1) review several newspaper articles and determine whether information is based on fact or opinion; 2) write a statement in defense of or against a view using information given in the articles; 3) develop an editorial based on the articles read in this lesson.

MATERIALS: Copies of three newspaper articles and one editorial for each group, Fact or Opinion Activity Sheet, For or Against Cards, pen or pencil.

BACKGROUND: Newspapers are excellent teaching tools. They often provide information on real life situations leading to interesting discussions in the classroom. For this lesson we have selected four articles from spring and early summer of 1996 that relate to the break-in and damage of speleothems in Floyd Collins' Crystal Cave. (Speleothem is the collective term for all cave formations-stalactites, stalagmites, gypsum, etc.) Crystal Cave is one of many caves in Mammoth Cave National Park that is no longer used for commercial cave tours. It is located several miles from any of the main roads. In 1996, three vandals broke into the cave on several occasions removing hundreds of pounds of speleothems, rocks, and a few artifacts. This was a serious federal offense. The men were arrested and tried in federal court where they pled guilty. This break-in encouraged local authorities to up-hold a 1988 Kentucky law stating it was illegal to sell cave formations. This case focused on many local rock shops and influenced the way they continue to conduct business.

Readers expect newspaper reporters to give the facts needed to understand the events taking place around them. Facts answer the questions: who, what, when, where, why and how. Opinions are based on and involve our emotions. Opinions can include words such as good or bad, may include complaints or praise, or may focus on the way we feel about a situation, person, event or word. Opinions may be based on a fact, but opinions add more than the information concerning who, what, when, where, why, or how the situation unfolded. Facts are expected in newspaper articles and opinions are often expressed in editorials and/or commentary columns. Is this always true?

With the articles included in this lesson, it is hoped that students will be able to distinguish between what is a factual statement and what is opinion. Because these articles are dealing with natural resources that are irreplaceable and difficult to price in dollar amounts, they tend to include information from both realms.

MAKING HEADLINES

PROCEDURE:

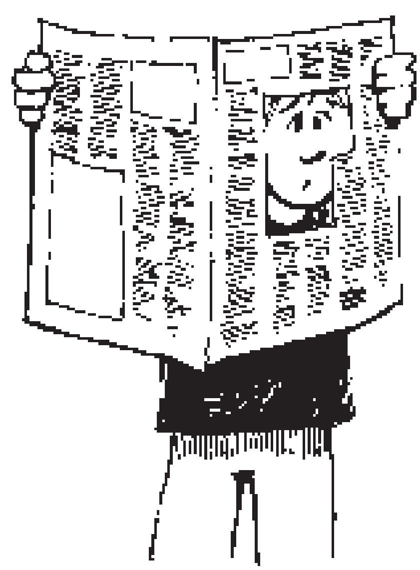
1. The students are divided into groups of three. The teacher gives each student a copy of the Fact or Opinion Activity Sheet and gives each group one set of the three newspaper articles. The teacher instructs each student within the group to read one of the articles and complete the first part of their activity sheet.
2. Students summarize and discuss each article within their group.
3. The teacher cuts the "For" and "Against" cards apart (cards are included in the lesson) and places them in a small container, making certain there is at least one card for each student.
4. The teacher has each student select a card from the container. If the student draws a "For" card he/she will write a statement supporting the sale of cave formations in local rock shops. If they draw an "Against" card they will write a statement in support of banning the sale of cave formations in local rock shops. Students should use information from the articles to support their assigned viewpoint.
5. Class members can share their statements if they choose to do so. The teacher asks the students to find a classmate with the opposite opinion. These two students then compare their statements. Is the statement they wrote a fact or an opinion? Is their statement based on facts or opinions?
6. The teacher may ask the students to think, but not voice, a response to the following questions: Do you agree with the card you drew? Did that make it harder or easier for you to compose your statement? If you were a lawyer and it was your assignment to take this to court, could you defend your position or would you turn down the case?
7. The teacher passes out copies of the editorial. The students read the entry. Does this article have any common themes with the earlier articles? What are they? The class lists the common themes on the board. The teacher asks the students to finish their activity sheet by writing an editorial using the title, "Placing a Price on Our Nation's Natural Resources." Do they agree that someone can place a value on air, water, rocks, plants and animals? Why or why not?
8. The students are invited to share their editorials.

