

"Hidden Worlds"
Science Article Assignment
Due Friday, Feb. 6, 2015

Name: _____ Period: _____

1. Answer the following questions on a **separate piece of clean paper**. Do not tear paper out of your notebook. This article is worth 92 points.

Vocabulary:

Speleologist – a scientist who studies caves

Dormant – not active

Microbes – very small organisms

Entomologist – scientist that studies insects

Bioluminescence – organisms, such as fire flies, that glow

1. In your own words explain how speleologists can survive in caves with temperatures reaching 100°F and a 100% humidity. Your explanation needs to be a full paragraph of five to six sentences. 15 points
2. In your own words explain how the Giant Crystal Cave in Naica, Mexico was formed. Be very specific. Your explanation needs to be a full paragraph of five to six sentences. 15 points
3. What are the largest known crystals in the world and how big can they get? Two part question. 8 points
4. What was the most exciting discovery that Penelope Boston made about the crystals? 8 points
5. What are *Arachnocampa luminosa* and where can they be found? 8 points
6. Paraphrase paragraphs 9 and 10. Your paraphrasing should be at least six to seven sentences. 20 points.
7. What will glowworms do if they are exposed to artificial light? 8 points
8. Explain how scientists were able to measure China's Miao Room. ***Be very specific.*** 10 points.

LIFE-SAVING SUITS

A person could survive for only about 10 minutes without these special cooling suits.

HOT SPOT

Liquid rock, or magma, heats the cave to 122°F.

HIDDEN WORLDS

Caves are mysterious places that hold remarkable secrets, from breathtaking mineral formations and enormous chambers, to out-of-this-world wildlife. Here are three of the most unusual caves on Earth.



RAZOR SHARP

The crystals are as sharp as knives and would cut your skin if you touched them without gloves.

CRYSTAL COMPOSITION

The crystals are made of gypsum—a compound used to make wall plaster.

GIGANTIC CRYSTALS

Some of the cave's crystals are 40 ft long!

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GIANT CRYSTAL CAVE

Najaa, Mexico

This cave might look icy and cold, but it's actually steaming hot—reaching temperatures of 50°C (122°F) and 100 percent humidity. Miners discovered this underground chamber filled with enormous crystals in 2000.

The Giant Crystal Cave is located 300 meters (984 feet) below Earth's surface. When researchers visit the cave, they have to wear protective suits and helmets. Suits are packed with ice and a fan system to circulate cool air that they breathe through face masks.

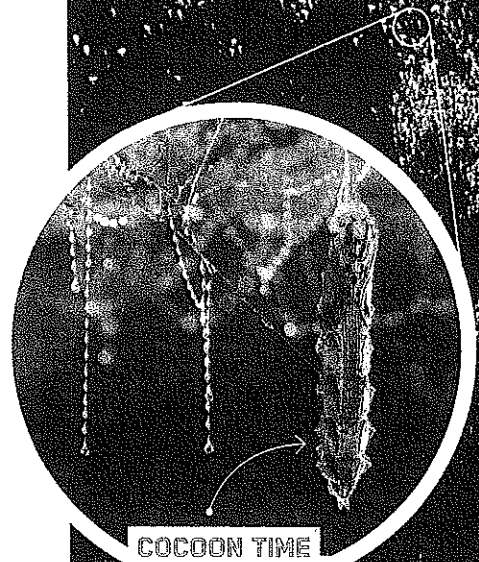
Still, "due to the extreme heat and humidity, you can't spend more than 30 minutes inside even when wearing the suit," says Penelope Boston, a *speleologist* (scientist who studies caves) at New Mexico Tech. "I once spent 55 minutes inside and almost died. My core temperature rose to 39°C (102°F), which caused my blood pressure to climb too high."

The cave's extreme heat is fueled by superhot *magma*, or liquid rock, found deep within Earth. About 20 million years ago, the magma forced its way upward, cracking Earth's crust. Acidic volcanic fluids seeped up through the cracks and slowly ate away at the crust's limestone rock. Chambers formed and became filled with these fluids. This liquid became saturated in minerals from the dissolved rock. The cave has no natural openings, so the mixture stayed at a relatively constant temperature. "These are the perfect conditions for growing crystals," says Boston.

