# Oceans of Possibility

***Teacher Notes***

Andrew Hughes will be travelling around Papua New Guinea and encountering ocean currents, aspects of ocean life and maybe gaining new insights into the ocean and its characteristics that people don't generally see, feel or understand.

This unit therefore explores the notion of the ocean as the last frontier of exploration and understanding left on earth.

It looks at the possibilities of knowing and understanding a great deal more than what we do now.

After gathering information on the ocean's physical features, resources, and ecology, the students can debate the merits of developing ocean resources and building undersea human habitats.

Students will be able to connect directly to Andrew for him to consider their direct questions. Through his contributions via the blog, students will be able to gain and share insights about the ocean.

Afterwards, students can post the results of their exploration and their proposals for future ocean development to the Expeditionclass.com/Webbing the Islands Forum for others to consider and respond to.

# Oceans of Possibility

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| **Learning Sequence Title:** | **Oceans of Possibility** |
| **Developed by:** | **A learning sequence from Microsoft Education, adapted to the Essential Learnings** |
| **Grade Level:** | **7 -8** |
| **Time Frame:** | **Time:** Approximately 6 hours over 6 weeks |
| **Generative Topic:** | ***What are the possibilities of the ocean?***<br><br>The purpose of this unit is to make students aware of the uniqueness of the ocean and that many areas are still largely unexplored.<br><br>Throughout this learning sequence, students will gain a deeper understanding of the ocean and the interconnectedness of human activity and the ocean environment. |
| **Focus Essential** | ***World Futures***<br>*Understanding systems* (Link: UG1)<br>Standard 3:<br>• Recognises interconnections within and between systems<br>• Understands causal relationships in systems, including some of their effects<br>Standard 4:<br>• Understands the interdependency of systems and their function within local and national communities.<br><br>*Creating sustainable futures* (Link: UG2)<br>Understands the uniqueness of local ecosystems and takes responsible action to sustain them.<br><br>This unit is designed to assist students develop the values of ***connectivity*** and ***responsibility***. |
| **Supporting Essentials** | **Thinking Reflective** |
| **Understandings Goals (UGs):** | • UG1: Students will have an understanding of the story of recent ocean exploration and current research.<br><br>• UG2: Students will gain an overview of the physical qualities and natural resources of the undersea world and its interconnectedness. |
| **Concepts** | Interdependence, connectedness, physical qualities, natural resources of the undersea world. |
| **Skills Focus** | To develop skills in:<br>• gathering and organising information from a variety of sources in both individual & group organisation<br>• formulating and defending a position based on objective fact and personal conviction.<br>• presenting a multifaceted proposal clearly and persuasively<br>• problem-based learning. |
| **Required Software** | Microsoft® Word 98/2000, Microsoft Encarta® Deluxe Encyclopedia 99/2000, Microsoft Encarta Interactive World Atlas/Virtual Globe, Microsoft Internet Explorer 4.0/5.0, Microsoft PowerPoint® 98/2000 – ***if not*** other encyclopedia are possible |

