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Inner Space Cavern, Georgetown
Cave Field Activity: Mapping Fractures

Subject: Science

Grade level: 6-8, 9-12

Rationale or Purpose: Cave passages typically form along fractures and faults. On tours in Inner Space Cavern, students will be able to observe and measure fractures in the cave walls and ceiling. By recording fracture orientations on a cave map and later correlating them to a geologic map of Texas showing the Balcones Fault Zone, students will be able to see the role of fractures and faults in cave development.

Prior Knowledge: This activity assumes students have seen the Virtual Fieldtrip presentation of Inner Space provided at http://www.esi.utexas.edu/outreach/caves/virtualtours.php and are familiar with the following:

- Cave rules
- Identifying cave formations
- Using a compass

Materials per team (2-3 students):

1 compass
1 data sheet with cave map of Inner Space Cavern
1 small flashlight
1 pencil

Lesson Duration: The length of the cave tour plus 10 minutes before and 10 minutes after. Note: Orienteering activities outside of the cave would augment the lesson and allow for some groups to be in the cave while others stay on the surface.

TEKS Objectives:

Chapter 112-
Subchapter B
112.22-
1A- demonstrate safe practices during field and laboratory investigations
2B- collect data by observing and measuring
2D- communicate valid conclusions
4A- collect, analyze, and record information using tools
112.23
1A- demonstrate safe practices during field and laboratory investigations
2B- collect data by observing and measuring
2C- organize, analyze, make inferences, and predict trends from direct and indirect evidence
2D- communicate valid conclusions
4A- collect, analyze, and record information to explain a phenomenon using tools
112.24
1A- demonstrate safe practices during field and laboratory investigations
2B- collect data by observing and measuring

2C- organize, analyze, make inferences, and predict trends from direct and indirect evidence
2D- communicate valid conclusions
4A- collect, record, and analyze information using tools
14A- predict land features resulting from gradual changes such as mountain building, beach erosion, land subsidence, and continental drift

Subchapter C

112.49

1A- demonstrate safe practices during field and laboratory investigations
2B- collect data and make measurements using precision
2C- organize, analyze, make inferences, and predict trends from direct and indirect evidence
2D- communicate valid conclusions
6B- analyze the processes that power the movement of the Earth's continental and oceanic plates and identify the effects of this movement including faulting, folding, earthquakes, and volcanic activity
6C- analyze methods of tracking continental and oceanic plate movement
8B- identify geologic formations that result from differing weathering processes

Activity:

Prior to fieldtrip:

Step 1: Contact the cave and reserve your group tour time. They need to know the number of students, time and date of visit, and what activities you plan to do while you're at the cave (tour, sluice, lunch).

The day of the fieldtrip, BEFORE THE TOUR:

Step 2: Talk with the cave tour guide and explain your class' experiment (the guide may already be familiar with the activity).

Step 3: Group students into teams; hand out compasses, data sheets and cave maps.

Step 4: Explain how to take a compass bearing, see "Compass Review" section for instructions on how to use a compass.

Step 5: Practice on the surface using the cave map.

- What is the orientation of the cable car track? (A: 330° or 150°, depending if you look up or down the track. Both bearings are correct.)
- What is the general orientation of the tour path? Hint: fold the map and make a crease from Lake of the Moon to the end of the cable car track, then measure the orientation of the crease (A: 45° or 225°).
- Do you notice any trends in the orientation of the longer cave passages or rooms? (One possible answer: the tour path follows the longest rooms and they all head northeast/southwest.)

DURING THE TOUR

Step 6: When your group enters the cave, find your location on the cave map.

Step 7: Measure the orientation of a fracture in the ceiling together as a class. Compare and record answers. Observe and record characteristics of the selected fracture. IMPORTANT: metal objects and batteries affect the accuracy of a compass; keep compasses away from clipboards and flashlights.

Step 8: Students record bearings and locations for three major passages and 10 major fractures throughout the course of the tour and record them by filling out the data sheet provided below.

Modification: Inner Space Cavern is not wheelchair accessible.

Student Product: Students will fill out a data sheet marking the location of the observation and the orientation. A grading rubric is included with the student materials.

Closure: Discussion questions for once the cave tour is over:

- Why were some fractures more obvious than others?
- What was the most difficult part of mapping fractures?
- Why would you map fractures within a cave? What does it tell you?

Assessment or evaluation: Collect data sheets & compasses. Grade the students' work according to the evaluation rubric that follows the Cave Field Trip Activity worksheet.

