

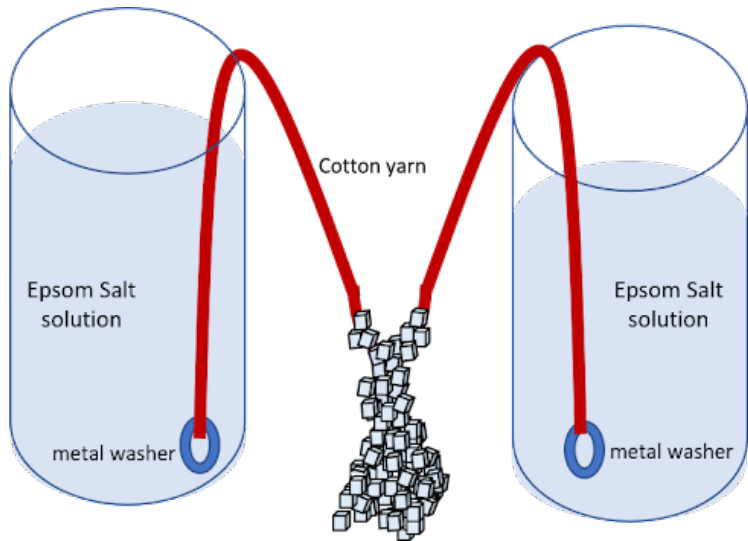
How do these rock structures form inside a cave?



Meramec Caverns, Missouri—How do these rock structures form inside a cavern?

- 1. Discuss with your classmates how you think these rock structures form inside Meramec Caverns.
- 2. Research the word ‘speleothem’ (mineral formations) to learn about these cavern structures. Take notes and use your information to evaluate the experiment below.
- 3. Evaluating an experimental design:
Look at the diagram to the right.

A group of students set up this experiment to model the formation of rock structures found in caves like those in Meramec Caverns. They dissolved Epsom salt in hot water and poured it into two containers. They tied a metal washer to each end of cotton yarn and put one end in each container. After a few days, they noticed small crystals forming on the yarn.



Using the diagram above and your research notes, describe how this experiment models the formation of rock structures (speleothems) like those in Meramec Caverns.

Do you think this model helps explain how cave structures (speleothems) can form? Why or why not?

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Image Information: The poster image shows geological formations made by mineral deposits inside the Meramec Cavern system. Found in the Meramec River Valley in the Ozarks of Missouri, these formations are called speleothems. They are formed when carbonate limestone is dissolved by water seeping through small cracks in the bedrock. Many factors affect the size, shape, color, and rate of formation development of these rock structures.

Question: *How do these rock structures form inside a cavern?*

Possible student answers: *Student might think the rock structures are formed by water moving through the area and carving out the cave, leaving behind these structures. Or that winds blow through the cave system and erode the rock. The cave might have been filled with water and the water drained away leaving these formations.*

Interesting Info: Cave formations involve rocks such as limestone containing calcium carbonate (CaCO3). Carbonate minerals are dissolved when rainwater (H2O), reacting with carbon dioxide (CO2) in the air and soil, forms a weakly acidic solution (carbonic acid, H2CO3). Other minerals produce speleothems of varying colors. Iron oxide or copper creates a reddish color, while manganese oxide produces a black or dark brown color. Pure calcium carbonate solutions are colorless and create the white, translucent structures. Temperature, water seepage and flow rates, along with surface conditions like ground cover, affect the rate of speleothem formation. Speleothem formations ‘grow’ over long periods of time and are useful tools in the study of climate change as they contain a paleoclimate record similar to ice cores and tree rings.

Support the Phenomena: Describe how this experiment models the formation of rock structures (speleothems) like those in Meramec Caverns. *The experiment models the formation of speleothems because the Epsom salt solution is like the groundwater that contains dissolved minerals. The washers anchor the yarn inside the cups allowing the saturated Epsom salt water to saturate the yarn. As the Epsom salt solution (mineral rich groundwater) is absorbed along the yarn it begins forming a drip where the yarn hangs down between the two containers. As the water evaporates, it leaves behind the salt crystals, mimicking how a speleothem begins to form.*

Do you think this model helps explain how cave structures (speleothems) form? Why or why not? *Yes. The experiment does model the formation of structures like those found in Meramec Caverns. The Epsom salt solution is like the water that has seeped through the limestone. The crystals that form along the yarn are like the mineral deposits inside the cavern.*

NGSS Science and Engineering Practices #2 – In K-2, students **use a model to represent patterns in the natural world**; In 3-5, students **use models to test cause and effect relationships**; In 6-8, students **develop a model to describe unobservable mechanisms**; In 9-12, students **revise the model to illustrate/predict the relationship between the components of the system**.

(Materials: Epsom salt solution (dissolve 3-4 teaspoons in each cup of hot water)); cotton yarn (30-50 cm); metal washers/ paper clips (to keep yarn end in cup); small plate under the drip area of the yarn.

- In K-2, have students recreate the two-cup experiment from their worksheet to see how crystals can form along the cotton yarn. Have them discuss how their experimental model is like the formations inside the cave.
- In 3-5, have students identify ways to change the experimental design (larger cups; different Epsom salt solution strengths; different types of yarn) to see if the change effects crystal development (smaller/larger crystals; fewer or greater crystal quantity).
- In 6-8, students recreate the two-cup experiment from their worksheet to produce crystals along the cotton yarn. They create an illustration describing the mechanisms (concentrated solution, absorption, evaporation) of how crystals form on the yarn.
- In 9-12, students modify the two-cup experimental design to predict/illustrate how changes in the model’s components (different salts; different solution concentrations; different types of yarn/string) effect the generation of crystal development.

More information: To learn more visit **Meramec Caverns**. For more information about natural caves, speleothems, and cave formations visit **National Caves Association** to see what activities they offer.