| UGs | Introductory Performances | Ongoing Assessment / Notes to Teachers |
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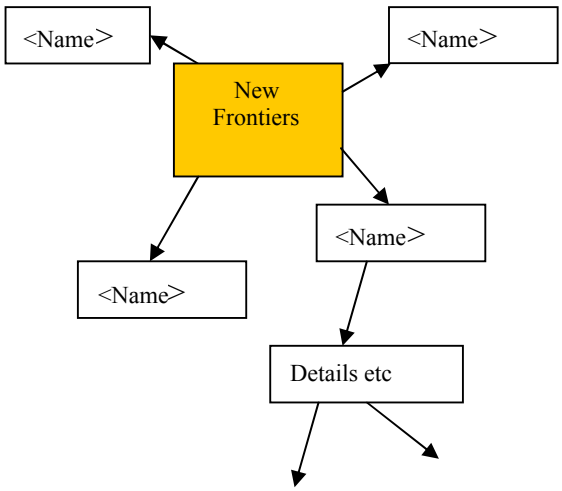
| | **TUNING IN ACTIVITIES**<br>**Activity 1:**<br>Undertake a Mindmap of all the New Frontiers left on Earth. Work with a partner using Inspiration or other software tools.<br>When completed present this to the class<br>  <br><br>Explore the concept of *New Frontier*<br>Make a class list of :<br>• What might have been considered a new frontier in the past but is no longer considered<br>• The characteristics of a new frontier<br>• A set of criteria by which an area or location or concept could be assessed as being a new frontier<br>Discuss and use the criteria to assess past and possible new frontiers. | ▲ Teacher Notes ( Assessment<br>( Preview the "Getting Started" Web links listed<br>1. in Appendix 1, and add the ones you Like best to your Favorites file. Supplement these with additional overview resources from the Web, Encarta and print materials.<br>2. Students present and discuss their MindMaps<br>This activity is designed to introduce the students to the unit and give information to the teacher regarding students level of initial understanding/ assess prior knowledge to adjust activities as needed.<br>o Assess students' prior knowledge and depth of understanding. Adjust activities as required<br>Assess the extent to which each student:<br>• contributes ideas<br>• demonstrates active listening skills<br>• summarieses points<br>• is able to apply criteria<br>• shares ideas with group.<br>On a class board write "*New Frontier.*"<br>3. Ask your class on what planets have we found crushing pressures equal to thousands of Earth atmospheres, temperatures that would melt lead, plumes of toxic chemicals, total darkness. Write their answers on the board.<br>4. Then add one more condition – thriving life – and announce the only place where all these conditions are known to exist: Earth's ocean.<br>5. Ask your students the following questions:<br>• What gets more attention (and why) – space exploration, or ocean exploration?<br>• Have the oceans been sufficiently explored, or is there more to learn?<br>• What are the most valuable ocean resources? Who owns them?<br>• Who should decide how they are used?<br>• Should we be concerned about the health of the ocean?<br>• Will we ever live in the ocean?<br>6. Tell your students that they will have the opportunity to explore these issues and decide the answers for themselves, and then share their discoveries with the rest of the class. |

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| | | 7. Finally, remind students that nearly three-quarters of the Earth's surface is covered by ocean, and that it is far more likely that we will colonise the oceans before we colonise the planets. Tell them that, as part of this project, they will be asked to consider the feasibility of undersea human settlements from practical, economic, and ecological perspectives. Will we ever live in the ocean? Should we?<br>8. Pass out the Student Activity pages and direct students to your Getting Started resources. For Activities of the Student Activity, divide the class into groups of two to four students each and assign each group a different ocean region to study (i.e., North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, etc.) and to colonise with their hypothetical habitat! |
| | **SETTING THE SCENE**<br><br>**Student Activity 2**<br><br>***Scenario Description***<br><br>The year is 2010. Earth's population is seven billion and counting. The problem: overcrowded cities, dwindling resources. The solution: colonise the planets? Not likely. Space may be the final frontier, but a near-term solution lies closer to home. The oceans cover three-quarters of the earth's surface and are rich in life-sustaining resources. In this activity, you will team up with your classmates to explore the undersea world, the pros and cons of development, and the possibilities for human habitats beneath the waves.<br><br>**What to do:** Rewind through the last 200 years of ocean exploration and discuss the current state of ocean knowledge and issues looming in the future.<br>1. The sea has fascinated humans for eons, but only in recent history have we been able to explore it in depth – both literally and figuratively. Launch Explorer and go to http://www.pbs.org/wgbh/nova/abyss/frontier/discoveries.html, scan the exploration timeline, and be prepared to discuss the following questions.<br>2. What factors have contributed to the explosion of ocean exploration and knowledge in the last 200 years?<br>3. Think about how ocean exploration has influenced:<br>• Theories of continental drift<br>• Ideas about the origins of life on earth<br>• Issues surrounding deep sea drilling and mining and development of ocean resources | ▲ NB: A Future Problem Soving Approach can be used i.e.<br>1. Identify the problems<br>2. Select an underlying problem<br>3. Generate Solution Ideas<br>4. Select Critera<br>5. Develop a plan of action<br><br>See http://fpsp.org.au<br><br>O Criteria for assessing work:<br>• clarity of ideas & message<br>• fluency of ideas<br>• photos & theme are well connected<br>• overall presentation<br>• working in a group. |

