

Weird, Red, and Slightly Gross!

"OK, we're 8,000 feet deep now..."

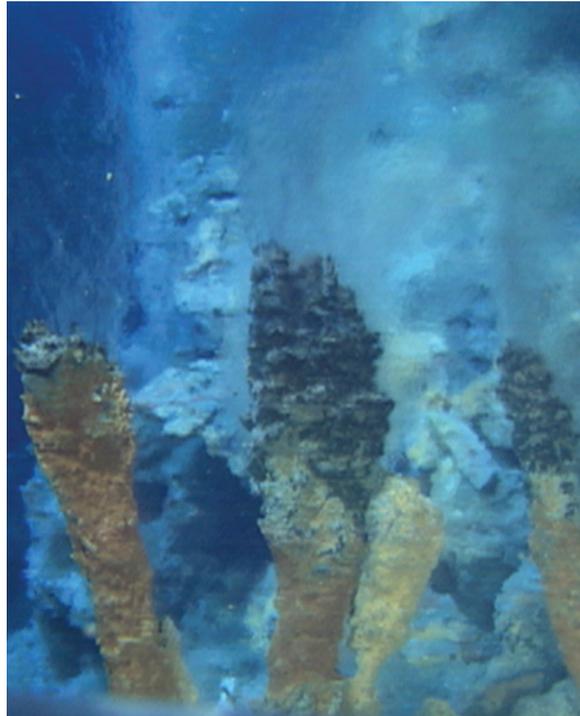
Hey, there's something on the bottom that looks like twisted stone chimneys with some kind of hot fluid jetting out from the top...

Wait a minute...there's all kinds of animals down here; giant clams and huge red worms sticking out of eight-foot-long tubes...

Believe me, no one has ever seen anything like this before..."

These observations, made on February 17, 1977 aboard the deep-diving submarine Alvin, were one of the biggest scientific discoveries of the last century: a totally new ecosystem thriving at near-freezing temperatures in the total darkness of the deep Pacific Ocean, and under water pressure more than 275 times greater than the pressure at sea level.

These ecosystems, now called "hydrothermal vent communities," do not depend upon green plants and sunlight for their food. Instead, they are able to use chemicals in the hot fluids pouring out of the twisted



Photograph of three small (12 inches tall) actively venting spires sitting on top of one of the chimneys in the Black Forest vent field. The chimneys themselves are about 23 feet tall. The fluids here are venting at 240°C (464°F) and are expelling black (mineral-rich) smoke into the ocean.

stone "chimneys." This process is called "chemosynthesis." Most hydrothermal vent animals aren't able to use these chemicals all by themselves. Instead they have partnerships with other organisms, usually bacteria. The tubeworms, for example, have a large organ called a trophosome, that contains chemosynthetic bacteria. They do not have a mouth, stomach, or intestines. The worms have long tentacles that stick out from the end of the tube. Inside the tentacles, the worms' blood contains hemoglobin (like human blood) that can absorb chemicals from the surrounding water. The blood carries these chemicals to bacteria living in the trophosome. The bacteria produce food that provides nutrition to the tubeworm.

In May, 2002, the NOAA's Ocean Explorer Galapagos Rift Expedition revisited the site where hydrothermal vents were first seen. See <http://oceanexplorer.noaa.gov/explorations/02galapagos/logs/photolog/photolog.html> for photos and videos from the expedition.

What You Will Do

Make a three-dimensional model of a giant tubeworm

What You Will Need

1. Materials that can represent parts of the tubeworm (see the drawing below). Here are some ideas, but with a little imagination you can probably find lots of other things to use:
 - Cardboard tubes (mailing tubes or paper towel rolls) for the trunk and tube
 - Pipe cleaners for tentacles
 - Modeling clay or papier mâché (news-paper and glue made from flour and water) for the vestimentum
 - Sponge for the trophosome
 - Small corks or pieces of round cereal can represent bacteria
2. Other supplies: glue, scissors, poster board, colored markers, and/or spray paint
3. Optional: a rotten egg in a tightly-closed jar

