



**Science Unit: *Marine Critters and Communities***

**Lesson 7: *Introduction to the Life of a Marine Scientist***

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| School Year:        | 2011/2012  |
| Developed for:      | Tecumseh Elementary School, Vancouver School District                                    |
| Developed by:       | Kathy Heise (scientist); Teresa Harris, Stephanie Pearce, and Chuck McNicholl (teachers) |
| Grade level:        | Presented to grade 7; appropriate for grades 5-7 with age appropriate modifications      |
| Duration of lesson: | 1 hour (could be extended to 1 ½ hours)  |

**Objectives**

1. Discuss the concept of hypothesis testing through research on Pacific white-sided dolphins at the Vancouver Aquarium.
2. Learn about the marine environment, and the threats that it currently faces.
3. Introduce ocean acidification, what causes it, and how it relates to fossil fuel use.

**Background Information**

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are relatively abundant on the BC coast. They can often be seen in large groups of 50 to over 200 animals in the northern Salish Sea and Howe Sound. Dolphins, like all marine animals, use sound much the way terrestrial animals use vision: to communicate, to detect prey and avoid predators and to navigate. Yet despite their ability to detect objects using echolocation, large numbers of dolphins (as well as other species) become entangled in fishing nets. Between 1978 and 1990, it is estimated that 49,000 to 89,000 Pacific white-sided dolphins were killed in high-seas fisheries that used drift nets.

In order to understand why dolphins are caught in nets that they should be able to detect, the Vancouver Aquarium has initiated a scientific study to better understand how dolphins use echolocation. The dolphins are blindfolded using eyecups and then asked to perform various tasks (Figure 1). Researchers have hypothesized that the more objects that are introduced into the habitat, the more dolphins will increase their echolocation use. They also hypothesize that the more noise that is introduced into the habitat, the longer it will take the dolphins to detect objects.

Fisheries bycatch is one of a number of threats facing dolphins and other marine life. Other threats include human harvesting (overfishing and whaling), manmade garbage (especially plastics and ghost fishing nets), toxic chemicals, invasive species, climate change, noise pollution, low oxygen levels, and ocean acidification.

The threat of increasing acidity of our oceans has only relatively recently received public attention, but is an extremely compelling issue that is caused by increasing CO<sub>2</sub> levels and increasing freshwater runoff. Just like the human body, the planet is primarily composed of water. And just like the human body, the ocean is vulnerable to changes in pH. Human blood pH ranges from 7.35 to 7.45, and changes beyond these levels can lead to serious illness and /or death. Already, the pH of the ocean has declined from an average of 8.2 to 8.05, and the trend is continuing. This decline in pH is affecting the ability of organisms to lay down calcium in their skeletons, and is known to have already impacted coral reefs and some



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species of plankton and bivalves. In the future this could have potentially far-reaching disastrous consequences for the health of marine food webs.

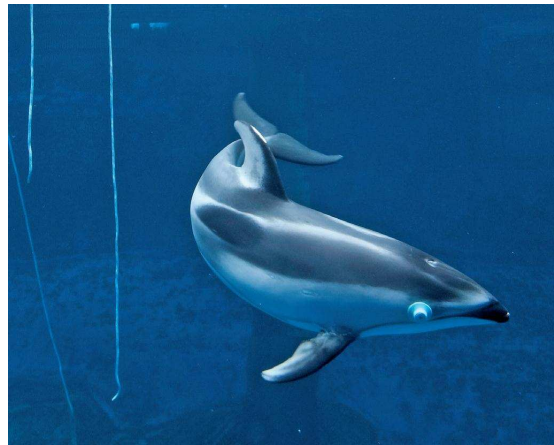


Figure 1. Pacific white-sided dolphin at the Vancouver Aquarium wearing eyecups as it swims around lines suspended in its habitat. All of the dolphins at the aquarium were caught and injured in fishing nets (bycatch).

### Vocabulary

|                              |   |
|------------------------------|---|
| <u>Bycatch:</u>              | Fish and other non-targeted species (birds, mammals, turtles) that are unintentionally caught in a fishery.   |
| <u>Hypothesis:</u>           | A cause and effect statement that can be tested, typically taking the form 'If... then'   |
| <u>Independent Variable:</u> | A variable that is changed in a study or experiment. For eg. in Activity 1 (below), the independent variable is the level of noise in the room.   |
| <u>Dependent Variable:</u>   | A variable that is affected by the change in the independent variable. Observations are generally made on the dependent variable. In Activity 1, the dependent variable is the ability of the students to hear and track the scientist's movements. |
| <u>Controlled Variable:</u>  | A variable that is not changed in a study (also called an experimental control).  |
| <u>Invasive species:</u>     | A species that does not naturally occur in an area and when introduced, causes environmental or economic harm.  |
| <u>pH scale:</u>             | A logarithmic scale of numbers ranging from 0 to 14 that describes the acidity or alkalinity of solutions. A pH of 7 is considered neutral.   |
| <u>Acidification:</u>        | Increasing acidity that results in a lower pH.  |
| <u>Brine Shrimp:</u>         | A small species of crustacean that can tolerate extremely salty environments. Also known as <i>Artemia sp.</i> or sea monkeys. Eggs (cysts) and food are generally available in pet stores that sell fish.  |