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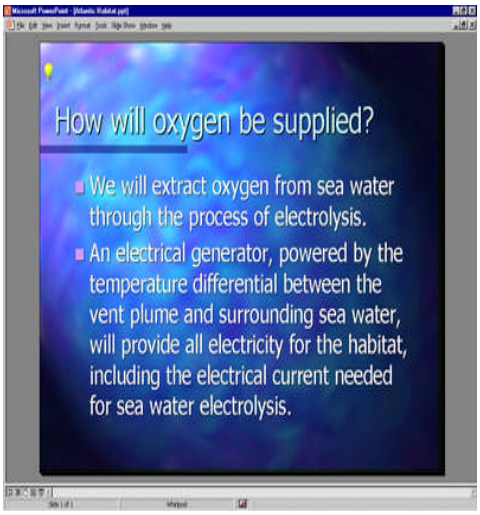
| | 4. Each student to share which discovery or discoveries they find most fascinating or significant, and why.<br>5. Do you think the ocean holds more undiscovered secrets?<br>6. Would you prefer to explore the ocean in a submersible in the cold darkness, miles deep, or from the relative comfort of a surface ship or research station?<br>7. Do you think humans will ever live in the ocean? Why or why not? | |
| | **Guided Inquiry Performances**<br>**(Finding out, sorting out, going further)** | **Ongoing Assessment / Notes to Teachers** |
| | **GUIDED INQUIRY**<br><br>**Student Activity 3**<br><br>***The Physical Ocean***<br><br>**Software:** Microsoft Word 98/2000, Microsoft Encarta Deluxe Encyclopedia 99/2000, Microsoft Encarta Interactive World Atlas/Virtual Globe, Microsoft Internet Explorer 4.5/5.0<br>**What to do:**<br>Use resources in Encarta Encyclopedia and on the Web to map the physical environment of the ocean to which your team has been assigned, including topography and tectonic features of the ocean floor, water temperature and currents, location of geothermal vents and seismic activity. Later on, you'll refer to your map for help in determining the best place to establish an undersea human settlement.<br>1. Create a new Word document and save it with the name of the ocean you've been assigned. You'll use this document to hold and organise the images and information you collect.<br>2. Launch Interactive World Atlas/Virtual Globe. Click on **Map Styles** > **Tectonic**.<br>• Use the navigation tool in the upper right corner of your screen to rotate the globe. Notice the boundaries between tectonic plates. Use the zoom function to get a closer look. Click **Legend** on the left side of your screen to learn more about the lines and symbols on the map. Can you find examples of spreading, converging, and transforming boundaries between tectonic plates? How are these kinds of boundaries different from each other? When you zoom in, you'll see that this globe also maps earthquake and volcano activity. Can you see a relationship between seismic activity and tectonic plates? | ⭘ Assess individual's contribution to the oral history in terms of a rating 1-5 against:<br>• Clarity of reason<br>• Quality of rationale<br>• Depth of scientific accuracy.<br>⭘ Assess the thoughtfullness, originality and fluency of the responses.<br>▲ Teachers/students without Encarta will be able to undertake this actitivty in alternative ways such as simple Internet searches, using a developed Hot List etc. |

- Rotate the globe and adjust the zoom to maximize the display of your assigned ocean on the screen. (The oceans on this map are not labeled, so you'll need to use the continents as reference, or perhaps refer to another map, e.g. **Map Styles** > **Physical Features**, to identify your ocean.) Point to the Options menu, click Copy, and then paste the map into your Word document.
- Add a legend to your map, using descriptions of the various map features based on the legend in Interactive World Atlas/Virtual Globe. You will be expanding your legend as you add more features to your map.

3. Launch Encarta Encyclopedia and click **Find** in the menu bar to open the Pinpointer (if it's not already open). Type hydrothermal vent into the Pinpointer, then click on the "**Hydrothermal Vent**" title to jump to the article.




