

Cave Formation Age Estimation



SUBJECTS: Science and Math

GRADES: 8 and GMO

ACTIVITY SUMMARY: Students will investigate actual growth rates of two flowstone formations—one from Inner Space Cavern and one from Natural Bridge Caverns. Students will graph differences in growth rates for each formation to explore variations in past climates. They will then estimate the size of each formation using a scaled photograph. Combining the formation's size and the average growth rate, they will predict the age of the entire formation; such age estimation will provide a better understanding of the dissolution and deposition processes within a karst environment.

DURATION: approximately 45-60 minutes

OBJECTIVES:

Students will be able to:

1. Calculate growth rates for cave formations.
2. Estimate the age of cavern formation from the growth rates.

TEKS ADDRESSED:

8th grade-Science

1A-demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

2C-collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

2D-construct tables and graphs, using repeated trials and means, to organize data and identify patterns.

2E-analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

Earth & Space Science-High School

1A-demonstrate safe practices during laboratory and field investigations.

2G-organize, analyze, evaluate, make inferences, and predict trends from data.

2I-communicate valid conclusions supported by data using several formats such as technical reports, lab reports, labeled drawings, graphic organizers, journals, presentations, and technical posters.

11A-compare the roles of erosion and deposition through the actions of water, wind, ice, gravity, and igneous activity by lava in constantly reshaping Earth's surface.

8th grade-Math

12C—select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

14A—identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

NATIONAL SCIENCE STANDARDS:

Content Standard D: Earth and Space Science

Grades 5-8

Structure of the Earth System

- Land forms are the result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption, and deposition of sediment, while destructive forces include weathering and erosion.

REQUIRED MATERIALS:

- Cave Formation Age Estimation handout
- Metric ruler
- Pencil
- Calculator

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**BACKGROUND:**

The distribution of formations hints at water flow paths into the aquifer. As the slightly acidic rainwater passes through rock, it dissolves away calcite and enlarges cave passages. Cave formations grow as the calcite is deposited. University of Texas scientists have set up experiments to study the relationships between water chemistry, drip rates, and how fast formations grow. Calcite formations preserve records of the Earth's history. Scientists from UT analyze samples in order to investigate the relationship between climatic conditions and how quickly formations grow. The data in this experiment was gathered as part of a doctoral dissertation.

This exercise is particularly insightful as a follow-up to a cave fieldtrip. The Virtual Tours for Inner Space Cavern and Natural Bridge Caverns serve as a good introduction to scientific experiments performed in these two caves. Find them on the ESI Caves website: <http://www.esi.utexas.edu/outreach/caves/virtualtours.php>

EVALUATION: Students can be evaluated by the accuracy of calculations and answers to discussion questions.

EXTENSION: This activity works well as a follow-up to a cave field trip.

Name: _____

Date: _____

Cave Formation Age Estimation

Background: A group of scientists from the University of Texas at Austin is investigating past climate conditions. They have taken two cores of flowstone from two central Texas caves—Inner Space Cavern and Natural Bridge Caverns. They dated the cores at several depths in each sample.

Assignment: You will calculate and graph growth rates for the two formations. Then using an average growth rate and a scaled photograph, you will estimate the age of each formation. Show all calculations on a separate sheet of paper. Pay careful attention to the unit conversions.

Conversions:

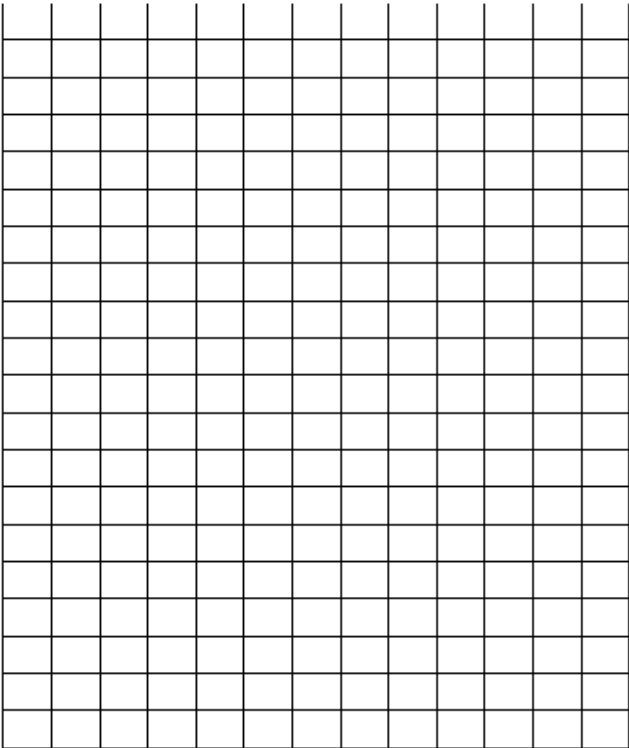
1cm = _____ mm 1 century = _____ years

Inner Space Cavern Flowstone Sample		
Depth (cm)	Age (years)	Growth Rate (mm/century)
3.90	13,210	X
14.80	14,430	
34.50	27,620	
Mean:		