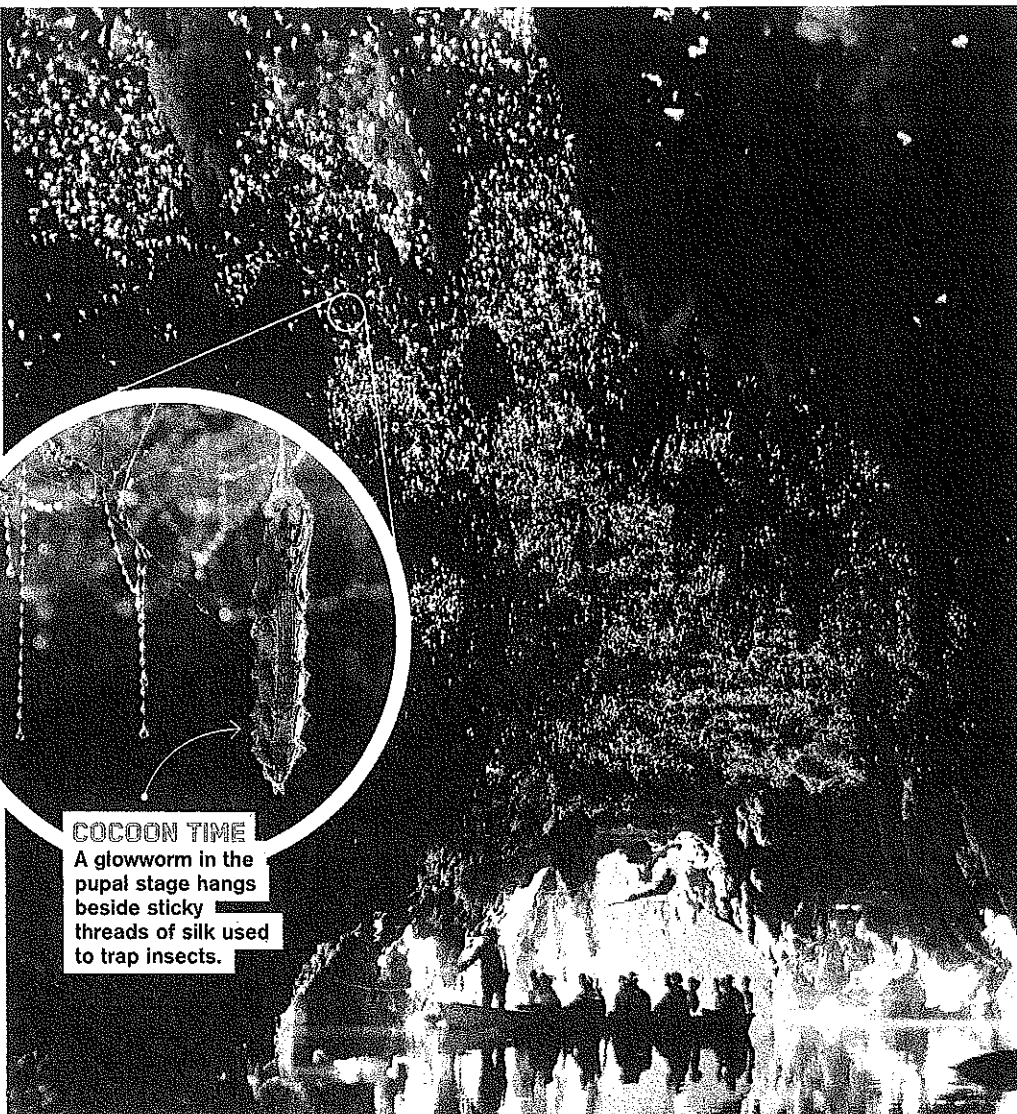
Over the past 10,000 to 500,000 years, gypsum crystals slowly formed. They're the largest-known naturally grown crystals in the world—some reaching about 12 meters (40 feet) long. The crystals are as sharp as knives and would slice your skin if you touched them without gloves.