- Read the article and sidebar. Why are vents important sea-floor features? Are there any vents in your ocean region? You'll find some of the known hydrothermal vent sites mapped at the following Web sites: http://cgi.pbs.org/wgbh/nova/abyss/frontier/vents.html (Pacific Ocean) http://cgi.pbs.org/wgbh/nova/abyss/frontier/ventsatlantic.html (Atlantic Ocean). Note that these maps also clearly show the topography of each ocean floor, including deep trenches, mountain ranges, and coastal plains.
- Use the draw function in Word to add vent locations to the map you pasted into your document in Step 2. Go to **View** > **Toolbars** > **Drawing**. Select **Autoshapes** > **Lines** or **Autoshapes** > **Basic Shapes** in the **Drawing** toolbar to draw on your map. Identify your vent symbol in the

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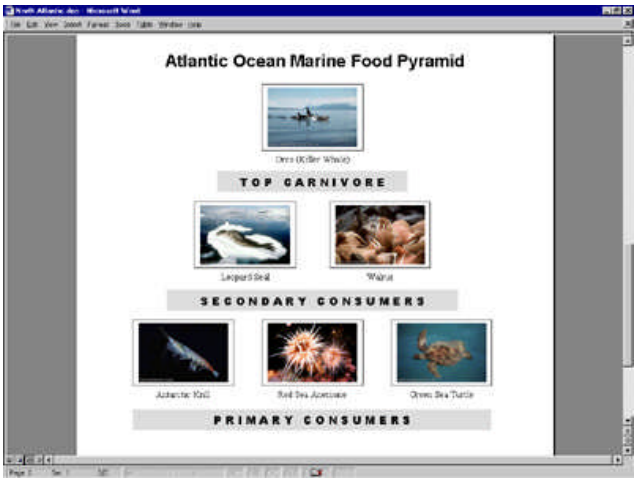
| | legend that you started in Step 1, or choose **Autoshapes** > **Callouts** to label the vent sites on the map itself.<br>4. The sea is a dynamic environment, with complex and changing patterns of current and temperature. Now you'll add these to your map to get a more complete picture of the physical conditions of your ocean region.<br>• Launch Encarta Encyclopedia and click **Find** in the menu bar to open the Pinpointer (if it's not already open). Type ocean currents into the Pinpointer, then click on "**Ocean Currents**" to open the ocean currents map. Notice how the currents move in your ocean region.<br>• Ocean currents move more than just water and ocean life – they transport heat. Currents moving away from the equator carry heat into cooler regions. Currents moving toward the equator carry cold water from the Polar Regions. Colored arrows on the currents map at http://www.geog.ouc.bc.ca/physgeog/contents/8q.html represent these relative temperature differences.<br>5. Access sea and weather conditions from weather stations and buoys around the world maintained by the National Oceanic and Atmospheric Administration's National Weather Service at http://www.noaa.gov/. Check out the current air and water temperatures and wave height in your ocean region and the areas where Andrew Hughes is travelling! | |
| | **Student Activity 3**<br><br>***The Living Sea***<br><br>**Software:**Microsoft Word 98/2000, Microsoft Encarta Deluxe Encyclopedia 99/2000, Microsoft Encarta Interactive World Atlas/Virtual Globe, Microsoft Internet Explorer 4.5/5.0<br>**What to do:** In this step you'll explore life in your ocean region, how it's inter-related, where it's concentrated, and how it's affected by environmental changes. | |




1. Launch Encarta Encyclopedia and click **Find** in the menu bar to open the Pinpointer (if it's not already open). Type **Marine Life** into the Pinpointer, then click on the "Marine Life" title to jump to the article.
   - On the Contents page, click on the Marine Food Pyramid interactivity.
   - Predict where each animal belongs in the pyramid, and then perform the interactivity. Were your predictions correct?
   - All the plants and animals at the base of the food chain live in shallow coastal regions or surface waters throughout the oceans. What are the implications for human use of the oceans and possible consequences of environmental damage, such as an oil spill?
2. Launch Interactive World Atlas/Virtual Globe.
   - Use the navigation tool in the upper right corner of the screen to rotate the globe and display your ocean region.
   - Click on your ocean region. When the popup menu appears, click **Animals** in the submenu to display some of the animals that live in your ocean region.