### Materials

- Powerpoint presentation
- Computer with speakers
- Internet access
- Projector
- Screen



## In the Classroom

### **Introductory Discussion**

1. An introduction to the marine mammals of the BC coast, and the sounds that they make
  - How might increasing noise affect dolphins in the wild? Do Activity 1 to demonstrate the 'cocktail party effect.'
2. Describe the echolocation study on the Pacific white-sided dolphins at the Vancouver Aquarium.
  - What hypotheses are being tested?
  - What are the dependent and independent variables in this study?
  - What are the controls?
  - What do you think the researchers will find?
3. Brainstorm other threats to marine life. Students may know about pollution and overfishing and possibly climate change. Introduced species, 'dead zones', the Great Pacific Garbage Patch, and increasing ocean acidification are other issues to discuss. Activity 2 (watch the video Why The Ocean Matters) and Activity 3 (watch the video Captain Charles Moore on the Seas of Plastic). Some potential questions include:
  - What causes climate change?
  - How does it affect weather around the world?
  - Where areas of the world are most likely to be impacted by increasing sea levels?
  - What does biodegradable mean? How is this different from photodegradable?
  - How does the ocean help reduce CO<sub>2</sub> levels in the atmosphere?
4. Expand on the explanation of ocean acidification by showing the video 'Acid Test' (Activity 4). At the end let the children know that in a future lesson we will be raising brine shrimp (Sea Monkeys) to see how changes in pH effects hatching success.

### **Science Activity 1**

Activity Title: The 'cocktail party' effect

Purpose of Activity: To help vision-based learners (humans) better understand the challenges which animals that rely on sound (eg. most marine animals) face when exposed to increasing noise levels.

Experimental Observations: The effects of increasing noise on the communication abilities of organisms.

Prediction: Increasing noise levels will make it more difficult for acoustically-oriented organisms to detect important sources of sound in their environment.

Methods and Instructions: Ask the students to close their eyes and point to where the scientist is standing. The scientist then begins speaking and walking around the room while the students try to track his/her voice. Ask the students to begin speaking in increasingly louder voices while continuing to attempt to track the scientist.



## Science Activity 2

Activity Title: Why the Ocean Matters

Purpose of Activity: This is a 3-minute film that highlights some of the beauty of the oceans, while also touching on some of the threats they face.

## Science Activity 3

Activity Title: The Great Pacific Garbage Patch

Purpose of Activity: This 8-minute film is a TED lecture given by Captain Charles Moore that draws attention to plastic pollution in the oceans.

## Science Activity 4

Activity Title: Acid Test

Purpose of Activity: This is 22-minute film that explains the ocean acidification problem. An alternate and shorter explanation of the problem is provided in the ABC news clip Ocean Acidification, referenced below.

## Closure Discussion

It is very important at the end of this lesson to give the students some sense of empowerment that they can help 'be the change'. Past examples of societal changes include the use of DDT and phosphates as well as efforts to rehabilitate salmon streams and wetland areas.

- How can you reduce the amount of plastic that you use?
- What can you do at home to help reduce your families CO<sub>2</sub> emissions?

## References

1. <<http://killerwhale.vanaqua.org/page.aspx?pid=1349>> Dolphins use sound to navigate. Vancouver Aquarium. Accessed May 21 2012.
2. <<http://www.dfo-mpo.gc.ca/Library/241969.pdf>> Whales, Dolphins and Porpoises of British Columbia, Canada. Fisheries and Oceans Canada. Accessed May 21, 2012.
3. Mitchell, Alanna. 2009. Seasick: the Global Ocean in Crisis. McClellan and Stewart Publishing.
4. <<http://video.nationalgeographic.com/video/environment/habitats-environment/habitats-oceans-env/why-ocean-matters/>> Oceans: Why The Ocean Matters. National Geographic. Accessed May 21 2012.
5. <[http://www.ted.com/talks/capt\\_charles\\_moore\\_on\\_the\\_seas\\_of\\_plastic.html](http://www.ted.com/talks/capt_charles_moore_on_the_seas_of_plastic.html)> Captain Charles Moore on the Seas of Plastic. TED talks. Accessed May 29 2012.
6. <<http://www.nrdc.org/oceans/acidification/aboutthefilm.asp>> Acid Test. National Resources Defense Council. Accessed May 21 2012.
7. <[http://youtube/W9cS0rl\\_Nyl](http://youtube/W9cS0rl_Nyl)> Ocean Acidification. ABC TV. Accessed May 21 2012.
8. <<http://www.mastersdegree.net/ocean-garbage/>> A graphic highlighting the pollution in our oceans; created by the design team at MastersDegree.net..