CLOSURE: What often makes news is an event that provokes the feeling of being either for or against a situation. Because we have the ability to feel and think, opinions often mix with fact in many news events. This causes us to become involved in the issue. As a good reporter our goal is to be as objective as possible concerning the information we are reporting. Editorials are a different story. The writer of an editorial will purposely draw in people's emotions to sway their opinion.

EVALUATION: The teacher is able to evaluate the students by reviewing activity sheets, class discussion, and student editorials.

EXTENSIONS:

1. As a follow-up activity the students could write an editorial on a topic affecting their school at the current time. This topic might also be a resource-related issue.
2. Have the students watch a half-hour news program and record the number of facts and opinions stated in a ten minute period. For the remainder of the broadcast the students could note how many of the stories were presented to get people emotionally or intellectually involved.
3. The students could research how another environmental issue is reported in a newspaper or magazine. They could answer the same questions about these articles as they did for the cave articles.



Making Headlines

Fact or Opinion Activity Sheet

1. Statement:

a. Using the information found in your article, write a statement expressing your point of view. (Use a separate piece of paper or the back of this page if necessary.)

b. Identify the statements from your article and label them as either "fact" or "opinion".

2. Write an editorial:

Write an editorial using the title, Placing a Price on Our Nation's Natural Resources. (Use a separate piece of paper or the back of this page if necessary.)

"FOR" OR "AGAINST" CARDS

FOR	AGAINST
FOR	AGAINST
FOR	AGAINST
FOR	AGAINST
FOR	AGAINST

THE COURIER-JOURNAL • • SUNDAY, NOVEMBER 30, 1997

EDITORIALS

Getting serious

TWO FEDERAL decisions last week can be counted as breakthroughs in the effort to preserve our natural heritage.

One, announced by Interior Secretary Bruce Babbitt, will ban most cars from Yosemite, Zion, and Grand Canyon national parks, where visitors will be brought to the natural wonders by bus and/or light rail.

The other, made by the Federal Energy Regulatory Commission, will force the removal of a private, 160-year-old hydroelectric dam, so that striped bass, sturgeon, Atlantic salmon and herring can spawn in a 17-mile stretch of Maine's Kennebec River.

The Clinton Administration is on the right track. The compromise of America's most cherished places by processions of fume-belching autos, pick-ups and RVs can't be tolerated forever. And the private appropriation of public streams shouldn't be treated as a permanent right.

The public's attitude in such matters is easy to predict. Few will complain about the elimination of car exhaust from our most sensitive parklands. And while Edwards Manufacturing Co. will challenge the dam decision in court, New England's environmentalists are elated. They've wanted the thing torn down for years.

Both decisions have broader implications.

In the next 15 years, the energy commission will be able to reconsider the licensing of 550 dams across the country. Naturally, the private interests will bray, as they always do, about the government's "taking" of assets. And, given our tradition of placing property rights before community concerns, it's likely that some of them will be entitled to relief. In the meantime, though, it's good to see the public win one for a change, up there in Maine.

The prospect is even better for progress against overcrowding, vandalism, polluted air and dirty water in the 367 units of our national park system.

> "It's not a question of plants and rocks being more important than people. It's a matter of preserving the experience that draws people . . . in the first place."

Higher entry fees and new user charges, which we have cautiously endorsed, are not enough, as the Clinton Administration is tacitly acknowledging. Nothing short of an outright auto ban will prevent the most popular parks from suffocating.

It's not a question of plants and rocks being more important than people. It's a matter of preserving the experience that draws people to the parks in the first place.

Each site is unique. More than 15 million come to Golden Gate National Recreation Area each year, to see the spectacular Pacific headlands that are within sight of downtown San Francisco. The challenge there is somewhat different from the one that park officials confront at Big Cypress swamp in Florida, which only a couple of hundred thousand visitors manage to find every year.

There is no one solution. But all of these public assets must be managed pro-actively, and wisely.

For Kentuckians and Hoosiers, the issue is not just the fate of places like Mammoth Cave and the Indiana Dunes. All of the nation's parks belong to all of us.

THE COURIER-JOURNAL
FRIDAY,
MARCH 1, 1996

3 plead guilty to destroying Crystal Cave in theft spree

By CYNTHIA EAGLES
Staff Writer

MAMMOTH CAVE NATIONAL PARK, Ky. — The damage to the cave that was once the resting place of Floyd Collins is extensive: Entire sheets of gypsum torn away, powdery piles of crushed gypsum crystals on the cave floor, and delicate, lacy helictites snapped clean from their roots and missing.

