

CLASSROOM ACTIVITY

Caving for Cures: Mining Drugs from Nature

Brian Bachmann, an assistant professor of chemistry at Vanderbilt University, has combined his professional interest in natural products drug production with his hobby of caving to set up the first systematic program to search for novel drugs produced by cave-dwelling microorganisms. Each microbe can produce tens of thousands of molecules, of which one to ten may have drug-like potential. Cave ecosystems are untapped reservoirs of biodiversity in which there is fierce competition for a limited supply of nutrients. Microbes that thrive in these highly competitive environments are good candidates for producing compounds that can be used to fight disease.

CLASS DISCUSSION

Establish Prior Knowledge

Discuss antibiotics with students. Use the following questions to guide the discussion. If students have difficulty answering the questions divide them into small groups. Assign one question to each group and have the group do Internet research to find the answer.

- What are antibiotics? *(Answers may include: a drug that kills or inhibits the growth of microorganisms such as bacteria.)*
- Where do antibiotics come from? *(Answers may include: Many antibiotics, such as penicillin, are derived from microbes found in nature. Others are synthetically manufactured.)*
- How do antibiotics work? *(Answers may include: Antibiotics target bacterial cell structures: the cell wall, protein synthesis, nucleic acid synthesis, metabolic pathways or the cell membrane.)*
- Why do scientists continually search for new antibiotics? *(Answers may include: Overt time, bacteria adapt and change so that the antibiotic is no longer effective.)*

Explain to students that in the video they are about to see, scientists explore caves to find microorganisms that one day may become nature to find bacteria that have drug-like potential.

Exploration

Have students watch the video and take notes. Use the following questions to guide a class discussion.

- How are synthetic molecules and natural molecules different? *(Answers will include: Natural molecules are biologically active and interact with biological systems in specific ways. With synthetic molecules there is no guarantee that they will interact with a biological target.)*
- Why are the scientists going into a cave to look for microorganisms? What makes cave organisms unique? *(Answers may include: A cave is cut off from sunlight, so no photosynthesis takes place. The organisms that survive in the cave environment have to compete for limited nutrients, so they have developed a variety of offensive and defensive processes. They attack and subdue one another by creating antibiotics. These compounds might have the potential to be used to make drugs.)*
- What is a metabolome? *(Answers may include: A metabolome is the tens of thousands of molecules produced by a single microbe. Only one to ten molecules in a metabolome have drug potential.)*
- How do scientists use modeling to determine if a microbe has drug-like potential? *(Answers may include: They identify the chemical framework of the molecule and create a three dimensional model of it. They use computer modeling to see if the particular shape of the molecule will fit a biological receptor in another molecule. The shape and chemical properties of a molecule will determine its biological activity.)*

CLASSROOM ACTIVITY

Caving for Cures (cont'd)

Wrap-Up

The scientist says that it can take over a decade and hundreds of millions of dollars to develop a drug that can be used in humans from a bacteria that kills a microorganism in a petri dish. Considering the time and money spent developing antibiotics, do you think the drug companies a right to charge high prices for these drugs?

(Answers will vary. Have students support their answers.)