How to Do It

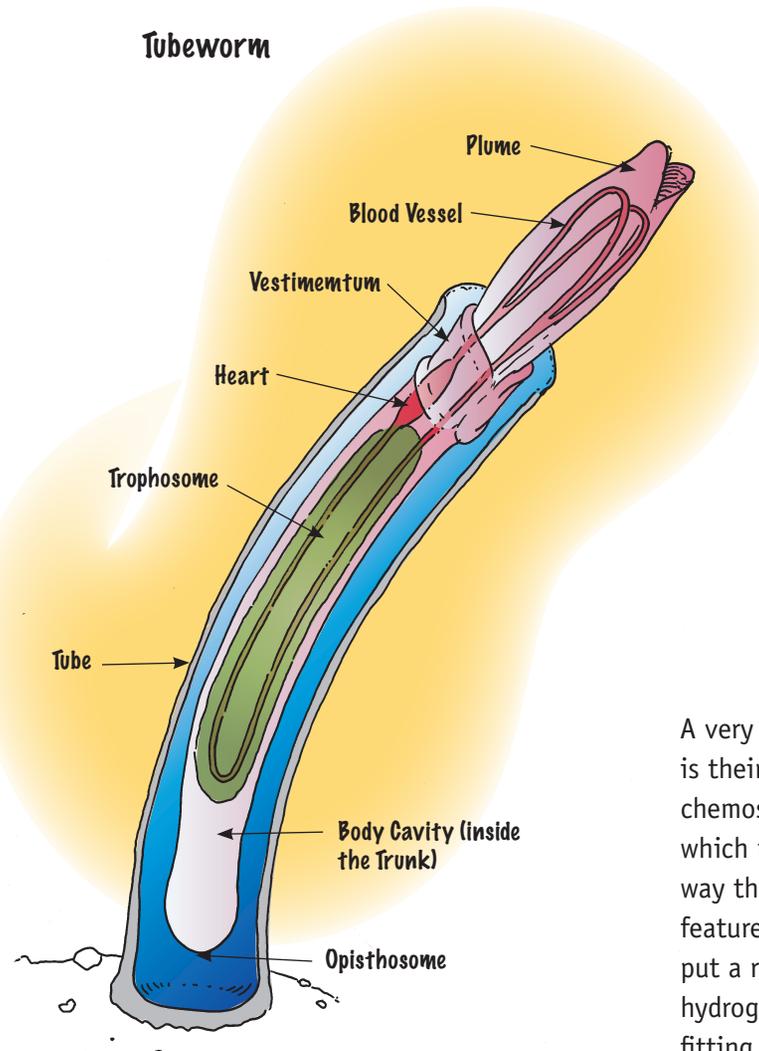
Since most of a tubeworm is hidden inside the tube, you should build your model as a “cut-away” (also called a cross section) so that the major structures can be seen. Here are the parts of a tubeworm that should be included in your model:

- **Tentacles** – All the tentacles together are call the “Plume”; these should be colored red, since they contain hemoglobin.
- **Vestimentum** – This is a muscular structure that has several functions:
 - It helps to hold the worm in its tube;
 - It generates new tube material;

- It contains pores that release sperm or eggs during spawning;
- It contains the tubeworm’s version of a heart and a brain.
- **Trophosome** – This dark green-brown organ has a spongy texture, and contains bacteria

that use oxygen, carbon dioxide, and hydrogen sulfide to make food for themselves as well as the worm; be sure to include something that represents bacteria (there are billions of bacteria in the trophosome, but you don’t need to include all of them in your model!)

- **Trunk** – This is where waste is stored, since tubeworms have no mouth, stomach, intestines, or anus (nasty, maybe, but it works for the tubeworm!)
- **Tube** – This is a hard hollow cylinder, and provides protection for the worm like the shells of other animals. The tentacles can be pulled completely inside the worm to avoid predators.
- **Opisthosome** – This organ (like the vestimentum) produces new tube material and helps anchor the worm in its tube.



A very noticeable feature about tubeworms is their smell. One of the chemicals used by chemosynthetic bacteria is hydrogen sulfide, which is what makes rotten eggs smell the way they do. If you want to include this feature in your model, you should probably put a rotten egg (or other source of hydrogen sulfide) in a glass jar with a tight-fitting lid so you can control the smell.

