Cave of the Winds
Activity Nine:
Mapping Caves

Lesson for Grades 9-12

One lab of about
50 minutes

Satisfies Colorado Model Content Standard for Science:

Standard 1, Benchmark #2 for grades 9-12. Select and use appropriate technologies to gather, process, and analyze data and to report information related to an investigation.

Standard 5, Benchmark #3 for grades 9-12. Graphs, equations or other models are used to analyze systems involving change and constancy (for example: comparing the geologic time scale to shorter time frame, exponential growth, a mathematical expression for gas behavior, constructing a closed ecosystem such as an aquarium).

Prerequisite: knowledge of carbonate minerals and groundwater, knowledge of basic geometry and trigonometry.

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Perpetually in the Dark: Mapping Caves

Learner outcomes

The learner will:

1. Understand the purpose of mapping caves.
2. Learn how caves are mapped.
3. Be able to read existing cave maps.
4. Learn how to map a cave with a compass, clinometer, and a measuring tape.

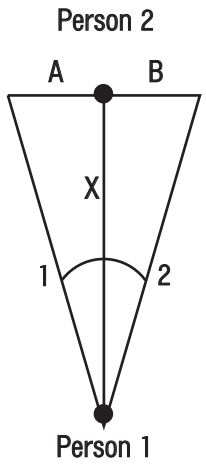
Vocabulary

Cave, surveying, compass, clinometer, compass directions, azimuth scale, metric units, map scale, right triangle.

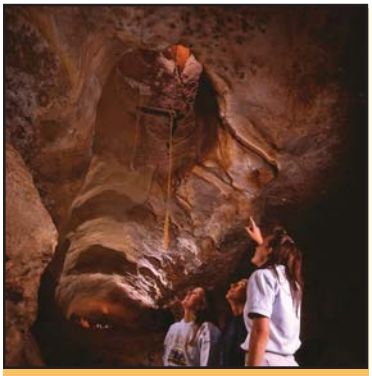
Background information

Mapping caves is tricky business since modern technology such as Global Positioning Systems (GPS) that use satellites to determine location may not be used underground. Cave mapping is commonly done with survey teams of at least three people using instruments such as a compass, a clinometer, and a measuring tape.

With these instruments, surveyors determine the length, width, height, and slope of one section of cave passage at a time. The length is measured with a measuring tape between two people, as is the width when possible. If the cave is too wide or the entire width is impassable, then a triangulation is performed using right triangles between two people. This triangulation is determined by locating the length with the measuring tape between person 1 and person 2, X, and angles 1 and 2 with a compass. Lengths A and B can then be determined by taking the tangent of the angle: tan 1= A/X and tan 2= B/X. Then the width is equal to A + B. A similar triangulation is used to determine the height of tall passages.



Once collected, the individual map sections are compiled to create a plan view map, a map from above with landmarks drawn in, and a profile map, a map slice through the cave to show elevation changes. This map must be accurate because future visitors will use it to navigate the cave. In addition, sketch artists usually draw cross-sections of the cave passage at the measure-



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ment points and sketch other possible side passages off the mapped path. In this lesson, students will learn how to map their own cave passage to compile a plan view and profile map.

Pre-activity Thought Questions

How are geological features mapped today? How could caves be mapped if they are below ground? How could you measure the height of a cave if it is too high to reach?

Materials needed

Cave of the Winds map (See student handout for this lesson).
Compass
Measuring tape
Clinometer (pre-made one or a protractor, straw, string, tape, and a weight)
Science notebooks
If mapping a pseudo-cave in a school hallway, need objects to represent stalactites, stalagmites, columns, and other speleothems.

Assessments

Speleothem notes in science notebooks
Survey notes in science notebooks
Final plan view and profile maps

Activity: Making your own cave map

The teacher will:

1. Discuss the ways caves are mapped and the purpose of mapping caves.
2. Arrange students in groups of 3-4 for ***surveying teams***.
3. At the school, once a makeshift cavern has been established with ***speleothems*** in a hallway or several rooms, have surveying teams of 3-4 students map the ***cave*** as they would a real cave passage.
4. The teams of students should produce a plan-view and a cross-sectional map of their cave.

Follow-up Questions

How easy is it to map a cave? In what ways might your map be inaccurate? What might happen if a real cave is inaccurately mapped?

Alternative Assessments

1. Compare other cave maps to Cave of the Winds map.
2. Attempt to map Cave of the Winds on your visit.

Bibliography

Nieland, J. ***Cave Surveying.*** SCS 7801 (available from Carlsbad Caverns National Park).
Gillieson, D. 1996. ***Caves: Processes, Development, Management.*** MA: Blackwell Publishers.

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Cave of the Winds
Activity Nine: Map of Cave of the Winds

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