How Giant Tube Worms Survive at Hydrothermal Vents

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Abbreviated Film Guide
Educator Materials

OVERVIEW

The HHMI film *How Giant Tube Worms Survive at Hydrothermal Vents* is one of 12 videos in the series "I Contain Multitudes," which explores the fascinating powers of the *microbiome*—the world of bacteria, fungi and other microbes that live on and within larger forms of life, including ourselves.

In 1977, scientists discovered a diverse community of organisms inhabiting the deep-sea hydrothermal vents of the Pacific Ocean. While they had long predicted the presence of deep-sea vents on the ocean floor, they did not expect to find animal life there in the absence of sunlight. The sources of energy in these ecosystems are hydrogen sulfide (H_2S) and other inorganic chemicals that are abundant in the water that rises from the vents. Some species of bacteria can use these inorganic compounds in chemical reactions to produce sugar and other organic molecules in a process called chemosynthesis. The surprising discovery was that chemosynthesis could support a large and diverse ecosystem. Some animals living near hydrothermal vents, such as the giant tube worm, *Riftia pachyptila*, have a symbiotic relationship with species of chemosynthetic bacteria. In *How Giant Tube Worms Survive at Hydrothermal Vents*, Dr. Colleen Cavenaugh describes how she first uncovered this symbiotic relationship and what it means for life deep in the ocean.

KEY CONCEPTS

A. Through advances in engineering and technology, scientists have been able to explore new habitats and discover new life forms and metabolic strategies.
B. Most ecosystems on Earth are sustained by photosynthesis at the base of the food chain. Hydrothermal vent ecosystems are powered by a process called chemosynthesis that produces energy from chemical reactions.
C. Like photosynthesis, chemosynthesis results in the production of sugar and other organic compounds through the fixation of CO_2, but it uses chemicals like H_2S as the energy source rather than sunlight.
D. Symbiosis is a close, long-term interaction between two or more different species of organisms. In some cases, both species benefit from the symbiotic relationship.

CURRICULUM CONNECTIONS

Standards	Curriculum Connections
NGSS (2013)	LS1.C, LS2.A, LS2.B
AP Biology (2015)	2.A.2, 2.D.1, 4.A.6, 4.B.2, 4.B.3
AP Environmental Science (2013)	I.A, II.A, II.B
IB Biology (2016)	2.9, 4.1, 4.2
IB Environmental Systems and Societies (2017)	2.1, 2.3
Vision and Change (2009)	CC2

PRIOR KNOWLEDGE

Students should

- have a basic understanding that organisms need energy to survive
- be familiar with the flow of energy through ecosystems
- be familiar with the process of photosynthesis and its importance in converting light energy into food.

KEY REFERENCE

Cavanaugh, C. M. Microbial symbiosis: Patterns of diversity in the marine environment. *American Zoology*, 34:79-89. (1994)