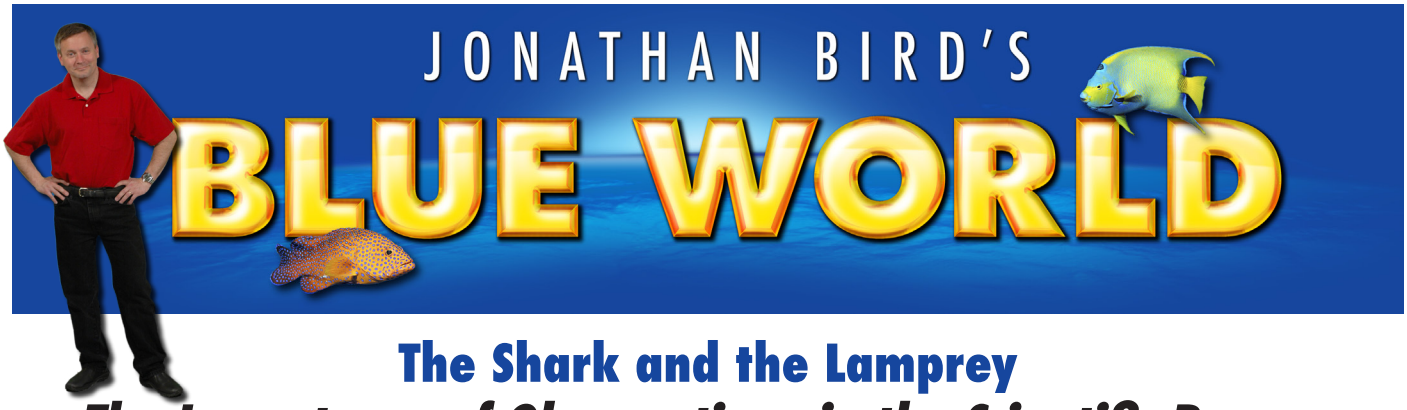

The Shark and the Lamprey

The Importance of Observations in the Scientific Process

by Bill Andrake

In this episode, Jonathan shares how a seemingly trivial observation while photographing basking sharks led to an important discovery about the biology of the parasitic sea lamprey.

Science Lesson: The Importance of Observations in the Scientific Process - Based on Webisode 15
Grade Level: 6-8
Time: One to three (45-50 min) class periods depending on background and amount of follow-up

Introduction

Curiosity is the fuel that drives science. From a very young age we take in information from the world around us, wonder how things work, and often test ideas to answer our questions. We are born scientists. So, perhaps what is more important than learning scientific information in our classrooms, is understanding and appreciating how that information is obtained. When students are encouraged to ask questions from their observations, and learn how to gather sufficient and appropriate evidence toward an answer, they take ownership of the information. A heightened interest in learned information can lead to new questions thereby fostering intellectual curiosity in students.

Science is a way that we answer questions, solve a problem, or explain a phenomenon. The scientific process begins with questions, but where do we get questions? We can get questions when we use our senses to gather information through **observations**. Many very important scientific discoveries from the invention of vaccines to electromagnetism have happened because scientists did not dismiss an observation.

This lesson guides students through a scientific investigation as they view Episode 15: "The Shark and the Lamprey". The investigation was launched from an off-hand observation, which noticed sea lampreys were attached to basking sharks.

Science Standards

National Science Education Standards

Life Science:

- Diversity and adaptations of organisms
- Populations and Ecosystems

Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Ocean Literacy Principles

- *Principle #5*: The ocean supports a great diversity of life and ecosystems
- *Principle #7*: The ocean is largely unexplored

Objectives

- To foster scientific inquiry.
- To gain experience in the scientific method or process.
- Students will understand that important ideas can come from a simple question or perhaps a seemingly meaningless observation.

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Prior Knowledge

Students should have a basic understanding of the scientific method or process.

Steps to the Scientific Method:
1. The scientific method begins with a *question*.
2. *Information* is gathered about the question.
3. Next a *hypothesis* or possible solution is formed.
4. The hypothesis is then tested with an *experiment*.
5. *Results* are analyzed and a *conclusion* is reached.

The conclusion may prove or disprove the original hypothesis. In either outcome, more information is known about the original problem and *if we are curious*, this leads to even more questions. Inquiry, or the search for knowledge, doesn't end as long as there is curiosity. It is a misconception to believe that there are fewer unanswered questions in science today then there were years ago.