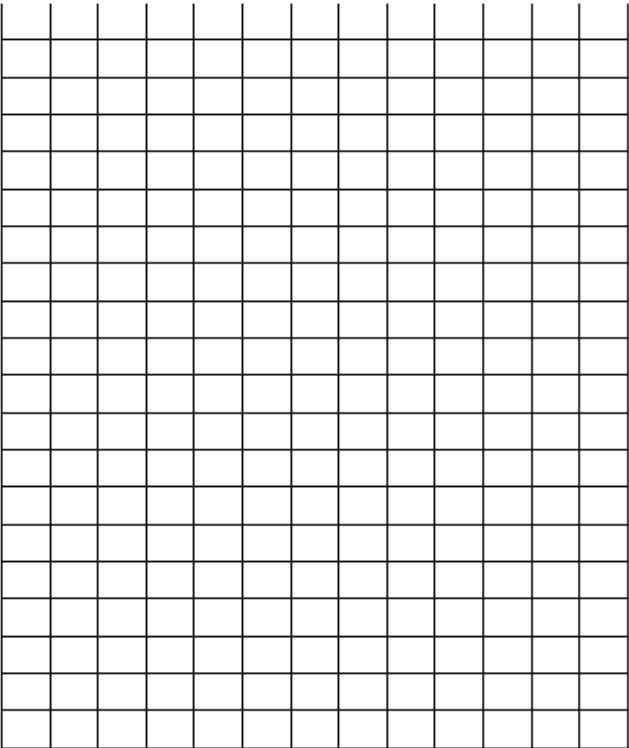
Natural Bridge Caverns Flowstone Sample		
Depth (cm)	Age (years)	Growth Rate (mm/century)
26.70	13,430	X
37.00	13,790	
49.90	14,570	
72.10	15,640	
78.90	16,800	
Mean:		

Create a bar graph showing the different growth rates (include a bar for the mean growth rate also) for the two samples. Label both axes and don't forget your units.

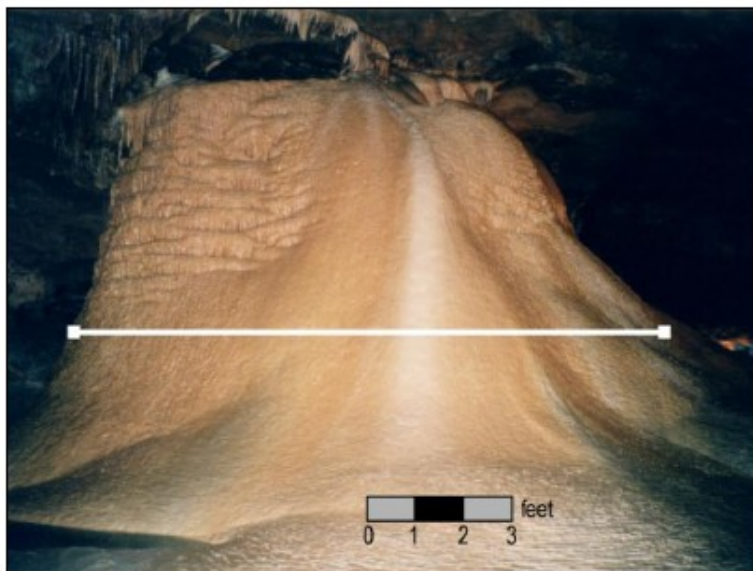
Inner Space Cavern Flowstone Sample



Natural Bridge Caverns Flowstone Sample



Use the scaled photographs below to estimate the diameter of the formations. Use the radius and the mean growth rate to calculate the approximate age. Be careful of the units. The scale only works for axes shown.

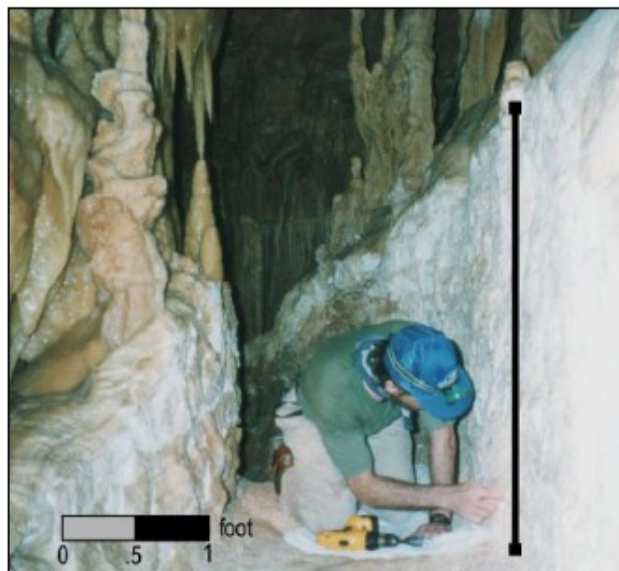


Flowing Stone of Time
Inner Space Cavern

Diameter: _____

Radius: _____

Age: _____



Flowstone Passage
Natural Bridge Caverns

Diameter: _____

Radius: _____

Age: _____

Discussion Questions

1. What are some factors that could influence growth rates?
2. Was the estimated growth rate faster or slower than you predicted?
3. Were the ages of the two formations you calculated younger or older than you hypothesized?
4. Using the growth rate for the Natural Bridge Caverns Flowstone sample, predict the approximate age of the Watchtower, given that it is 50 feet tall and approximately 7 feet in diameter. Assume both formations were formed under similar climatic conditions. (Hint → 1 inch = 2.54cm)