

Expedition 14 - Dive & Discover Explorations of the Seafloor
See Due Date in Greensheet or in Module Area of Canvas

Expedition Objective:

- In this expedition, we will examine an incredible marine ecosystem, which was unknown 30 years ago. The discovery changed our understanding of life on this planet and elsewhere in the solar system.
- **Homework** - post in your expedition learning group according to the instructions in the Module Area of Canvas for this expedition

Part I - Going Deep with Alvin on a Dive of Discovery

1. Examine the video and photographs of these amazing creatures living in hot springs in underwater volcanoes!
2. View at: <http://youtu.be/rfOF2FdZksU>

Immediately drag fast forward to the 12:00 minute mark and watch until the 18:50 mark (7 minutes)

Where does your dive with Alvin begin?

What did the scientists aboard Alvin discover in 1977?

What seafloor feature is the location for the dive?

What do they see out the porthole?

What are hydrothermal vents?

How does the vent ecosystem survive?

Part II - Inside an active, underwater volcano along a mid-ocean ridge, the Juan de Fuca Ridge off Oregon and Washington

Go to: http://oceansjsu.com/105d/exped_dive/1.html

1. Introduction - Welcome to Our Dive into an Underwater Volcano

Examine the video and photographs of these amazing creatures living in hot springs in underwater volcanoes!

We will venture inside an active, underwater volcano along a mid-ocean ridge, the Juan de Fuca Ridge off Oregon and Washington, to view bizarre organisms that were discovered by accident during a dive with the submersible Alvin in 1977.

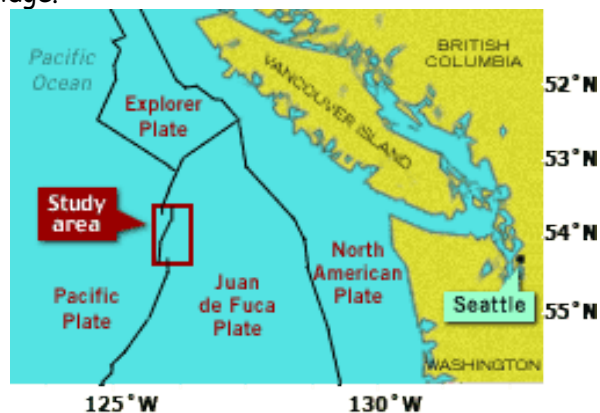
2. The Setting - Plate Tectonics and Seafloor Spreading - Earth's Oceanic Crust

How is the seafloor and the Earth's crust constantly forming at the bottom of the sea, along a volcanic mountain range, called the mid-ocean ridge?

3. Let's Begin Our Research Expedition!

Let's board the ship and steam towards the survey site located off Washington.

We have already generated a map of the seafloor using a multibeam sonar system attached to the bottom of our ship, so now create a detailed map of a small portion of the mid-ocean ridge off Oregon and Washington consisting of the Juan de Fuca Ridge and the Explorer Ridge.



We will first use an *Autonomous Benthic Explorer*, more commonly known as *ABE*, which is the first underwater robotic vehicle of its kind. *ABE* was designed and built at the [Woods Hole Oceanographic Institution \(WHOI\)](#) in the mid 1990's.

Where will you study the vents?

Describe how you acquired the data to find the underwater volcanoes?

4. How Do We Find Individual, Active Volcanoes Along the Mid-Ocean Ridge?

Once we have collected the seafloor mapping data with ABE, let's produce animations of "flying over" the seafloor. Use these animations to identify the seafloor volcanoes, above which we will begin studying the overlying waters to see if these are sites of active hot springs.

Describe how you used visualization methods to examine the seafloor in the vicinity of the mid-ocean ridge to locate potential regions of hydrothermal vents?

5. How Do We Locate Hot Springs Within the Underwater Volcano?

Next let's use water bottles to collect water samples, deep in the ocean, over top the mid-ocean ridge, and an instrument known as a CTD (conductivity-temperature-depth), which will allow us to study the properties of the seafloor to see if there is evidence of temperature anomalies or suspended particles that may indicate the presence of plumes associated with hydrothermal activity (hot springs) in this region.

Describe how you sampled the seawater to study the hot plumes of fluids coming from the vents?

6. Where are the Best Places to Dive with the Submersible ROPOS?

Describe how you examined the properties of the seawater to study the hot plumes of fluids coming from the vents?

7. Let's Begin the Next Phase of Our Study:

What vehicle will you use to study the vents?

8. Preparing to Dive

How far below the sea surface will ROPOS descend before reaching the seafloor?

9. Hell Vent

What is this feature called? _____

How is this feature formed?