Extension: **See post-visit lesson plan: Cave Formation Age Estimation.** In a post-lesson activity, students can interpret core data and use it to estimate the age of two cave formations in both Inner Space Cavern and Natural Bridge Caverns.

Compass Review

> Note: Not all compasses are the same. These directions are appropriate for the Brunton Nexus and several of the other beginner compasses. Check the instructions included in the packaging for more specific details about your compass.

To take a bearing:

- Point the arrow on the fixed portion of the compass in the direction of the desired bearing.
- Swivel the bezel of the compass until the red arrow frames the compass needle.
- Read the bearing from the numbers on the bezel that line up with the blue arrow.

To measure orientations directly from a map:

- Use the north arrow and the square edges of the map to guide you.
- Don't look at the needle; line the flat edge of the compass up with the border of the map.
- Swivel the bezel to line the hollow arrow up with the north arrow on the map.
- Move the compass over what you're measuring (keeping the flat edge parallel to the side of the map).
- Read the orientation off the bezel of the compass.

Team members: _____

Expedition date: _____

Cave Field Trip Activity: Mapping Fractures

Goal: Observe and measure cave passages and fractures in the cave walls and ceiling in order to investigate the role of fractures and faults in cave development.

Methods: Each team will locate and measure the orientation of 10 fractures and 3 major passages. Mark the location of your observation on the cave map provided and record your data in the table below.

Examine the cave map; can you observe any trends in the orientation of the passages? State your hypothesis: _____

_____

		Cave Formations (circle yes or no)			
Site (mark on map)	**Orientation** (in degrees)	**Stalactites** (on the ceiling)	**Soda Straws** (on the ceiling)	**Stalagmites** (on the floor)	**Water dripping**
Passage 1		Yes No	Yes No	Yes No	Yes No
Passage 2		Yes No	Yes No	Yes No	Yes No
Passage 3		Yes No	Yes No	Yes No	Yes No
Fracture 1		Yes No	Yes No	Yes No	Yes No
Fracture 2		Yes No	Yes No	Yes No	Yes No
Fracture 3		Yes No	Yes No	Yes No	Yes No
Fracture 4		Yes No	Yes No	Yes No	Yes No
Fracture 5		Yes No	Yes No	Yes No	Yes No
Fracture 6		Yes No	Yes No	Yes No	Yes No
Fracture 7		Yes No	Yes No	Yes No	Yes No
Fracture 8		Yes No	Yes No	Yes No	Yes No
Fracture 9		Yes No	Yes No	Yes No	Yes No
Fracture 10		Yes No	Yes No	Yes No	Yes No

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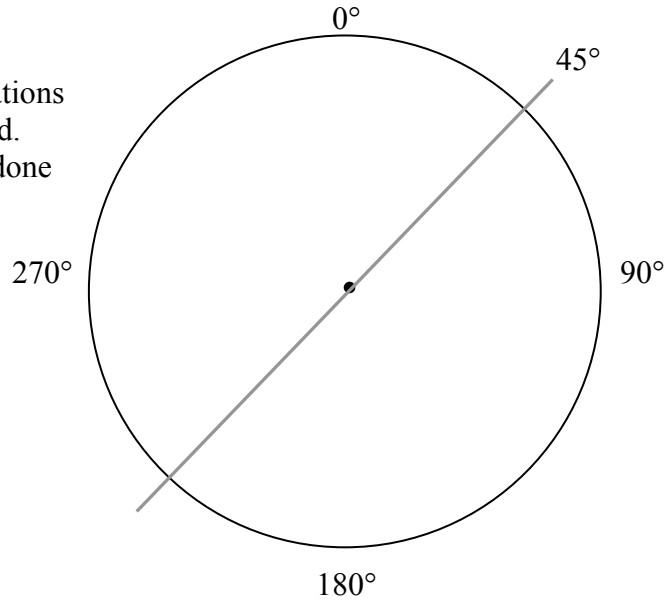
Data analysis: In the space provided below, use the data you recorded and your observations while on the tour to answer the following questions. Use complete sentences when appropriate.

1. In the circle to the right create a rose diagram by drawing a light line for each of the fracture orientations and bold line for passage orientations you observed. The general tour path orientation of 45° has been done for you as an example.

   Explain any trends you see in the diagram.



2. Explain any fracture characteristics did you observed in the cave? Typically, did they have formations or water drips?