And on an outer wall, in bold white paint, two names sprayed in a corner: "Leon R." and "Tony H."

Yesterday, Wendell Leon Reynolds, 18, of Munfordville, Anthony Wayne Hawkins, 33, of Radcliff, and Anthony Dale Stinson, 23, also of Munfordville, pleaded guilty to federal charges that they destroyed Crystal Cave at Mammoth Cave National Park when they stole cave formations from it last spring.

Reynolds and Hawkins now face maximum sentences of 35 years in afederal prison, plus fines of $750,000 each. In addition, Stinson admitted that he stole two clay masks of Collins and his brother, Homer. He could be sentenced to a total of 45 years in prison, plus a $1 million fine.

Sentencing was set for May 22.

The three admitted to U.S. District Judge Thomas B. Russell that from April to June they made repeated trips "in the dead of night," as the indictments charge, tunneled under an entrance gate and hauled out 800 pounds of "cave rocks" in duffel bags. Baseball bats were their tools

STAFF MAP BY STEVE DURBIN

of choice.

"Some of them we broke, and some of them were loose," Reynolds told the judge yesterday.

"We put the rocks inside duffel bags and carried them out," Stinson said in court.

In stealing the formations, the vandals dragged the heavy rocks up and down steep cave paths, then got out by squeezingthrough a muddy hole no more than a foot wide and about two feet deep to get out. Then they lugged the heavy bags another mile to their vehicles.

Crystal Cave "is trashed for eternity," said Randy Ream, the assistant U.S. attorney who prosecuted the case.

The National Park Service estimated they damaged roughly a mile in one passage, and ruined a quarter-mile of another. A tour for reporters yesterday revealed that the vandals pulled away entire sheets of gypsum along some passages, and took whole sections of the lacy formations known as helictites.

Related to stalactites and stalagmites, the familiar cave "icicles," helictites grow in curlicues that defy gravity and logic. Damage to the cave was put at $270,000 by the government.

Ream said the trio peddled their cache to rock and souvenir dealers that line the entrance roads to the park. For all their efforts, they got $1,000 or less, Ream said.

Federal investigators confiscated the booty but did not arrest the shop owners. Ream said he couldn't prove that the shop owners knew the formations came from the park.

The vandalism enraged the executive director of the American Cave Conservation Association, David Foster, who criticized the National Park Service for being slow to install a better gate at the cave, and the Mammoth Cave area rock shops, for ignoring a 1988 state law that bars the sale of "speleotherms," as cave formations are formally known.

However, Foster acknowledged that it's only a misdemeanor to sell the rocks, and has been a low priority to law enforcement.

See THREE
Page 3, col. 4, this section

Three admit cave damage

Continued from Page B 1

His criticism of the park service's protection of Crystal Cave was echoed by Carol Collins, whose husband is a great-nephew to Floyd.

Vickie Carson, a National Park Service spokeswoman, responded that the park service has a new cave gate-building program under way. She also said the park service runs patrols and surveillance to watch cave entrances, and also relies on tips from neighbors.

In 1925, while trying to find a new entrance to Crystal Cave that would be closer to the main highway — and thus lure more tourists — Floyd Collins became trapped and died in what is now known as Sand Cave. Crystal Cave became known as Floyd Collins' Crystal Cave. It closed in 1961 when the national park service bought it.

Stemming thefts of Kentucky cave treasures

STAFF PHOTOS BY MICHAEL HAYMAN

Rick Olson, a Mammoth Cave National Park ranger, examined cave formations that were thought to have been damaged by thieves in Floyd Collins' Crystal Cave.

Rock formations became easy souvenirs despite law

By ANDREW MELNYKOVYCH
Staff Writer

MAMMOTH CAVE NATIONAL PARK, Ky. — Stealing helictites, bizarre rock formations that look like petrified pasta, from Floyd Collins' Crystal Cave is no simple task.

It requires walking a mile down a gravel road in Mammoth Cave National Park, descending a flight of steep and slippery stone stairs, tunneling under a steel gate and then venturing nearly a mile into the cave itself, going up and down underground hill and dale.

Then there's the business of using hammers, hatchets and bare hands to break the formations into manageable pieces. And finally, the return trip — this time hauling out the heavy loads.

Why would anyone go to all that trouble?

For money. The thieves have been vandalizing Kentucky's subterranean heritage and selling the stolen pieces in rock shops on the road from Cave City to the national park.

