



Hot Lava Frozen in Time

Teacher Information:

Time Commitment: 1 hour and 15 minutes

Location: Ape Cave

There are two components to this activity. Students simulate the formation of a lava tube in order to gain a better understanding of its construction. Then, students develop and evaluate models about the formation of geological features in Ape Cave. Students will be better served if they have prior knowledge of the following vocabulary words:

- 1) Magma: molten rock beneath the surface of the earth.
- 2) Magma Chamber: an underground cavity containing gas-rich liquid magma that feeds a volcano.
- 3) Lava: molten rock that has erupted on to the earth’s surface through a volcanic vent.
- 4) Basalt: volcanic rock usually dark in color that contains 45 to 54% silica, and is generally rich in iron and magnesium. Typically flows great distances from its source.
- 5) Lava Tube: a cave or tunnel formed inside a lava flow. Lava tubes are created when the outer surface of a stream of lava cools and solidifies, but the molten interior continues to flow. After the molten interior drains away, a hollow tube or tunnel is left behind.

Goal:

- 1) Students will be able to use imaginative and analytical skills to develop and evaluate models about the formation of Ape Cave and the features within it.

Objectives:

- 1) Students will be able to describe how a lava tube forms
- 2) Students will be able to identify and describe how three geologic features within the cave formed.
- 3) Students will understand why collecting rocks, touching the cave walls and littering are prohibited in the cave, and will abide by the Monument regulations.

Essential Materials Needed:

- 1) Student worksheets on clipboards covered by plastic bags (cave ceiling drips).
- 2) Pencils (pens stop writing when they get wet)
- 3) One flashlight for each student, and/or one propane lantern for every five students.
- 4) Warm clothes (42 degrees F in Cave), rain jackets, sturdy shoes, and a first aid kit

More Hot Lava Questions	More Frozen in Time Answers
<p>E. This rock is called the “meatball”! How did it form?</p>	<p><u>Answer to Question E</u></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p>F. Basalt lava cools to form solid rock or does it. How can the lava be solid if water drips from the ceiling? Pick up a red or black rock for a clue. (Put the rock back in the same spot you found it after you answer this question.)</p>	<p><u>Answer to Question F</u></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p>G. Walk to the bottom of Ape Cave and look for evidence of something else that flowed into Ape Cave. Describe it and explain how you think it got here?</p>	<p><u>Answer to Question G</u></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>
<p>H. Ape Cave is 2 ¼ miles long, but geologists found evidence that indicates it was once about 4 miles long. What do you think shortened Ape Cave, breakdown or debris washed in the cave? Explain your answer.</p>	<p><u>Answer to Question H</u></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>

