SUGGESTED REFERENCES

- *RECONNAISSANCE STUDY OF AN ACTIVE SULFUR SPRING CAVE AND ECOSYSTEM, article by Louise Hose and James Pisarowicz*
  http://www.caves.org/pub/journal/PDF/V61/v61n1-Hose.pdf
- *How Caves Form*
  http://www.esi.utexas.edu/outreach/caves/caves.php
- *ScienceDaily -- Snottites, other biofilms hasten cave formation*
  http://www.sciencedaily.com/releases/2006/12/061212091813.htm

NATIONAL SCIENCE EDUCATION STANDARDS

Grades K - 4, 5 - 8
Science as Inquiry
Abilities necessary to do scientific inquiry
Understandings about scientific inquiry

Grades K - 4
Life Science
The characteristics of organisms
Life cycles of organisms
Organisms and environments

Grades 5 - 8
Life Science
Structure and function in living systems
Regulation and behavior
Populations and ecosystems
Diversity and adaptations of organisms

Grades 5 - 8
Personal and Social Perspectives
Personal Heath
Populations, resources, and environments
Natural hazards
Risks and benefits

**Source: National Science Education Standards, 1996, National Academy Press*

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ACID CAVES - *A Living Laboratory*

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SYNOPSIS

There are several cave systems that support unique ecosystems in the remote jungles of southern Mexico. One specific cave, the Villa Luz, is known for the bacteria in its thermal sulphur springs that produce hydrogen sulfide gas. When the gases form bonds with oxygen, the result is sulfuric acid. The acid eats away at the cave walls, constantly altering the patterns in the cretaceous limestone.

The caves are home to spiders, bats, and a unique fish species referred to as the Cave Molly. The caves are also well known for their snottites. Snottites are mucous-like formations that resemble stalactites.

Exploring the caves is very dangerous for scientists as there are potentially lethal levels of hydrogen sulfide gas. They must wear respirators and protective clothing as they enter the cave system in an attempt to document and understand the rare ecosystem.

CURRICULUM UNITS

- CHEMICAL ENGINEERING
- CHEMISTRY
- ECOLOGY
- ENVIRONMENTAL SCIENCE

RUNNING TIME

17 minutes

BACKGROUND

Scientists are intrigued by the resilient organisms that can endure the harsh environments like the acid caves of Villa Luz. Researchers carefully plan expeditions into the caves to better understand these rare ecosystems. They do not enter the caves without protective clothing, a special breathing apparatus, special lights, and safety devices such as warning sensors that blink when they encounter gases at deadly levels. Poisonous gases such as hydrogen sulfide and carbon monoxide are prevalent in the caves and can kill a person in minutes.

It is impressive that anything can endure these extreme conditions, but spiders, bats, fish, and multiple colonies of microbes flourish. It is these microbes that are responsible for the rapid decay and transformation of the cave walls. The limestone hills, along with water above and below the ground help to create the perfect foundation for the chemical processes that eat huge holes in the earth. The caves have been given the nickname “the Underground Himalayas.”

The rapid structural changes are partially due to the microscopic life forms that live on sulfur instead of sunlight. These microbes form colonies of fungi, blue-green algae, and bacteria that excrete large quantities of sulfuric acid. In addition there are extremophilic bacteria that are aptly named “snottites”. They hang all over the caves and are similar in shape to stalactites but have the consistency of mucus, or “snot”.

CRITICAL THINKING EXERCISES

1. Explain how caves formed by water erosion may differ from caves formed by chemical erosion. How are they similar?
2. Evaluate the types of creatures living in another cave in the world, and the environment they thrive in. How is Villa Luz unique?
3. Compare and contrast Mammoth Cave in Kentucky and Villa Luz.
4. Explain, using natural selection, how the spiders can survive and prosper in Villa Luz.
5. The sulphuric acid found in Villa Luz cave causes erosion, and is harmful for humans to breathe. Infer adaptations plant and animal life will need to live in this extreme environment.

CAREER POSSIBILITIES

- CHEMIST
- ECOLOGIST
- ENVIRONMENTAL ENGINEER
- GENETIC ENGINEER
- GEOLOGIST

ADVANCED ORGANIZERS

Prior to viewing this program, students should have some understanding of the following Benchmarks for Science Literacy, Oxford University Press which are excerpted and, in some cases, abbreviated below. Refer to the Benchmarks for more information.

Benchmark 5. The Living Environment
Section A: The Diversity of Life, Grades 6-8

- One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy rich foods. Some kinds of organisms, many of them microscopic, cannot be neatly classified as either plants or animals.
- In classifying organisms, scientists consider details of both internal and external structures.

Benchmark 5. The Living Environment
Section B: Scientific Inquiry, Grades 3-5

- Scientific investigations may take many different forms, including observing what things are like or what is happening somewhere, collecting specimens for analysis, and doing experiments.

Benchmark 5. The Living Environment
Section D: Interdependence of Life, Grades 6-8

- The world contains a wide diversity of physical conditions, which creates a wide variety of environments: freshwater, marine, forest, desert, grassland, mountain, and others. In any particular environment, the growth and survival of organisms depend on the physical conditions.

**Benchmarks can be found at www.project2061.org/tools/benchol/bolintro.htm*

VOCABULARY

Acetylene . . . . . A colorless, highly flammable, and explosive gas often used for metal welding and as an illuminant.

Biofilm . . . . . A complex structure adhering to surfaces that are regularly in contact with water, consisting of colonies of bacteria and usually other microorganisms such as yeasts, fungi, and protozoa that secrete a mucilaginous protective coating in which they are encased.

Carbide . . . . . A chemical compound consisting of carbon and a more electropositive element, such as calcium or tungsten.

Extremophilic . . . . . An organism adapted to living in conditions of extreme temperature, pressure, or chemical concentration, as in highly acidic or salty environments.

Hydrogen Sulfide . . . . . A colorless, poisonous gas that smells like rotten eggs. It is formed naturally by decaying organic matter. It is also emitted by volcanoes and fumaroles.

Snottites . . . . . Single celled extremophilic bacteria that hang from caves and are similar in shape to stalactites but have the consistency of mucus.

Sulfur . . . . . A pale-yellow, brittle nonmetallic element occurring widely in nature, especially in volcanic deposits, minerals, natural gas, and petroleum.

Sulfuric Acid . . . . . A clear, colorless to brownish, dense, oily, corrosive, water-miscible liquid, H_2SO_4, usually produced from sulfur dioxide. Used chiefly in the manufacture of fertilizers, chemicals, explosives, and petroleum refining.