   Identify which of these are primary consumers, secondary consumers, and top carnivores.
3. In your Word document, insert a page break to start a new page. Choose **View > Toolbars > Drawing** to open the Drawing toolbar.
   - Draw a text box, make five copies, and arrange them into a three-tier pyramid modeled after the Encarta Marine Food Pyramid (minus the Producers level).
   - Copy and paste images of the animals from your ocean region into the boxes on

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| | the appropriate levels of your pyramid. If a pasted image expands the box, click and drag a "corner handle" on the image to resize it and restore the box to its original vertical dimension.<br>• After you've filled your pyramid with images, use the Select Objects tool in the Drawing toolbar to select one row of boxes at a time, and then choose **Draw > Align or Distribute > Align Bottom** to tidy things up.<br>• Create additional text boxes to label your pyramid, pyramid levels, and each of the animals pictured. Be sure to cite the source of your images.<br>4. Where is life concentrated in the ocean? What are its limits?<br>• Return to the Discoveries of the Deep timeline at http://www.pbs.org/wgbh/nova/abyss/frontier/discoveries.html and find examples of sea life at extreme depths and near geothermal vents. Is life everywhere in the ocean?<br>5. Despite the ability to thrive under extreme conditions, ocean life is also extremely sensitive to changing conditions.<br>• Check out the phenomenon of coral bleaching in the "Coral Reef" article in Encarta Encyclopedia.<br>• Read the "El Nino" article in Encarta Encyclopedia. What are the causes of El Nino? Is global warming a factor? What are the effects on the food chain?<br>6. On the map in your Word document, identify the animals and ecological zones in your ocean region that you think would be most affected by changes in the environment. | |
| | **Activity 4**<br><br>***Developing Ocean Resources***<br><br>**Software:** Microsoft Encarta Deluxe Encyclopedia 99/2000, Microsoft Encarta Interactive World Atlas/Virtual Globe,<br><br>**What to do:** In this step you'll explore the wealth of natural resources in your ocean region, how you might use these resources in constructing and maintaining your habitat, and some of the issues you might encounter.<br><br>1. The sea floor is rich in minerals and valuable | ○ Self assessment of work using a teacher / student developed rubric |

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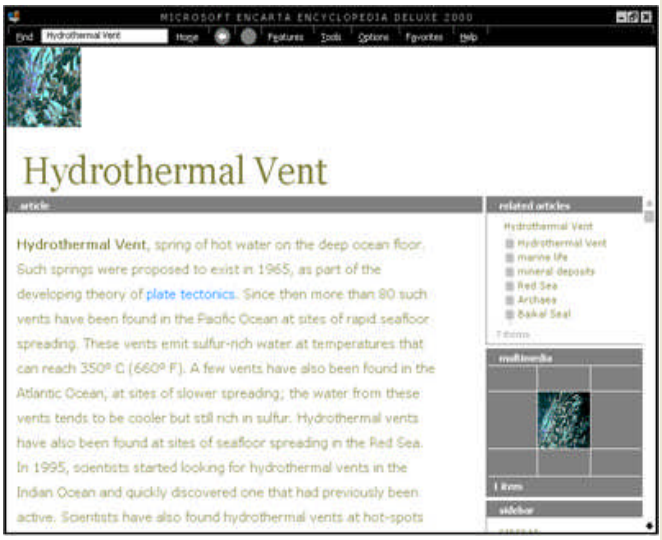
| | metals. For example:<br>• Where tectonic plates are spreading, as in the mid-Atlantic ridge, there is a constant upwelling of mineral rich magma.<br>• Converging and transforming boundaries are also associated with volcanic activity that brings valuable metals to the ocean floor.<br>• Hydrothermal vents spew super-heated plumes of mineral-rich water.<br>2. Identify theses areas on your map as potential mining sites.<br>3. Deep-sea mining is a relatively new activity that raises issues involving mineral rights and conservation, to name a few.<br>• For an overview of economic and political factors, see the "Ocean Metal Mining" section of the Encarta Encyclopedia "Mining" article.<br>4. There are other ocean resources that could be developed to help sustain an undersea settlement:<br>Aquaculture, or farming the sea, can multiply the ocean's natural food productivity. For information about the current state of aquaculture around the world, see http://www.aquanet.com/.<br>Besides being rich mineral sources and oases for sea life, hydrothermal vents could be harnessed to provide heat and power for human installations.<br>Ocean water itself could be broken down to provide life-sustaining oxygen.<br>5. In your Word document, **Insert** a three-column table.<br>• In the first column, list all the resources you can think of that might be useful in the construction and maintenance of your ocean habitat.<br>• In the second column, note if and where these resources might be found in your ocean region.<br>• In the third column, state possible issues that might offset the benefits of developing the listed resources. | ○ Criteria for the Review include:<br>• the extent to which the student can communicate ideas clearly<br>• clarity of the students' own thinking about the item. |
| | **CULMINATING PERFORMANCE** | **Ongoing Assessment / Notes to Teachers** |
| | **Activity 5**<br><br>***Make your case***<br><br>**Software:** Microsoft Word 98/2000, Microsoft PowerPoint 98/2000<br>**What to do:** Now you need to decide where and how | ○ Students will present to the rest of the class. This is an opportunity for the students to demonstrate their knowledge of oceans from their specific perspective. This activity will be used as a means of assessment for most of the unit.<br>○ Criteria for assessment will be:<br>• Level of achievement against the understanding goals |

