Activity #6 - Hydrothermal Vent Food Web

Objective:

Students will make a food web diagram of the hydrothermal vent community and show the flow of energy and materials in this ecosystem.

Materials:

- hydrothermal vent organism cards
- art paper
- marking pens

Procedures:

1. Teacher gives lesson on food chain levels: producers, consumers, carnivores, top carnivores and decomposers.
2. Obtain a set of organism cards. Read the cards. Determine the correct position of each card on the food web chart. (Enlarge this chart using art paper and marking pens)

Simple Chemicals →	Primary Producers →	Primary Consumers →	First Order Carnivores →	Top Order Carnivores

Draw arrows connecting each member with the animals that eat it. The arrow points to the eater. The arrow's direction indicates the direction of energy and material flow in an ecosystem. When the arrows are all drawn, they resemble a spider web...hence the name "food web."

1. Use your food web to list 3 food chains. Begin with simple chemicals and include producers, consumers, carnivores and decomposers in your food chain.

2. Share one food chain with the class

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Evaluation:

- Some hydrothermal vents seem to last only a few years, others may last many decades. But at some point the vent stops releasing hot, sulfide-rich water. When a vent stops, the living community faces big changes. Which is the first member of the community affected? (Bacteria are the first trophic level of the community affected, since they need hydrogen sulfide from the vents to carry out chemosynthesis).

- The tubeworms and mussels depend upon chemosynthetic bacteria for food, and they would probably die out next, with the rest of the food web collapsing quickly thereafter. Hydrothermal vents are not found close to one another. Vent organisms might possibly be produced at one vent and travel to a new one drifting in their planktonic larval stage. List some characteristics of the vent larvae that might improve their chances of survival and ability to colonize new habitats. (Larvae are long lived, highly mobile and contain rich food reserves. They may have large eyes or chemical sensors to be able to detect new vent habitats at a distance and migrate towards them. They may possess camouflage, spiny appendages, poison or foul taste that would prevent them being eaten along the way.)

- What do you think might cause a hydrothermal vent to stop venting? (Shifting of plates and movement of rocks deep within the crust may close off certain vents and open others.)

- Scientists were amazed to find life at hydrothermal vents. They have begun to think that life may be able to exist in other areas first thought to be too hot or too cold. What might this mean in terms of seeking life on other planets? (The discovery of a complex biological community in the deep sea vents has given scientists cause to consider the possibility that organisms may be able to survive in habitats we once thought incapable of supporting life.)

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Photo -Woods Hole Oceanographic Institute

Vent Tubeworm, *Riftia pachptyla*

Tubeworms have no mouth, eyes, or stomach (“gut”). Their survival depends on a symbiotic relationship with the billions of bacteria that live inside of them.

Photo -University of Delaware

Pompeii worm, *Alvinella pompejana*

The most heat-tolerant animal on Earth, able to withstand a bath as hot as 176°F. The gray “fleece” on its back is actually bacteria which the worm feeds upon.

Vent Mussel, *Bathymodiolus childressi*
(Mollusca: Mytilidae)

Bacteria in these mussels convert methane to food, so they have an abundant food supply all year round.

Image - Deep Cove Trading New Zealand

Vent Ratfish, *Hydrolagus affinis*
(Pisces: Chimaeridae)

The vent ratfish is a carnivore and feeds on a variety of animals smaller than itself. It eats crabs, shrimps, smaller fish and the vent mussel.

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Galatheid crab, *Munidopsis alvisca* also known as a "squat lobster"

Squat lobsters are small crustaceans that roam about the vent ecosystem feeding on small animals and debris.

Vent Octopus, *Graneledone pacifica*

Octopus are very active, carnivorous mollusks. They capture other animals such as crabs, shrimp and mussels.

Image-Richard Lutz, Rutgers University, Stephen Low Productions and Woods Hole Oceanographic Institution.

Zoarcid fish - An eelpout, *Pachycara gymninium*

These two-foot long white fish are top predators around vents. They eat everything from tubeworms to shrimp. Despite their huge appetites, these fish are slow and lethargic. They spend a lot of time floating around clumps of tube worms and mussels.

Vent Tube-Dwelling Anemones, *Cerianthus* sp.

Tube anemones of the genus *Cerianthus* attach themselves to the sea floor and capture animals with their stinging tentacles. Most are found in shallow waters, the vent species thrives 1.5 miles below the surface.