Boston says the most exciting discovery she's made is within the crystals themselves. Tiny pockets in the crystals have trapped liquid that contains 10,000- to 50,000-year-old dormant microbes. Boston says that learning more about this "very unique population of critters" might tell us if life can exist in other extreme environments, like outer space.

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COCOON TIME
A glowworm in the pupal stage hangs beside sticky threads of silk used to trap insects.



GLOWWORM CAVES

Waitomo, New Zealand

Waitomo is home to one of the most unusual animals on Earth: *Arachnocampa luminosa*. This species of insect has evolved to live in a dark, damp environment and is found only in Waitomo's caves.

The insect starts its life as a glowworm, a worm-like *larva* (immature stage of development). It eventually undergoes *metamorphosis* into an adult fungus gnat fly, which resembles a large mosquito. "Both the glowworm and adult glow," says Rudi Schnitzler, an entomologist in New Zealand.

The animals glow by "burning" their poop, Schnitzler says. A light-producing organ in their abdomen gives off enzymes that, when they come in contact with oxygen, produce *bioluminescence* while breaking down waste. The more oxygen used to break down its waste, the more its body glows.

10 As larvae, the glowworms attach themselves to a cave's ceilings and walls. There they produce sticky silk threads that dangle down. Insects are attracted to the larvae's glow and get stuck in their sticky traps. The glowworms then pull the food into their mouths to eat.

Glowworms stay in this larval stage for up to a year and grow to about 4 centimeters (1.6 inches) long. Then they become a *pupa*. During this stage the glowworms encase themselves in a cocoon. After a couple of weeks, they emerge as an adult fly. The adults live for only a few days and never eat, but they glow to attract a mate.

Interestingly, "the glowworms dislike [artificial] light," says Schnitzler. "They will retract and turn off their glow when exposed to it." Visitors to New Zealand's Glowworm Caves have to shut off their flashlights if they want to see the spectacular show, he says.

A LONG HIKE
The chamber is 2,795 ft long—almost eight football fields could fit end to end.

BRIAN BRAKE/SCIENCE SOURCE (GLOWWORM CAVE); SOLVIN ZANK/NATUREP/LAMINDEN PICTURES (COCOON); ROBBIE SHONE/AURORA PHOTOS/CORBIS (MAO ROOM); STEFAN FICHTEL/NATIONAL GEOGRAPHIC CREATIVE (CAVE DIAGRAM)

MIAO ROOM

Ziyun, China

Scientists have recently measured the largest-known cave chamber in the world—the Miao Room in southern China. Its volume is 11 million cubic meters (390 million cubic feet). That's big enough to fit 130 jumbo jets inside.

"Caves form in *karst* regions, where it's relatively easy for water to dissolve rock," says Harley Means, a geologist at the Florida Department of Environmental Protection. Much of China's *bedrock*—the layer of solid rock that sits underneath the soil—is limestone, which dissolves easily.

As rain falls, it picks up carbon dioxide, creating a weak acid called *carbonic acid*. As the acidic rainwater filters into cracks in the bedrock, *calcite* (a compound that makes up limestone) dissolves away. After millions of years of *erosion*, a cave is carved out.

To measure China's Miao Room, a team of explorers used a *laser scanner*. This high-tech device shoots beams of light outward. The beams hit an object and bounce back to the scanner. The scanner times how long it takes for each beam to return and calculates the distance to the cave wall. Millions of these measurements were combined to create a 3-D map of the cave.

"Now we're able to 'travel' through the caves in the computer and make it quite realistic," says Andy Eavis, an explorer from England who led the expedition. "We can play around with virtually putting jumbo jets, the Eiffel Tower, and the White House into the chamber to give an idea of the cave's enormous scale."

—Andrew Klein



CORE QUESTION

Explain the difference between how the Giant Crystal Cave and the Miao Room formed.

Boeing 747
(shown for scale)

COLOSSAL CAVE

More than 130 jumbo jets could fit inside the chamber, which reaches 627 ft in height.

3-D CAVE MAP

Using data collected on the team's expedition, researchers created a 3-D map to virtually explore the Miao Room.