That is where three men who received federal prison terms last month for ransacking Floyd Collins' Crystal Cave found ready buyers for the helictites and other formations they stole — formations that took millions of years to create and only seconds to destroy.

This confiscated cave rock was for sale in a souvenir shop.

"If there weren't a market, there wouldn't be any traffic in it," said Mammoth Cave National Park Superintendent Ron Switzer.

Selling cave formations has been illegal in Kentucky since 1988. But the open trade in cave formations went unchecked until the past two weeks, when the Kentucky State Police opened an investigation. One rock-shop owner has been charged with violating state law.

"This all could have been avoided completely if the law had been upheld from the very beginning," Carol Collins said. She is married to a nephew of famed cave explorer Floyd Collins, who developed the cave that bears his name.

The destruction in Floyd Collins' Crystal Cave has focused attention on a long-standing problem in Kentucky's cave country. Visitors have been removing formations from caves and leaving graffiti behind for nearly two centuries. Only in the past 40 or 50 years has that conduct been considered vandalism.

Nevertheless, the destruction of caves continues. Those that are neither protected within Mammoth Cave National Park nor operated as privately run tourist attractions bear the brunt of the abuse, said Dave Foster, executive director of the American Cave Conservation Association.

See THIEVES
Page 5, col. 3, this section

Thieves stole cave treasures

Continued from Page B 1

Many have been looted for their formations, but "a lot of the vandalism is just that," Foster said. "There's a lack of awareness that these are irreplaceable resources."

Foster's group, which operates a cave museum in Horse Cave and offers tours of Hidden River Cave, and the national park are trying to get out the message that caves are fragile places deserving protection.

That will require changing the attitude of many local residents who believe caves are an economic resource, rather than a natural one, Switzer said.

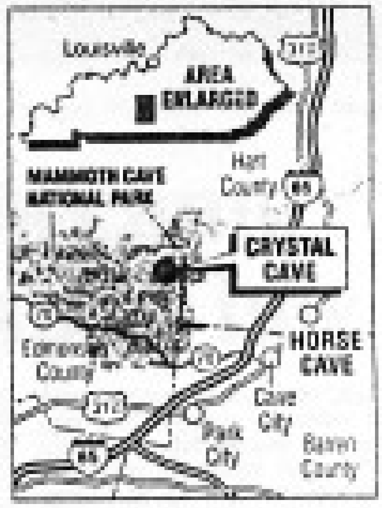
Caves within Mammoth Cave have been vandalized before. There were several highly publicized cases in the 1970s when workers at a since-closed Job Corps camp in the park entered Floyd Collins' Crystal Cave through another entrance.

But the situation is far worse in the many unprotected caves on private land, Switzer said. "I don't have any hope of protecting all the cave resources in this region," he said. "We're going to do what we can within the boundaries of the park to protect a representative sample."

But park officials have come under fire for not doing enough. Foster and Collins said security has been a problem at Floyd Collins' Crystal Cave since 1961, when the National Park Service bought it from the family that purchased it from the Collins family in the 1920s.

"It's hard to get any cave completely secure," Collins said. "But I think they could have done better."

Park rangers routinely patrol only the main roads and rarely venture beyond the locked gate where the gravel road to Floyd Collins' Crystal Cave begins. The vandals were able to make at least six trips to the cave before their work was discovered.



STAFF MAP BY WES KENDALL

During one of those visits, a park ranger saw their car parked at the gate. He noted the license number but did not investigate further.

Finding a parked car was not unusual, Switzer said, defending the ranger. The ranger was alone on duty that night and had nobody to call for backup in the event of trouble.

Switzer said that points out the impact of budget cutbacks on the national parks. To Foster, the message is the park isn't putting people into the jobs where they are most needed.

But park officials and cave conservationists hope some good comes of the destruction of Floyd Collins' Crystal Cave, including stricter laws against the sale of cave formations, better enforcement of existing laws and a heightened awareness of the need to protect Kentucky's caves.

"We can't put the damaged formations back together again," Foster said. "But we can take this as a wake-up call and make sure it doesn't happen again."

Cave-rock crackdown ends inaction

By ANDREW MELNYKOVYCH
Staff Writer

CAVE CITY, Ky. — Early last month, anybody could walk into Big Mike's or Debbie's — two rock shops near Mammoth Cave National Park — and choose from a selection of cave formations, sold openly in violation of state law.