to build your habitat to make the best use of available resources, protect the environment, and serve the needs of the inhabitants.




1. Write answers to the following questions in your Word document.
   - Where in your ocean region will you locate your habitat? On the ocean floor, in deep water or shallow? Or perhaps suspended near the surface in deep water? Why? What are the advantages of being under the water rather than on the surface?
   - How many people will live in your ocean habitat? Think about the number of people you will need to perform the work that sustains your habitat, balanced against the costs of sustaining a group of that size.
   - How large must the physical structure be?
   - How will you provide heat, energy, oxygen, and fresh water for your habitat?
   - How will you feed the inhabitants?
   - The habitat will be expensive to maintain, but revenues from mining or aquaculture could offset some of the costs. Does this influence your choice of location?
   - Given the sensitivity of marine ecosystems, one of your objectives is to minimise the habitat's impact on the surrounding environment. How will you handle waste disposal? Noise pollution?
   - Will your habitat be self-sufficient? Why or why not?
   - Do you think humans will ever colonise the oceans on a large scale?
2. Launch PowerPoint and select **New Presentation**.
   - On the first slide, give your presentation a title, name your ocean region, list your team members, and include the date of your presentation.
   - In your next series of slides, introduce your ocean region and all the features you have

- Depth of understanding of diffferent perspectives and cause and effect
- Quality of written work to convey messages

- Students are either given a pre-prepared rubric (see Appendix 2) to assess their peers' performances or the whole class can sit down to work one out. Either way, the expectations from the performance need to be explicitly stated. After each performance the assessing student would explain their ratings and provide a positive critique

- Crietera for assessment:
  - relevance of ideas
  - demonstration of understanding
  - effectiveness of plan
  - impact on future scene
  - quality of action plan

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| | mapped. Copy the map and the marine food pyramid from your Word document and paste them into slides in this section of your show.<br>• On subsequent slides, present the details of your proposed habitat in the following form: question (from Step 1 above), answer, and reason(s). Devote a slide to each question. Keep your text brief. Develop & demonstrate an action plan.<br>3. Present your PowerPoint show to the class and prepare to defend your proposal and debate the issues!<br>4. As a follow-up, you and your classmates can post your presentations on the school intranet or on your school's Internet site. Make your presentation Net-ready by going to **File>Save as Web Page** (in PowerPoint 2000) or **File>Save as HTML** (in PowerPoint 98). | |
| | **Conclusion of Unit** | **Self Evaluation Rubric** |
| Self | Ask students to complete the self-evaluation rubric based on what they achieved. | ○ Students will:<br>• Reflect on what they have achieved/their performance<br>• Submit the rubric to the teacher for final assesment. |