Teachers Answer Sheet for Hot Lava Frozen in Time

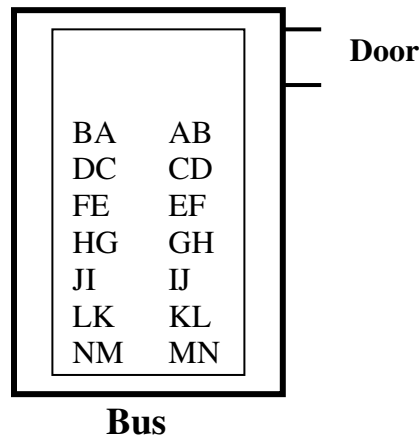
Hot Lava Questions	Frozen in Time Answers
<p>When the eruption of basalt lava began 1900 years ago, the 2000-degree lava flowed over the surface of the ground where the ceiling is today. As the eruption ended months later, the lava flowed over the surface of the ground on the cave floor.</p> <p>A. What are the lines on the cave walls and how did they form?</p> <p>B. Look up to the cave ceiling. If the lava once flowed over the surface of the ground 45 feet above your head, what happened to the ground it once flowed over?</p>	<p><u>Answer to Question A.</u> <i>The level of lava in the tube rose and fell as the eruption surged or slowed down. When it stabilized for a period of time, lava built up on the walls, making minor ledges or lines on the cave walls that reveal the depth of the lava (much like a ring is produced in a bathtub). The gutters are actually miniature cave walls. They formed when surges of lava flowed through the tube, but did not occupy the entire width of the passage. The height of the gutter reveals the height of the surge.</i></p> <p><u>Answer to Question B.</u> <i>As the lava flowed down a stream channel that was here 1900 years ago, its surface cooled, creating a hardened crust. The crust insulated the molten lava beneath, allowing it to travel great distances. The 2000-degree flowing lava beneath the crust melted and carried away the rock and soil in the stream channel. This thermal erosion deepened and widened the stream channel, forming cave walls [much like water deepens and widens river channel].</i></p>
<p>A lava tube can take a year or longer to cool, and as it cools lava shrinks or contracts.</p> <p>C. Look at the walls and ceiling and describe evidence that the lava cooled and shrank?</p> <p>D. You have walked over large piles of rock, and there is a large rock on the cave floor here. Where did this rock come from? Geologists would define this rock as being a piece of _____?</p>	<p><u>Answer to Question C</u> <i>When the eruption subsided, the lava drained out, leaving a tube. As the walls and ceiling cooled, they shrank, causing them to crack. The cracks on the wall are called contraction cracks.</i></p> <p><u>Answer to Question D</u> <i>Sometimes the cooling and cracking process weakened the walls and ceiling, causing them to collapse or breakdown. Piles of rock are referred to as breakdown. The rocks fit back into the walls and ceiling like jigsaw puzzle pieces. The large rock in question fell from the ceiling above. Also note the bright red soil baked by the lava flow that was exposed when the wall collapsed at this site. Most breakdown occurred when the cave formed 1900 years ago. 10,000 earthquakes were recorded in 1980, and no new breakdown was discovered in Ape Cave.</i></p>

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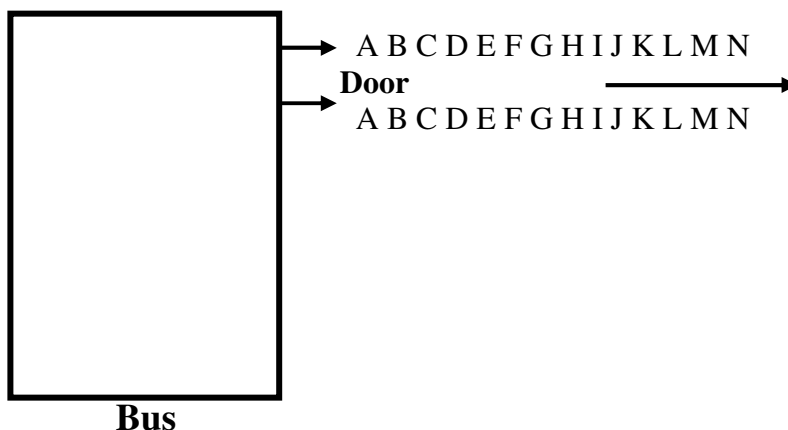
More Hot Lava Questions	More Frozen in Time Answers
E. This rock is called the “meatball”! How did it form?	<p><u>Answer to Question E</u></p> <p><i>The meatball is a round ball of lava that is actually a piece of breakdown that fell from the ceiling while lava was still flowing through the cave. It floated on the surface of the lava flow and was carried down stream until it became wedged and “welded” in a narrow spot, well above the current cave floor.</i></p>
F. Basalt lava cools to form solid rock or does it. The average thickness of the cave ceiling is 15 to 20 feet. How can the lava be solid if water drips from the ceiling? Pick up a red or black rock for a clue. (Put the rock back in the same spot you found it after you answer this question.)	<p><u>Answer to Question F</u></p> <p><i>Cracks in the walls and ceilings allow water to enter the cave, but most water percolates through millions of tiny holes that can be seen in the lava rocks. The holes reveal where gasses were once dissolved in the fluid basalt lava. Although the lava is in fact solid rock, the gas bubbles allow it to absorb water like a sponge. This is why it “rains” in the cave.</i></p>
G. Walk to the bottom of Ape Cave and look for evidence of something else that flowed into Ape Cave. Describe it and explain how you think it got here?	<p><u>Answer to Question G</u></p> <p><i>The ash and pumice blocking the bottom of Ape Cave was washed into the cave 450 years ago during an eruption of Mount St. Helens. The ash and pumice was deposited in flat sections of cave, but not on steeper slopes. A careful examination of the cave walls will reveal a subtle flow mark (a line of fine pumice and ash) that demonstrates the depth of the mudflow.</i></p>
H. Ape Cave is 2 ¼ miles long, but geologists found evidence that indicates it was once about 4 miles long. What do you think shortened Ape Cave, breakdown, debris washed in the cave, or both? Explain your answer.	<p><u>Answer to Question H</u></p> <p><i>The ash and pumice that washed into the cave 450 years ago plugged the bottom of Ape Cave. There is a ½ mile long blockage separating Ape Cave from another cave called Lake Cave. The same ash and pumice is found in Lake Cave, as well as flow marks indicating the two caves were once joined together. A narrow section or sections created by breakdown may have contributed to the blockage, but the true story is buried in the bottom of the cave.</i></p>