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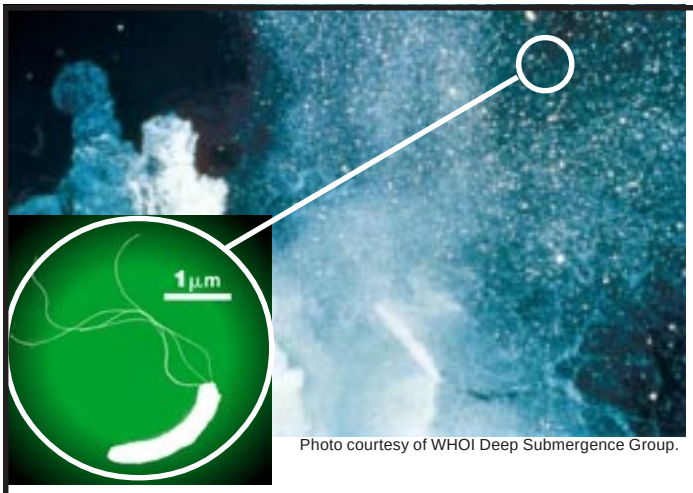

Photo courtesy of WHOI Deep Submergence Group.

Single Bacterium Photo - Craig Taylor+Carl Wirsen,
Woods Hole Oceanographic Institution

Vent Bacteria, *Arcobacter sulfidicus*

The four long tails on the vent microbe are flagella that help propel it through the water. It uses the process of chemosynthesis to produce carbohydrates from the hydrogen sulfide that pours out of the vents. These bacteria—like plants in most other ecosystems— form the base of the food web in vents.

Blind Vent Shrimp, *Rimicaris*

This is the species of white shrimp that swarm the black smoker chimneys, feeding on the bacteria that live there.

Photo by Al Giddings © National Geographic Society

“Dandelion” Siphonophores

The animals in these colonies are related to the Portuguese-Man-O- War and other jellyfish. They use long whisker-like tentacles to anchor themselves on rocks and to move around. The sting and eat shrimp and other animals and it may also be that the dandelions are scavengers.

Vent Clam
Calyptogena magnifica

Vent clams form beds in the cracks that form in the lava. They thrive on the bacteria which live inside their tissues. Luis Hurtado of the Monterey Bay Aquarium Research Institute has found evidence that the bacteria may have lost their ability to reinfect *C. magnifica* from the environment and are passed on by the mother to her eggs.

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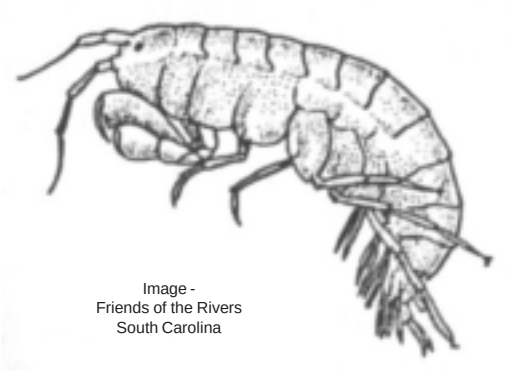


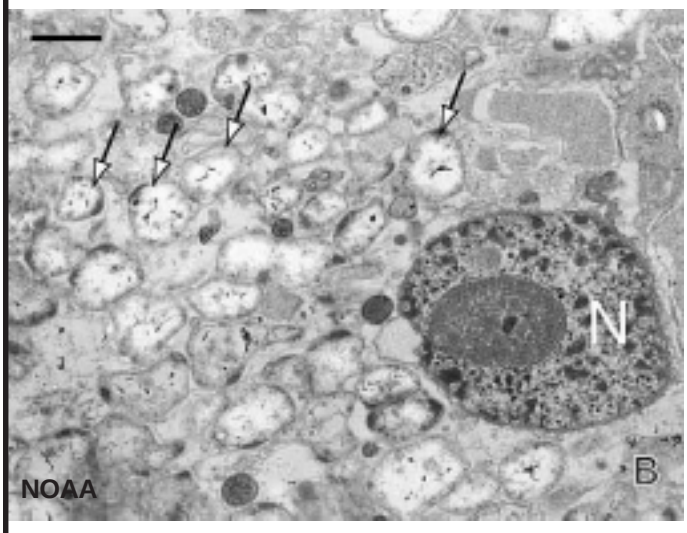
Image -
Friends of the Rivers
South Carolina

Vent Amphipod, *Ventiella sulfuris*

A small crustacean, related to crabs and lobsters, found embedded in bacterial mats around the vents. Probably feeds directly on the bacterial mats.

Blind Brachyuran Crab, *Bythograea thermydron*

These crabs live around vent sites in the Pacific Ocean. These round white crabs are fierce predators. They eat bacteria, shrimp, mussels, clams, tubeworms, and even each other.



Symbiotic Chemosynthetic Bacteria

Endosymbionts of vent bivalves. A. Methanotrophic (large arrows) and sulfide-oxidizing (small arrows) bacteria in mussel gills. B. Sulfide-oxidizing bacteria (arrows) in clam gill cells. N = nucleus; scale bars = 1mm.

Vent Zooplankton

Drifting animals in the water column find plenty of food in the form of the chemosynthetic bacteria which thrive in the hot sulfide water.

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sample/simplified food web