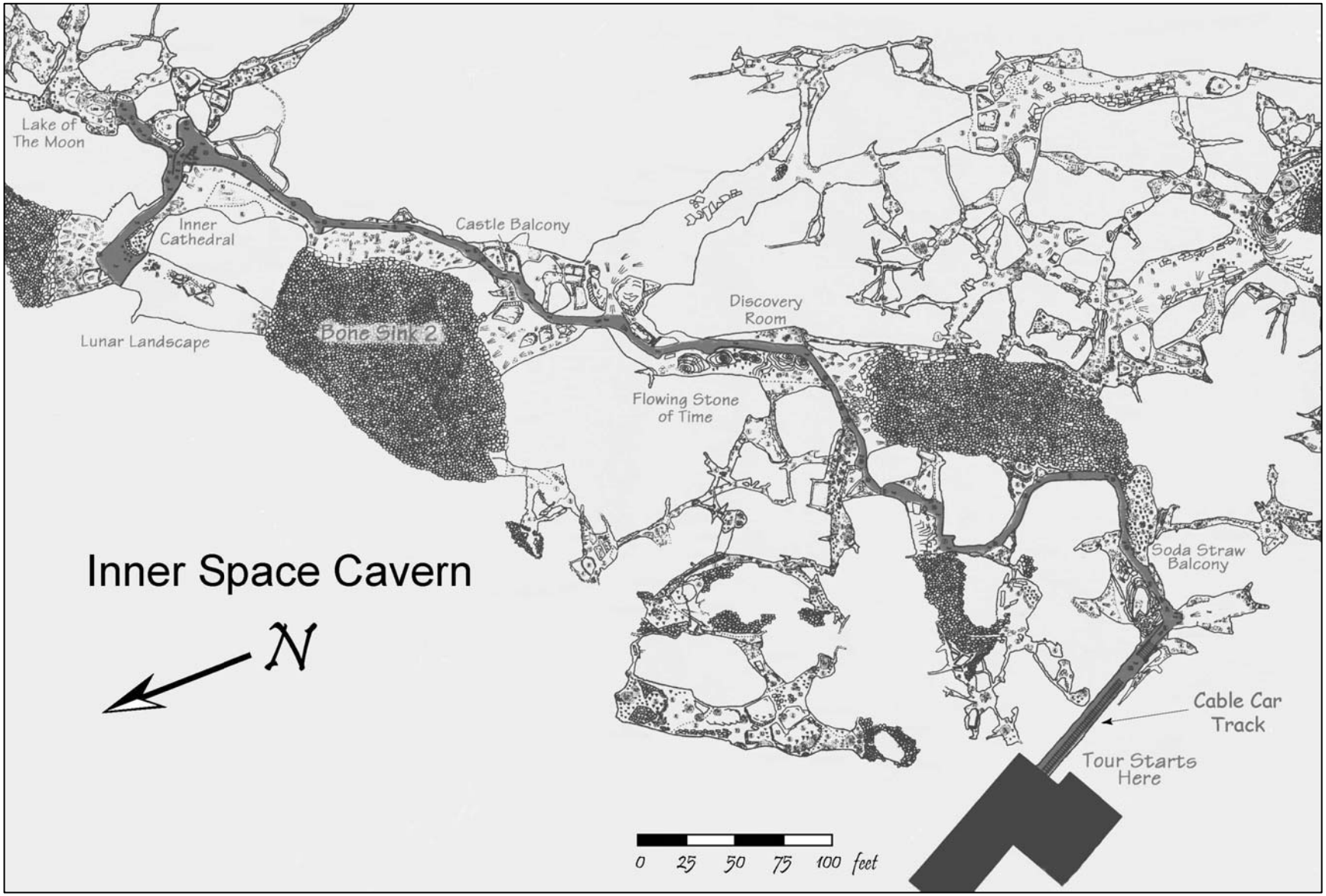
3. What evidence did you observe that indicates the role of fractures in controlling the flow of water through a cave?

4. Is there a correlation between the orientations of passages and fractures? Explain your answer.

5. Hypothesize how the passages formed.

Cave Map

Label the locations of each compass bearing directly on this map by using abbreviations such as P1 (for Passage 1) or F3 (for the third fracture bearing).



Cave Field Activity: Mapping Fractures

Grading Rubric

Circle the appropriate score for each category:

	Not Done	Poor	Average	Good	Excellent
Trip Safety					
Stayed with team and obeyed cave rules	0	4	8	12	15
				Points in this section:	
Data Collection					
Preliminary Data (as a class)	0	1	3	4	5
Passage Orientations and Formations Recorded	0	3	5	8	10
Fracture Orientations and Formations Recorded	0	5	10	15	20
				Points in this section:	
Data Analysis					
Graphing Orientations	0	5	10	15	20
Questions on Fractures	0	4	8	12	15
Questions on Formations	0	4	8	12	15
				Points in this section:	
				Total points:	/100