Instructional Sequence:

1. En route, explain how Ape Cave got its name. The cave formed 1,900 years ago, but wasn't discovered until 1951 when a logger named Lawrence Johnson stumbled upon it. He told a friend named Harry Reese, about his finding. Harry was the leader of a local youth group, and they were the first to explore the cave. A bigfoot story from this area inspired the group to call themselves the Mount St. Helens Apes, and they named the cave in honor of their group.
2. Shortly before you arrive, explain that Ape cave was formed during an eruption of basalt lava. Basalt lava is the type of lava erupted in the Hawaiian Islands. It is very fluid and can flow great distances. When you arrive at Ape Cave, liken the bus to the magma chamber of Mount St. Helens, and the doors the vent where lava flows out. Have the students disembark from the bus in a simulation activity representing lava-tube formation, as illustrated below:
 - A) Assign students a letter of the alphabet and have them disembark in alphabetical order. Student A's exit together, Student B's exit together, etc.



- B) As the first pair exits the bus, have them join arms and form an arch. As subsequent pairs exit the bus they must walk under the arch and then form another arch at the end of the line. Continue in this fashion until the last pair of students exits the bus. Walk under the long tunnel of arched arms and inspect the "lava tube".



3. Before you enter the “student lava tube” explain that you have found a hole in the ground that scientists call a *skylight*. Caves without skylights can’t be explored, because there is no way to enter them. Point to the tunnel of arched arms, and explain that you can see the roof of the cave. Remind the students that the roof insulated the hot lava beneath it, allowing the cave to form. Explore the student lava tube and point out “features”.
 - A. Enter the “student lava tube” and describe the cave walls and ceiling. Find a student with a horizontally striped shirt or belt on. Explain that stripes or belts are like lines and ridges on the cave walls called *flow marks*. Flow marks reveal the depth of the lava as it flowed through the tube.
 - B. Continue down the tube until you find a student with a zippered jacket, or something that could represent a vertical crack. Explain that when the lava cooled it shrank, causing it to crack. These cracks are called *contraction cracks*. Sometimes contraction cracks weakened the walls and ceiling, causing them to collapse or *breakdown*. Pretend to climb over a large rock or pull a student out of the “lava tube” and have him or her crouch down like a boulder. Explain that you can see where the rock fell from the ceiling, because it appears like it would fit back into the wall like a jig saw puzzle piece.
 - C. Complete your exploration and ask students and chaperones if they feel comfortable with the idea or ‘model’ of lava tube and cave feature formation? [*Lava tubes form when air-cools the top of the lava flow and it hardens. This keeps the lava underneath hot and fluid, allowing it to continue to flow. The hot fluid lava underneath the crust melts soil and rocks, cutting a deep channel, which forms the walls of a lava tube. When the lava drains out, it leaves a tube*] Discuss any questions that students raise, and explain that you will be testing their understanding of lava tube formation inside the cave.
4. Walk 300 feet up a paved trail to the cave entrance. Stop in the paved area overlooking the cave entrance, next to the kiosk with interpretive signs. At the overlook, set clear expectations for cave exploration behavior. Chaperones are responsible for supervising their group of student’s behavior while in the cave and for assisting students complete the worksheet “*Hot Lava Frozen in Time*”.
 - A. The teacher will remain in the lead at all times.
 - B. The collection of rocks or other features is prohibited--\$250 fine
 - C. Do not touch the cave walls. A thin whitish-tan life form, called cave slime, coats the cave walls and ceiling. Cave slime is killed when touched, and takes many years to re-grow (i.e. There is still evidence of graffiti from the 1950’s and 1960’s.)
 - D. No running or horseplay. Lava is sharp and can inflict serious injury when people fall on it.
 - E. Sound is greatly amplified inside the cave, so use quiet “indoor” voices.
 - F. Do not shine lights in other people’s eyes, and keep lights on at all times.