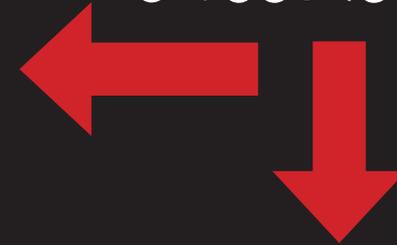
Want to Do More?

1. Visit <http://www.whoi.edu/oceanus/view-Article.do?id=2400> to find out about black smokers (the "chimneys" around hydrothermal vents that emit hot fluids).
2. Visit <http://www.pmel.noaa.gov/vents/home.html> for more information and activities on hydrothermal vent communities.
3. Visit <http://www.divediscover.whoi.edu/vents/index.html> to learn more about the discovery of hydrothermal vents, including recordings of scientists aboard the submarine *Alvin*.
4. Visit <http://oceanexplorer.noaa.gov/explorations/02fire/logs/magicmountain/welcome.html> for fly-through movies of the Magic Mountain hydrothermal vent site on Explorer Ridge (in the northeastern Pacific Ocean, about 150 miles west of Vancouver Island, British Columbia, Canada).

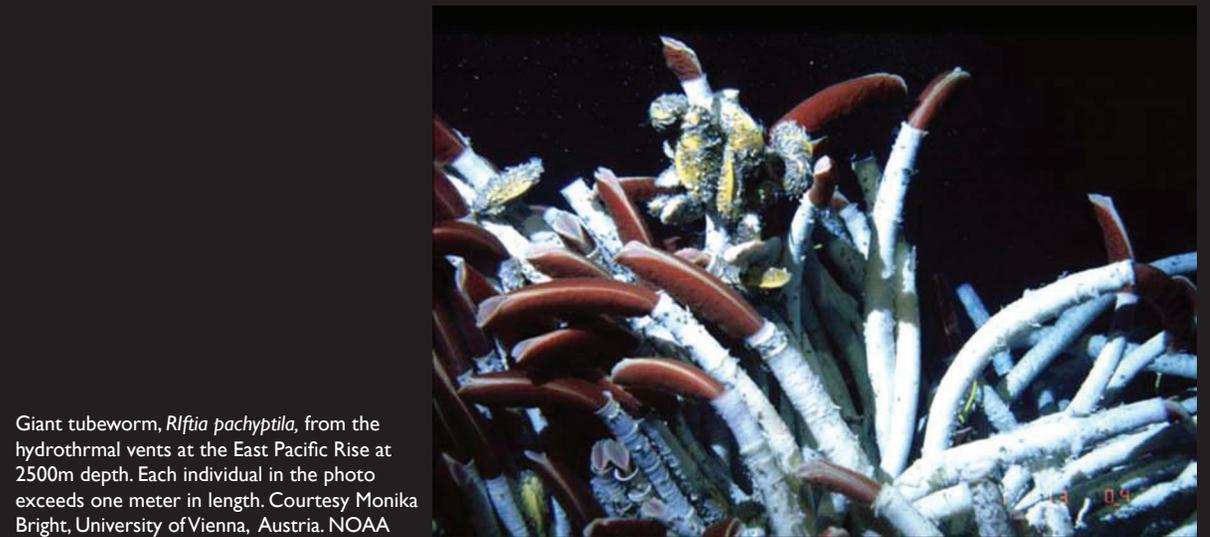
This activity is adapted from "Let's Make a Tubeworm!", a lesson from the Ocean Explorer 2002 Gulf of Mexico Expedition ([http://oceanexplorer.noaa.gov/explorations/02mexico/background/edu/media/gom_tube_gr56.pdf](http://oceanexplorer.noaa.gov/explorations/06mexico/background/edu/[http://oceanexplorer.noaa.gov/explorations/02mexico/background/edu/media/gom_tube_gr56.pdf)); by Mel Goodwin, The Harmony Project, Charleston, SC.



WOW!!!!
 These tube worms
 are about
 3 feet long!



Riftia tubeworms, mussels, and scavenging crabs found at the hydrothermal vent site East Wall, located at 90 North on the East Pacific Rise. Photo courtesy of C. Van Dover, NOAA.



Giant tubeworm, *Riftia pachytila*, from the hydrothermal vents at the East Pacific Rise at 2500m depth. Each individual in the photo exceeds one meter in length. Courtesy Monika Bright, University of Vienna, Austria. NOAA