

LESSON: RoboLobsters

Summary: Students read the article “RoboLobsters: The Beauty of Biomimetics” and create an advertisement for the completed RoboLobster. While being creative, students must be thorough and accurate in their advertisement addressing the “five w’s” (who, what, when, where, and why) and create a schematic diagram of the RoboLobster showing its “extraspecial” features.

EHP Article(s): “RoboLobsters: The Beauty of Biomimetics,” *EHP Student Edition*, January 2005: A486–489
<http://ehp.niehs.nih.gov/members/2004/112-8/innovations.html>

Objectives: By the end of this lesson students should be able to:

1. Identify key features and uses of the new biomimetic Robolobster technology.
2. Anticipate and communicate potential limitations of the technology.

Class Time: 1–2 hours

Grade Level: 9–12

Subjects Addressed: Life Science, Biology, Health, Environmental Health, Environmental Science, Biochemistry (in extensions)

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Prepping the Lesson (15–20 minutes)

INSTRUCTIONS:

1. Obtain a class set of *EHP Student Edition*, January 2005, or download article at www.ehponline.org/science-ed and make copies.
2. Make copies of the student instructions.
3. If you will be using class time to make the diagrams, assemble blank paper/poster paper and a variety of colored markers.

MATERIALS (per student):

- 1 copy of *EHP Student Edition*, January 2005, or 1 copy of the article “RoboLobsters: The Beauty of Biomimetics”
- 1 copy of the student instructions
- 1–2 pieces of blank paper/poster paper
- Colored markers or pencils

VOCABULARY:

Algorithms
 Autonomous
 Biomimetic
 Chemosensory
 Olfactory
 Point source pollution



BACKGROUND INFORMATION:

The article "RoboLobsters: The Beauty of Biomimetics" discusses the development of new, real-time "sniffing" technology used to track pollution plumes (or mines) to their source. This is potentially a very useful technology that could greatly simplify the sampling process. Current methods for tracking pollution in water requires manpower to hand-collect and track multiple samples. Often, several steps are required to process the samples and discover the type and concentration of pollutants in the water. This tends to be time-consuming and expensive.

Saving time when tracking pollution could be very important in catching and stopping the source. Time and water currents will eventually dilute the contaminant. Unless the contaminant is from an ongoing pollution source, continuous dilution makes it more and more difficult to piece together the "scene of the crime." Imagine a police officer trying to collect data from a crime scene on a sand dune. Just when the officer is ready to make a mold of a footprint, the wind begins blowing and the footprint is lost.

RoboLobster is unique because it does several things at once in a very difficult environment. Not only does it "sniff" for the presence of chemicals, it takes continuous samples, immediately differentiating between concentrations. When the RoboLobster detects a high concentration it can move and navigate itself through the water and around obstacles.

For more information on current water sampling techniques, refer to the links in the Resources section.

RESOURCES:

Environmental Health Perspectives, Environews by Topic page, <http://ehp.niehs.nih.gov/topic>. Choose Innovative Technologies, Marine and Coastal Science

U.S. Environmental Protection Agency, Analytical Methods for Testing Water, <http://www.epa.gov/waterscience/methods/>

U.S.G.S., Sampling Methods, <http://ca.water.usgs.gov/pnsp/pest.rep/meth.html>

Implementing the Lesson

INSTRUCTIONS:

1. Provide an introduction of common forms of environmental sampling.
2. Hand out copies of *EHP Student Edition*, January 2005, and refer students to the article "RoboLobsters: The Beauty of Biomimetics" or hand out copies of the article.
3. Hand out copies of the student instructions and drawing materials.
4. When students have completed their advertisement, have them present it to the class.

NOTES & HELPFUL HINTS:

It may be helpful to have a discussion about factors to consider in the design of the RoboLobster. For example, a potential problem RoboLobster may encounter is navigating around large objects. You may discuss how students might address this issue.

Aligning with Standards

SKILLS USED OR DEVELOPED:

Reading comprehension; critical thinking and response; written and oral communication

SPECIFIC CONTENT ADDRESSED:

Physical and chemical properties measured in water, water pollution, scientific discoveries and inventions

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS MET:

Physical Science

- chemical reactions

Life Science

- behavior of organisms

Science and Technology Standards

- abilities of technological design
- understanding about science and technology

Science in Personal and Social Perspectives

- environmental quality
- natural and human-induced hazards
- science and technology on local, national, and global challenges



Assessing the Lesson

Students answer questions, create a schematic drawing, and present an advertisement to demonstrate their understanding of the information provided in the article.

Students need to address the following information in their advertisement:

WHO: Students can be creative with a company name but should list the original creator of RoboLobster, Frank Grasso

WHAT: A robotic “lobster” that can track a variety of pollution sources in water.

WHEN: Students can decide when RoboLobster will be available.

WHERE: Students may offer a variety of models that work in salt water, fresh water, deep or shallow water, turbid or clear water, calm or rough water. Give more points to students who specifically differentiate the water types. Students should also include ordering/purchasing information for the RoboLobster.

WHY: Answers may vary but could include to protect public health, to be able to quickly identify pollution sources (old methods include sampling in many different places, which is expensive and time-consuming), to help enforce environmental laws.

Schematic diagram needs to be realistic based on the information provided in the article and should identify features or parts of the RoboLobster. Student answers will vary, just be sure they are consistent with the information in the article and are logical/reasonable. The schematic should include information about RoboLobster’s features, for example:

- Sensors/sampling areas: Antennae that move around continuously sampling, sensors that can be easily switched out to detect different chemicals.
- Propulsion: A propeller for quick movement through water.
- Durability: A hard plastic exterior that can take bumps and dings and won’t rust, water tight seals, minimal number of openings to minimize potential leakage.

Other selling features: Rechargeable long-life battery, self-correcting mode to prevent orientation problems, tracking signal, manual mode to help RoboLobster get out of tight spots, radio sensor to prevent RoboLobster from running into solid objects, data logging, monitoring low versus high concentrations of a chemical.

Consider scoring students on creativity, neatness and care given to the advertisement, and class presentation.



Step 1: Read the article “RoboLobsters: The Beauty of Biomimetics,”
EHP Student Edition, January 2005: A486–489.
<http://ehp.niehs.nih.gov/members/2004/112-8/innovations.html>

Step 2: Create an advertisement for the “completed” RoboLobster. Your advertisement can take the form of a magazine ad, a brochure, or a TV commercial. Be sure to address the five w’s:

Who

What

When

Where

Why

Step 3: In your advertisement, include a schematic diagram of the RoboLobster showing its “extraspecial” features including where its sensors are located and how they work, propulsion mechanism(s), durability, and other features you think would help sell the product. Be sure to consider features that may address problems the RoboLobster could encounter (like getting around large objects). Be creative, accurate, and informative!