5. Enter cave and walk down the stairwells. Proceed 35 to 40 feet straight ahead (down cave) to a flat area with a smooth cave floor and stop. Explain that each group of five students is to find the geologic feature listed on their worksheets in the cave then suggest possible explanations for how they formed. Your explanations have to be consistent with our model of lava tube formation, and make logical sense. Encourage students to be creative and brainstorm as many reasonable explanations as possible, based on your observations and your basic model.
 - A. Explain that each group of five students and their chaperones should work together to answer questions A and B. Point to the ceiling, lines on the walls, and cave floor, and explain that they will need to look at these features to answer question A and B. Have your students write down as many ideas as possible about how they think these features may have formed.

6. Walk down cave another 30 feet to the end of the flat area, and proceed over gentle slope of loose rock. At the bottom of this sloping rock pile is another large flat area with a smooth cave floor. Proceed 30 feet straight ahead to a large (4 foot diameter) rock in the middle of the cave floor, and stop in front of the boulder.
 - A. Explain that each group of five students and their chaperones should work together to answer questions C and D. Point to the large rock in the middle of the cave floor, and to the cracks in the walls and in the ceiling. Explain that they will need to look at these features to answer question C and D. Have your students write down as many ideas as possible about how they think these features may have formed.

7. Remain in the lead and continue down cave for about ½ mile (20-minutes). As you proceed, the cave will gradually become narrower (10-12 feet high, 6-8 feet wide), until you reach the narrowest section, where adults will have to briefly lower their heads (Assure people that are uncomfortable with enclosed spaces that this narrow section does not last long, and that the cave will quickly widen). Walk about 75 feet past the narrow section and look up for the “meatball”, a perfectly round lava ball wedged in a narrow spot between the cave walls. Stop beneath the meatball.
 - A. Explain that each group of five students and their chaperones should work together to answer question E. Point to the meatball and explain that they will need to look at the meatball to answer this question. Have your students write down as many ideas as possible about how they think this feature may have formed.

8. Remain in the lead and proceed another about 20 to 30 feet. Look for a large hole on the right side of the cave wall with lots of loose red and black rocks in it. Stop in front of the hole.
 - A. Explain that each group of five students and their chaperones should work together to answer question F. Point to the ceiling, and rocks in the hole in the wall, and explain that they will be using these features to answer question F. Have your students write down as many ideas as possible about how they think water passes through solid rock.

9. Proceed to the bottom of the cave (about 5 minutes). When you reach a very narrow, sandy, two-tiered section, you have reached the bottom of the cave. Each narrow segment dead ends, but allow students time to explore the sections if they desire too (NOTE: students will get dirty if they do so).
 - A. Explain that each group of five students and their chaperones should work together to answer question G and H. The cave is very sandy here and there is a lot of white pumice rocks. Do not point out these features to students. Have your students observe the area and then write down as many ideas as possible.
10. Leave the bottom of the cave, and proceed back up to the parking lot (about 30 minutes).