Last week, after a visit by the Kentucky State Police, there was not a stalactite, stalagmite or helictite to be found in either shop.

But cave conservationists aren't praising the crackdown. They're asking, "What took so long?"

Barren County Attorney Ben Rogers, whose job includes prosecuting violators of the state law, says the answer is simple: Nobody ever complained about the illegal sales. "If it was such an obvious problem, it makes me wonder why nobody had ever filed a complaint."

David Foster, executive director of the American Cave Conservation Association, headquartered in Horse Cave, said, "Most people think if it's illegal, the police and prosecutors ought to be taking care of it."

National park officials and cave conservationists say the open trade in cave rocks — and failure to enforce the 1988 state law making it a misdemeanor — were driving forces behind last year's looting of Floyd Collins' Crystal Cave. Formations taken from the cave were sold to both Big Mike's and Debbie's and later were confiscated as evidence in the federal case against the three looters.

The rock shops were not charged in the case because federal prosecutors did not believe they could prove the owners knowingly bought formations taken from the national park.

On May 12, a reporter was able to buy specimens at both shops, and sales clerks unhesitatingly identified the items as cave formations. They later were confirmed as such by a federal geologist.

One seller of cave formations pleaded ignorance of the law.

"I just found out . . . when the state police came out and investigated me," "Big Mike" Fontana said Wednesday. "We're not criminals trying to do something illegal."

Fontana has taken down signs advertising "cave rocks" and said, "We're not going to sell them no more." He said the rocks bought by a reporter came from Mexico 15 years ago.

Fontana denied buying rocks from local caves, and he said none of the rocks taken from Floyd Collins' Crystal Cave was recovered from his shop.

Sworn testimony in the case indicates that the looters sold two batches of formations to Fontana's shop. And Assistant U.S. Attorney Randy Ream said two boxes of rocks from the cave were recovered from Big Mike's.

Debbie Passmore, who owns Debbie's with her husband, David, would not talk about it last week. David Passmore was charged after a state police detective found 143 cave specimens in the shop May 23.

STAFF PHOTO BY MICHAEL HAYMAN

This souvenir shop in Cave City advertises "cave rock" for sale but had none last week after a Kentucky State Police crackdown.

MAKING HEADLINES

CORE CONTENT

PL-M-1.1.3	Communication, cooperation, rules, and respect are important to the effective functioning of groups.
PL-M-2.3.2	Rules of behavior and fair play (e.g., accepting authoritative decisions, assessing one's own performance level, accepting skills and abilities of others through verbal and nonverbal actions for spectators and/or participants) during games are necessary.
PL-M-3.3.2	Improving environmental conditions (e.g., air and water quality) and preserving natural resources impact personal and community health.
RD-H-x.0.7	Formulate opinions in response to a reading passage.
RD-H-x.0.6	Paraphrase important parts of a passage.
RD-H-x.0.1	Locate, evaluate, and apply information for a realistic purpose.
RD-H-4.0.8	Identify essential information needed to accomplish a task.
RD-H-2.0.13	Analyze the content as it applies to students' lives and/or real world issues.
RD-M-x.0.10	Connect information from a passage to students' lives and/or real world issues.
RD-M-x.0.9	Reflect on and evaluate what is read.
RD-M-x.0.8	Make predictions, draw conclusions, and make generalizations about what is read.
RD-M-x.0.7	Skim to get the general meaning of a passage.
RD-M-x.0.6	Scan to find key information.
RD-M-x.0.1	Identify an author's purpose in literary, informational, persuasive, and practical/workplace materials.
RD-M-4.0.11	Locate and apply information for a specific purpose (e.g., following directions, completing a task).
RD-M-3.0.17	Identify bias and/or misinformation.
RD-M-3.0.15	Identify the argument and supporting evidence.
RD-M-3.0.14	Distinguish between fact and opinion.
RD-M-3.0.13	Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.
RD-M-3.0.12	Identify an author's opinion about a subject.
RD-M-2.0.13	Identify supporting details and explain their importance in a passage.
RD-M-2.0.12	Apply knowledge of organizational patterns (e.g., cause and effect, comparison, contrast, sequence) to understand a passage.
SS-M-4.4.3	The natural resources of a place or region impact its political, social, and economic development.
WR-M-1.4	Transactive writing is informative/persuasive writing that presents ideas and information for authentic audiences to accomplish realistic purposes like those students will encounter in their lives. In transactive writing, students will write in a variety of forms.