10. Measuring the Vent Temperature

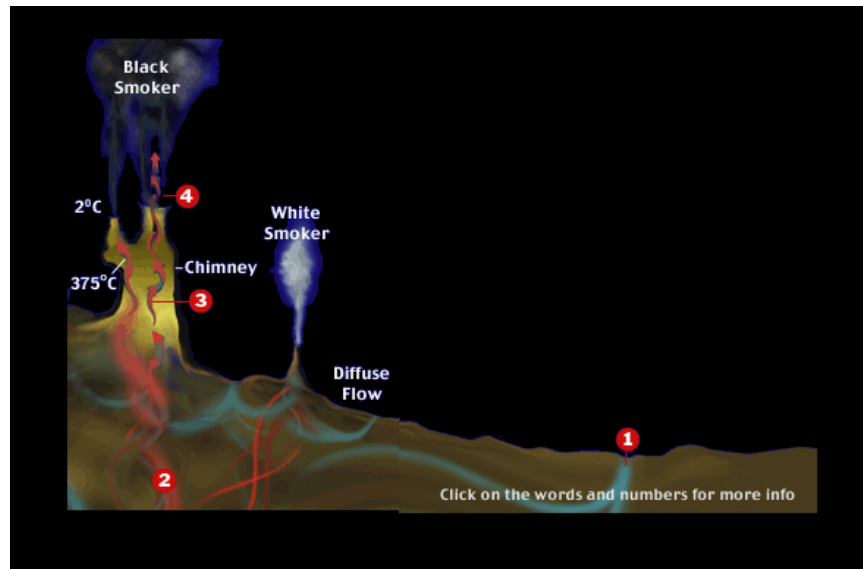
How hot can the water temperature reach coming from a vent? _____

11. On to Inferno Vent

12. Flame Illusion

Why doesn't the seawater boil if it is more than 350°C at the vents?

13. What is the "Plumbing" of the Vents? What is the Source of the Vent Fluids?



How is the chimney built around a hydrothermal vent (go through the numbers on webpage)?

- 1.
- 2.
- 3.
- 4.

14. Sampling the Vent Fluids

What is different at this vent than previous observation at a black smoker?

15. Tubeworms

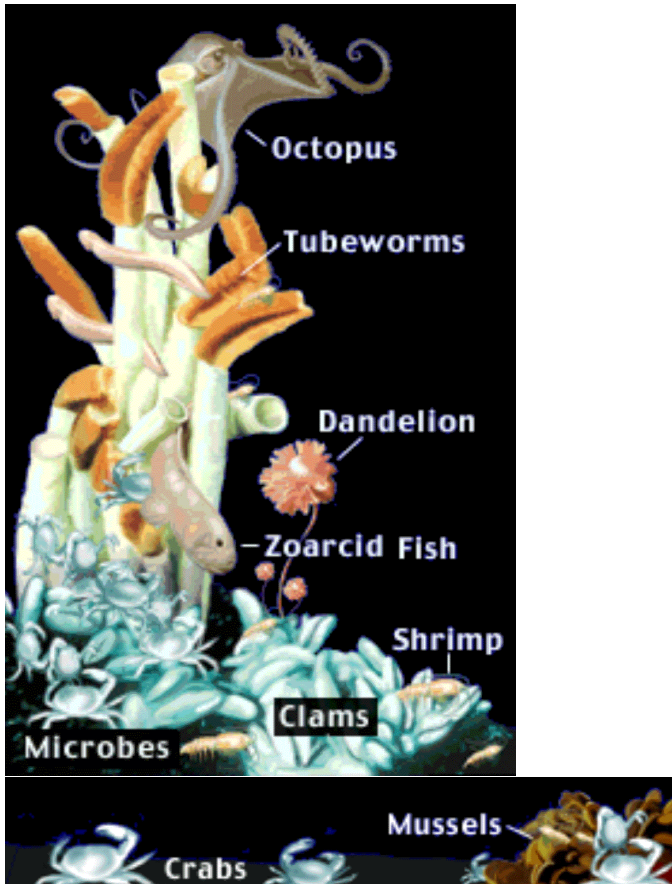
16. A Territorial Fight Between Worms

17. Sampling - A Fight with a Crab

18. Octopus - A Visiting Predator

19. Vent Ecosystem - Click on the names of the following organisms in this ecosystem:

microbes, clams, and tubeworms



Describe the Microbes (Bacteria)

What role does hydrogen sulfide (H_2S) play in providing energy to the chemosynthetic bacteria?

What is the significance of the microbes (bacteria) in this ecosystem?

What is meant by chemosynthesis (energy derived from a chemical reaction) and how is this process different from photosynthesis?

What is meant by a "symbiotic" relationship between the worm and the bacteria (and how do both organisms benefit)?

Describe the Mussels & Clams

Describe the Tubeworms

Describe the relationship between the tubeworms (Riftia sp.) and the bacteria?

How are clams like mussels and tubeworms (with respect to the bacteria)?

20. Other Heat-Tolerant Worms

21. Return to the Surface

Summarize how you applied a scientific approach to a problem of the earth and environment, learning outcome #3 of Area R courses

22. Deep Sea Find that Changed Biology - combining geology, chemistry, biology and oceanography combined for one of the most exciting scientific

What, in your opinion, is the main theme of this segment?

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