Helpful Vocabulary and Facts

Basking Shark: *(Cetorhinus maximus)*	The second largest fish in the world after the whale shark. It can reach a length of 45 ft. and feeds only on plankton. The basking shark is found in the world's temperate oceans.
Biologist:	A scientist who studies living things.
Copepods:	Tiny crustaceans, related to crabs, shrimps, and lobsters, which make up the largest proportion of zooplankton in the ocean.
Hypothesis:	A possible answer to a question in the scientific process based on prior knowledge or information.
Kidneys:	Organs in vertebrate animals whose main job is to filter nitrogen wastes from the blood stream for release in urine.
Nitrogen:	An element that makes up 78 % of our air. Nitrogen along with carbon, hydrogen, and oxygen is a vital element in the molecules that make up living things, including proteins and DNA.
Parasite:	An organism that lives in or on another "host" organism from which it gets its nutrition, thus harming its host.
Plankton:	Organisms (usually tiny) that drift with ocean currents and form the base of many ocean food chains. Zooplankton is animal plankton whereas Phytoplankton is photosynthetic "plant plankton" or algae.
Sea Lamprey: *(Petromyzon marinus)*	This eel-like fish belongs to an ancient group of "jawless fishes." They use a suction cup like mouth to attach to the skin of a host fish, scraping away tissue with its many sharp teeth in order to feed on the host's blood.
Urea:	A nitrogen-containing waste produced from the breakdown of nitrogen containing molecules such as proteins in living tissues. Urea is filtered from the blood of mammals by the kidneys and becomes a major component in urine. Kidney diseases can often lead to increased blood levels of urea. Sharks maintain high urea concentrations in their blood at levels that would be poisonous to most vertebrate animals.

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Activity

Materials:

A means of playing the episode for the class. Either a Season One DVD of *Jonathan Bird's Blue World* or on line access: http://www.blueworldtv.com/s1_e15.html.

Prior to viewing the video:

It may be useful to have a discussion about basking sharks and lampreys. Find out what students know about them. *(see "helpful vocabulary and facts")*

- What type of fish are lampreys? How are they different from most fish?
- Compare the size of the Basking shark (45 feet) to a classroom or length of corridor.
- Discuss the importance of plankton and why larger marine animals such as whales and basking sharks are adapted to feeding on plankton.

Watch the video:

Pause the video occasionally to collect information and allow for discussion of events as they unfold. Suggested pause times are shown below with possible discussion questions.

Possible talking points:

2:10 mark in the video

- What is the question that the scientists are trying to answer on this expedition?

2:30 mark into the video

- From the map, can you figure out why the Bay of Fundy has the highest tides in the world?

3:05 mark into the video

- What adaptations does the basking shark have for filtering plankton ?

5:23 mark into the video

- Talk about the threat of extinction facing the Northern right whale and why locating the whales helps to locate the sharks.
- Is it easier to locate feeding whales or basking sharks? Why?

7:00 mark into the video

- It might be worth discussing how much time and effort it could take just to locate a basking shark. After all, the Bay of Fundy is a large body of water.
- Discuss the challenges trying to do work in the field and how unanticipated problems occur in science and methods may need to be changed.
  For example, how did the crew change their method for getting close to the sharks? Why did they have to change their approach?

8:05 mark into the video

- In science it is important to have records of data or observations. Why was a video record of the lampreys on the shark important ?
- Once there is camera evidence for lampreys on the sharks, has the original question been answered?
- If the video confirms that lampreys are on the shark then why was it important to actually collect them?
- *In science once one question is answered it leads to others.*

9:05 mark into the video

- What questions are the biologists going to try to answer ?
- Discuss the lamprey and its adaptations for living on the shark.
- What is urea ? *(see "helpful vocabulary and facts")*

Post Video Discussion:

1. Why were lampreys not originally believed to parasitize sharks?

2. So why was finding lampreys on sharks important?

3. What has further research from this expedition concluded:
   Are the lampreys feeding on the shark's blood or are they simply "hitching a ride?"
   How are these lampreys able to survive on the shark's toxic blood ?

4. Humans also release urea into our blood which must be filtered out by our kidneys. What danger might someone with a kidney disease face?

5. Maybe if scientists were to learn more about how kidneys in lampreys are able to process high concentrations of urea, perhaps this could lead to a treatment for some types of kidney disease.

AND… this could have happened because of a seemingly trivial observation about lampreys on sharks.

Extending the Activity

There have been many important discoveries throughout history which happened because scientists were able to see something valuable from a mistake or a seemingly irrelevant observation.

As Louis Pasteur once said, "chance favors the prepared mind."

Students could research such discoveries. For example:

1. In 1796, Edward Jenner came up with a vaccine for the deadly smallpox virus because he paid attention to and acted on stories that people who contracted cowpox from their cows did not get smallpox.

2. In 1820, Hans Christian Oersted was lecturing in front of his students. A magnetic compass happened to be near a demonstration requiring electric current. Oersted noticed that the magnetic needle in the compass moved in response to the electric current. This observation was credited as the discovery of electromagnetism.

3. In 1928, Alexander Flemming happened to notice a bacterial culture that he was working with was contaminated by a mold. Before throwing it out he noticed that bacteria did not grow in the area near the mold. This observation led to the development of penicillin, one of, if not the most important, antibiotics ever invented.

Answering questions leads to new questions.

For example, students may come up with questions about basking sharks or lamprey biology.

- The loud outboard motor scared off the sharks. How do sharks hear? Do they have ears?
- How do the basking sharks trap or filter plankton out of the water?
- Do lampreys kill the sharks ? What would happen if they did? Would a good parasite want to kill its host?
- What happens if they do kill the shark? How do they find another host? Can they attach to other fish?

Discussions on how to approach answering such questions could be worthwhile and lead to a better appreciation for how scientific information is obtained.