SUM(IT)-UP

SUBJECTS: Science, Social Studies, Math, English/ Language Arts, Foreign Language

GRADES: 6-8

DURATION: One class session

GROUP SIZE: One classroom of 25-30 students

SETTING: Indoors

KEY VOCABULARY: Organic Act, mandate, protect, provide, aquatic, groundwater, watershed, runoff, tributary, spring, sinkhole, karst, Sinkhole Plain, pit, dome, vertical shaft, carbonic acid, pollution, scientific investigation, science conference, natural resources, canopy, adaptation, subterranean, troglobite, troglophile, trogloxene, herbicide, biologist, centipede, prefix, suffix, limestone, sandstone, historic, cemetery, carrying capacity

ANTICIPATORY SET: We have been studying about Mammoth Cave and the unique karst region of south-central Kentucky. Today, as a review, we are going to have a quiz game competition. How many of you have ever watched, or are familiar with, the game show "Jeopardy"?

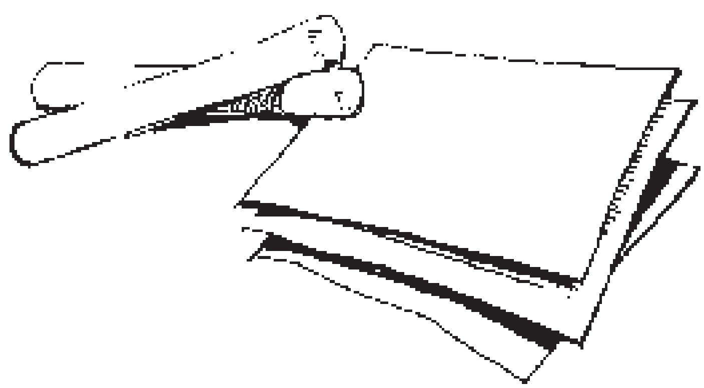
OBJECTIVES: The students will be able to answer questions on a variety of topics from Mammoth Cave curriculum activities, culminating with one final question.

MATERIALS: Chalk or dry erase markers, Category Cards, Question Cards, Questions & Answers

SUM(IT)-UP

BACKGROUND: Previous material from the Mammoth Cave curriculum has focused on the protect and provide mandates of the National Park Service and on ways that a balance between these two concepts is constantly juggled at Mammoth Cave National Park. Protection of the groundwater resources depends upon understanding the unique Karst geology found within the Sinkhole Plain area of south-central Kentucky. This unique geology presents special challenges to some of the life forms found in the region, especially to those creatures living all or part of their lives in caves. An understanding of these natural resources and possible hazards can assist community planners in making the best decisions in regard to expansion. This understanding can help officials (city council members, magistrates, etc) as well as citizens protect natural and cultural resources and still provide for the economic, social, health needs and other concerns of its residents and visitors.

In order to understand their resources, community leaders and scientists must first learn as much as possible about the plants, animals, and geology of their region. Students practiced various scientific methods of investigation for both natural resources (**That's My Tree!)** and for historical research (**Back to the Past**) as they worked with this curriculum. They learned the basis for scientific expressions and realized that the Greek and Latin root words used in science could help them with their scientific research and with their native language skills (**It's All Greek (and Latin) to Me!**).



The caves that draw visitors from around the world can create conflicts for national park and community managers as they attempt to protect the special features that lure visitors - sometimes beyond the capacity of the resource! In the lesson, **Mammoth Math**, students learned the importance of using statistical data in making these decisions. And from **Making Headlines**, students learned to gather their information carefully as they practiced sorting facts from opinions.

SUM(IT)-UP

PROCEDURE:

