Science Unit: ***Biodiversity & Extreme Environments***

Lesson 2: ***Deep Sea Vents***

School Year:	2009/2010
Developed for:	Lord Kitchener Elementary School, Vancouver School District
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Grade level:	Presented to grade 5/6/7; appropriate for grades 4 – 8 with age appropriate modifications
Duration of lesson:	1 hour and 30 minutes

Objectives

1. Explore the vent and non-vent deep sea.
2. Discover the similarities and differences between 3 extreme habitats: deep sea sediments, hydrothermal vents and the rocky intertidal zone.
3. Predict the relative biodiversity of these 3 extreme habitats.

Background Information

Lesson 2 builds on lesson 1 (Extreme Environments), so it's suggested that you begin with a quick review of the rocky intertidal zone with an emphasis on the variable and steep environmental gradients. Next introduce the deep sea – the vast expanse of the sea floor that covers ~60% of the Earth's surface. Most of the deep sea (>1000 km) is covered by sediments and many areas look like mud flats or deserts with very little life. Deep waters are constantly cold (about 2 degree Celsius), always dark, and typically very food poor thus most animals that live in or on the sediments are typically quite small. Theses animals depend on photosynthetically-derived food which is created in the upper layer of the ocean (where sunlight penetrates) that gradually sinks to the seafloor.

Next provide a brief overview of the hydrothermal vent ecosystem. Most vents are located along Mid-Ocean Ridges and are formed when cold, dense sea water seeps through cracks in the seafloor and travels to depths where the seawater is heated and chemically interacts with the hot crustal rocks. Through heating the vent water become buoyant and raises back to the seafloor visibly exiting as gushing streams of hot water. This "vent fluid" is super heated, and is laden with chemicals such as hydrogen sulphide, and is completely depleted of oxygen. Chemosynthetic bacteria that use hydrogen sulphide as an energy source are the bases of the vent food web – thus animals living at vents have a local source of food and are not dependent on photosynthesis in surface waters.

The end of this lesson will ask students to predict (roughly) the relative "biological diversity" or "biodiversity" of these 3 ecosystems (intertidal zone, deep sea sediments, deep sea vents). Encourage the students to simply apply their own concepts of this term, and next week we'll look at how scientists define and measure biodiversity.

Vocabulary

Word:	Brief definition.
Deep Sea	Area of the ocean below 1000m depth.
Deep sea sediments	The seafloor below 1000 m that is covered by sediment (e.g. sand and mud). It is a vast ocean habitat that covers approximately 60% of the Earth's surface.

Deep sea vents (hydrothermal vents)	Deep sea hot springs that occur along mid-ocean ridges. The vent fluid is rich in hydrogen sulphide that supports chemosynthetic bacteria which are the base of the vent food web.
Biodiversity	The variety of life in a given area (e.g. lake, region, biome or the whole Earth). The most common aspect of biodiversity is species diversity.

Materials

- Worksheet #1
- Create a venn diagram worksheet (3 circles – 1 for each environments)
- Pencils per group

In the Classroom

Introductory Discussion

1. Review rocky intertidal zone and introduce two deep sea environments: the sedimented (non-vent) deep sea and the deep sea hot vent ecosystem.
    - What is the intertidal zone?
    - What environmental conditions do rocky intertidal animals have to cope with?
    - How big is the deep sea? What does it look like?
    - What are deep sea hot vents? When were they discovered? How do scientists study them? How hot are they?

    After this introduction, break the students into groups of 4 for activity #1 (see below).
2. After students complete activity #1, bring the class together again to discuss “biodiversity”.
    - What is biodiversity?
    - Which places on Earth are very biodiverse? Why?
    - Which places are not very biodiverse? Why?
    - How do scientists measure biodiversity?

    After this discussion, students complete activity #2 (see below)

Science Activity #1

Activity Title: Marine Environment Comparison

Purpose of Activity: To think about the similarities and differences among 3 environments: Intertidal Zone, Deep Sea (non-vent) and Hydrothermal Vents

Methods and Instructions:
Set-up prior to activity: Prepare a 3 circle venn diagram worksheet (1 per group) & print off a copy of worksheet #1 for each group (Worksheet # 1 includes 1 photo of each environment: rocky intertidal zone, deep sea sediments, and deep sea vents). Divide students into groups of 4.

1. In groups, students compare the photos of each environment (Worksheet #1) and fill in a venn diagram (to be prepared by teacher) comparing the similarities and differences among the 3 ecosystems.
2. Each group reports on their results to the class.

Science Activity #2

Activity Title: Ecosystem Biodiversity

Purpose of Activity: To have students think about their perceptions of biodiversity in 3 different ecosystems

Methods and Instructions:
Set-up prior to activity: Students remain in their groups of 4. Have a quick class discussion about the term "biological diversity" or "biodiversity".

1. Each group then returns to review their venn diagrams and they rank the 3 ecosystems in terms of their relative biodiversity (their prediction), and say why they think their ranking is correct. For example, ask the students if they think deep sea sediments are more or less biodiverse than deep sea vents and why?

We will discuss their predictions again next week and we'll find out the answer in lesson 6 (after we analyze data from deep sea vents and the rocky intertidal zone)!

Closure Discussion

1. What were the 3 environments we discussed today?
2. How are they similar? Different?
3. Why do you think biodiversity is higher in ecosystem X than ecosystem X? (Replace each X with the ecosystems that are discussed.)

References

1. Van Dover, C.L. 2000. The Ecology of Deep Sea Hydrothermal Vents. Princeton University Press.
2. Gage, J.D. and Tyler, P.A. 1991. Deep-Sea Biology: A Natural History of Organisms at the Deep-Sea Floor. Cambridge University Press.
3. http://www.kidsnet.org/sfkc/sfkc20050304-1.html An Octopus' Garden: Deep Sea Hydrothermal Vents. [good website with lots of links] Assessed March 2010.

Extension of Lesson Plan

1. Watch and discuss the deep sea vent video: http://www.youtube.com/watch?v=4LoiInUoRMQ