# *Appendix 1 Resources Websites*

Exploration timeline
http://www.pbs.org/wgbh/nova/abyss/frontier/discoveries.html

National Oceanic and Atmospheric Administration's National Weather Service
http://www.noaa.gov/

Plate tectonics
http://volcano.und.nodak.edu/vwdocs/volc_images/tectonic_plates.html

Earthquake zones
http://www.crustal.ucsb.edu/ics/understanding/globe/globe.html

Hydrothermal Vents:
http://www.pmel.noaa.gov/vents/home.html
http://pubs.usgs.gov/publications/text/exploring.html
http://library.thinkquest.org/18828
http://www.pbs.org/wgbh/nova/abyss/frontier/vents.html
http://www.pbs.org/wgbh/nova/abyss/frontier/ventsatlantic.html

In search of the giant squid
http://www.nationalgeographic.com/features/97/kaikoura/

Ocean mining
http://library.thinkquest.org/18828/data/ethics.html

Conservation
http://www.aquanet.com

**Microsoft Encarta Encyclopedia**
Coral Reef
Deep Sea Exploration
Mining
Ocean and Oceanography

**Microsoft Encarta Virtual Globe**
Tectonic View of Earth

## *Appendix 2: Evaluation Rubric*

| CATEGORY | 4 | 3 | 2 | 1 | SCORE |
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| **Information Gathering** | Accurate information taken from several sources in a systematic manner. | Accurate information taken from a couple of sources in a systematic manner. | Accurate information taken from a couple of sources but not systematically. | Information taken from only one source and/or information not accurate. | |
| **Information** | Cites all sources, good description of habitat, lists all threats & dangers, organised, no spelling / grammatical errors. | Cites most sources but needs improvement, good description of habitat, organised, few spelling errors. | Few citations, fair description habitat, unorganised, many spelling errors. | No citations, no description of habitat, disorganised, spelling errors throughout paper. | |
| **Addressing the problem** | Addressed the problem fully and in a feasible, creative manner. Consistency of thought evident problem & solutions are aligned & evidence based. | Addressed most aspects of the problem. Some aspects not feasible or creative consistency of thought evident. | Several inaccuracies, did not address the problem. Lots of side issues evident. | Does not address the problem. Solutions not achieved or consistent. | |
| **Ecosystem/Habitat** | Explanation of habitat is accurate, meets all essential needs of organisms. Work is highly creative. | Few inaccuracies in explanation, meets most essential needs of organisms. Work is creative. | Several inaccuracies in explanation, meets few essential needs of organisms / habitats. Thinking needs work. | Explanation is inaccurate, meets no essential needs of organisms. Needs much more research. | |
| **Presentation** | Describes habitats and solution well, thoughts are well organised, answers questions well. Solutions and model were highly creative | Description had few errors, thoughts were organised, could use some work, could not make connections. Solution and model showed creative thinking. | Description of ecosystem & habitat needs work, thoughts were disorganised, could answer questions. Solution reasonably well thought out | Does not describe ecosystem or habitat, thoughts were disorganised, could not answer questions. | |
| **Understanding** | UG1: Demonstrated an excellent understanding of the story of recent ocean exploration and current research.<br><br>UG2: Demonstrated an excellent overview of the physical qualities and natural resources of the undersea world and its interconnectedness. | UG1: Demonstrated a sound understanding of the story of recent ocean exploration and current research – some gaps in understanding evident in the solution.<br><br>UG2: Demonstrated a sound overview of the physical qualities and natural resources of the undersea world and its interconnectedness. | UG1: Some understanding of the story of recent ocean exploration and current research – some gaps in understanding evident in the solution. Needs work on conceptual understanding.<br><br>UG2: Demonstrated a sound overview of the physical qualities and natural resources of the undersea world and its interconnectedness. Needs work on conceptual understanding | UG1: Little understanding of the story of recent ocean exploration and current research – some gaps in understanding evident in the solution. Little conceptual understanding demonstrated.<br><br>UG2: Has little overview of the physical qualities and natural resources of the undersea world and interconnectedness. | |