1. Prior to class the teacher should choose any five Sum(it)-Up Category Cards. These should be taped in a line across the top of the board or other area easily seen by the students. Tape five numbered cards, in numerical order from one to five, under each category. The teacher may wish to tape or write the question on the back of the card prior to hanging or they may elect to simply read the corresponding question as the students choose the category. Note: Additional questions and/or categories may be added if the class has more then 25 students.
2. The teacher asks: Are you familiar with the game show "Jeopardy?" After dividing into teams, team members will take turns answering questions on topics they have studied. These topics focus on caves and the south-central Kentucky area.
3. Divide the class into three teams. Station each group in separate areas of the room.
4. The teacher explains that each team will send one student at a time to the front of the room to write their answer on the board. In order to score, students must write their answer in the form of a question.
5. Send the first rotation to the board and have the three student contestants pick up a piece of chalk or a dry erase marker. Team one picks the category. The first question is read. (Questions and answers for each category are found on the Questions & Answers Sheet. Some alternate, correct answers are also given.) The first of the three "contestants" to correctly write the answer in the form of a question, put the chalk/marker down, and turn around and face the class gets the points.
6. The next player from each team now goes to the board for the second question.
7. This process is continued until all the questions are answered. Like the television program, the winning team selects the next category. But in this version, contestants do not select the level of the question. They will just answer each question in order.
8. All questions are worth the same point value (100 points) but questions will increase in difficulty as the category progresses.
9. After all the questions are exhausted, the final Sum(it)-Up topic will be read. Teams vote on a final Sum(it)-Up representative. Each team will decide on the number of points to wager. Use the same procedure as above in asking the question, but this round is worth double points for correct answers.

CLOSURE: We have reviewed the topics we have been working on. Prizes include -- Mammoth Cave knowledge, the challenge of competition, and the thrill of victory!

EVALUATION: The teacher is able to evaluate the students through observation, points earned, and each student's participation.

EXTENSIONS:

Have the students create questions to use in a second game.

QUESTIONS & ANSWERS

CATEGORY: CAVE LIFE: "Location, Location, Location"

1. In the darkness of a cave, animals can not rely on their sense of sight. Name three other senses these animals might rely upon.

   What are touch [feeling], smell, and hearing?

2. These are elongated to assist animals in dark caves to "feel".

   What are antennas?

3. Bats aren't blind, but they use this to "see" in the dark.

   What is sonar? [echolocation]

4. These aquatic cave animals have no eyes. Their name reflects this inability to see.

   What are blind cavefish? [eyeless crayfish]

5. These creatures live their entire life in a cave. They are true cave dwellers.

   What is a "troglobite?"

6. As a cave visitor, people and bats would be classified as this.

   What is a "trogloxene"?

CATEGORY: GEOLOGY: "Rock-n-Roll"

1. This stone was deposited by an ancient sea.

   What is limestone?

2. This rock forms the protective "roof" over Mammoth Cave.

   What is sandstone?

3. These are found where underlying rock layers have collapsed to form depressions.

   What are sinkholes?

4. This is the name of the rolling plain found in south-central Kentucky, near Mammoth Cave National Park.

   What is the Sinkhole Plain? [Karst; karst topography]

5. Caves are formed when the carbonic acid found in water does this to limestone rock.

   What is dissolves?

6. This is an area of land that collects rainwater and melted snow as it drains to the lowest point. HINT: Don't shed a tear if you're wrong.

   What is a watershed?

CATEGORY: POTPOURRI: "In the 'C'"

1. A subterranean cavity full of life, history, and wonder.

   What is a cave? [Mammoth Cave]

2. An insect commonly found in a cave.

   Where are cave crickets? [cave beetle]

3. The living visit this place to honor and learn about the people who lived before.

   What is a cemetery?

4. A meeting of scientists where they present and discuss new research.

   What is a (science) conference?

5. They are found deep within the cave in an aquatic habitat.

   What are blind cavefish? [eyeless crayfish]

6. Created by tree tops competing for sunlight.

   What is a canopy?

7. The maximum number of people that can go in the cave each day.

   What is capacity?

8. To preserve, to protect, to avoid destructive use of natural resources, to maintain a constant environment.

   What is conserve?

CATEGORY: WATER: "Water, Water Everywhere"

1. Underground it's the Echo River. Above ground it's called this.

   What is the Green River? [Echo River Spring]

2. This finds holes and cracks in the rock as it moves over the ground.

   What is water?

3. It carries toxins from farms, highways, and the railroad to the ground water.

   What is runoff? [water; sinkhole]

4. When this floods it carries needed nutrients to underground organisms for food.

   What is the Green River?

5. These are mini rivers that feed into larger ones.

   What are tributaries? [anastomosis]

6. This is the spot where water comes out of the ground to empty into a surface stream or river.

   What is a spring?

7. Water quickly travels down these "directional" paths to the water table

   What is a vertical shaft? [dome; pit]

CATEGORY: VEGETATION: "Make Like a Tree"

1. Below ground it was made into pipes that carried water. Above ground it has tulip shaped blossoms. It is very straight and tall. HINT: The Kentucky state tree.

   What is a Tulip Poplar tree?

2. The dominate trees in the forest of Mammoth Cave National Park.

   What are the oak and hickory trees?

3. The journey of these fallen parts provides nutrients for underground microbes.

   What are leaves? [decaying vegetation]

4. This is created by tree tops competing for sunlight.

   What is a canopy?

5. A good variety of this is necessary to have a healthy forest.

   What are tree species? [vegetation]

6. Decaying leaves and water combined to create this chemical responsible for dissolving limestone.

   What is carbonic acid?

CATEGORY: GREEK & LATIN: "Getting to the Root of it all"

1. This is a root word that means “cave”.

   What is “troglo” “[speleo]”?

2. The location of something (like a cave or ant nest) that is under the ground.

   What is "subterranean"?

3. To the cave I am a true lover.

   What is a "troglophile?"

4. In places other than national parks, I'm used to kill pesky plants.

   What is "herbicide"?

5. A person who studies living things.

   Who is a "biologist"?

6. Using your Latin, name a surface creature with 100 feet.

   What is a "centipede"?

7. Life that is dependent upon water.

   What is "aquatic"?

SUM(IT)-UP

QUESTIONS & ANSWERS

CATEGORY: MIND YOUR P's & Q's: "'P' is the Word"

1. This is a segment found at the beginning of a word.

   What is a prefix?

2. A Latin word meaning "before".

   What is "pre-"?

3. In the United States, these can find their ancestors in cemeteries.

   What are people?

4. The two missions of the National Park Service.

   What are to "protect" and to "provide"?

5. This has a negative affect on the water quality.

   What is pollution?

6. An educated guess about the outcome of an experiment, based on data already collected.

   What is a prediction?

CATEGORY: Reaching the Summit

TOPIC #1 - IT RULES

QUESTION: The Act that established the National Park Service.

ANSWER: What is the Organic Act?

TOPIC #2 - NEIGHBORHOOD NEEDS

QUESTION: The source of drinking water in south-central Kentucky.

ANSWER: What is groundwater?

TOPIC #3 - DOWN THE DRAIN

QUESTION: The bowl-shaped depression that swiftly carries water under ground.

ANSWER: What is a sinkhole?

TOPIC #4 - A LITTLE CHANGE

QUESTION: This change over time helps an animal to survive.

ANSWER: What is adaptation?

TOPIC #5 - SCIENTIFIC RESEARCH

QUESTION: To be certain they really understand, scientists ask a lot of these.

ANSWER: What are questions?

SUM(IT)-UP

CATEGORY CARDS

LOCATION, LOCATION, LOCATION	ROCK-N-ROLL
WATER, WATER EVERYWHERE	MAKE LIKE A TREE
IN THE "C"	GETTING TO THE ROOT OF IT ALL
"P" IS THE WORD	REACHING THE SUMMIT

QUESTION CARDS

1	2
3	4
5	6

SUM(IT)-UP

CORE CONTENT

SC-M-3.5.4 The number of organisms an ecosystem can support depends on the resources available and abiotic factors (e.g., quantity of light and water, range of temperatures, soil composition). Given adequate biotic and abiotic resources and no diseases or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem.

SC-M-3.5.3 For most ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.

SC-M-3.5.2 Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers because they make their own food. All animals, including humans, are consumers, and obtain their food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

SC-M-3.5.1 A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem.

SC-M-3.4.2 Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival. Extinction of species is common; most of the species that have lived on Earth no longer exist.

SC-M-3.4.1 Biological change over time accounts for the diversity of species developed through gradual processes over many generations. Biological adaptations include changes in structures, behaviors, or physiology that enhance survival and reproductive success in a particular environment.

SC-M-2.3.4 The Sun is the major source of energy for Earth. The water cycle, winds, ocean currents, and growth of plants are affected by the Sun's energy. Seasons result from variations in the amount of the Sun's energy hitting Earth's surface.

SC-M-2.2.1 The Earth's processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth's history is also influenced by occasional catastrophes such as the impact of an asteroid or comet.

SC-M-2.1.7 Global patterns of atmospheric movement influence local weather. Oceans have a major effect on climate, because water in the oceans holds a large amount of heat.

SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.

SS-M-4.4.4 Individual perspectives impact the use of natural resources (e.g., watering lawns, planting gardens, recycling paper).

SS-M-4.4.3 The natural resources of a place or region impact its political, social, and economic development.

SS-M-4.4.2 The physical environment both promotes and limits human activities (e.g., exploration, migration, trade).