Aquatic Invaders: Invasive Species

Material taken from:
"Design the Ultimate Invader", Aquatic Invasions! A Menace to the West, Oregon Sea Grant. Contacts:
Sam Chan, Aquatic Ecosystems Health Educator, samuel.chan@oregonstate.edu
Tania Siemens, Research Assistant, AIS, tania.siemens@oregonstate.edu

Introduction:

Invasive species are organisms that are introduced from somewhere else and take over the environment. They cause problems for other plants, animals, and people. Invasive species often have physical traits that enable them to reproduce and spread rapidly and outcompete native species for resources. And invasive species often have physical traits that make them difficult to control.

During this fun lesson, students will apply their knowledge of biology, ecology, and society to design the ultimate invasive species. Use this lesson as a standalone exercise. Or use it as an effective pre- and post evaluation of a unit about species ecology. In Part A, students will first design an invasive species using only their imaginations. After learning about invasive species biology and ecology, students will evaluate and redesign their ultimate invader in Part B to make it even more invincible.

Objectives:

Students will be able to:

- Gain awareness of some local aquatic invasive species
- Apply their current knowledge of biology and ecology to design the ultimate invasive species.
- Apply knowledge gained of invasive species to critically evaluate and revise their ultimate invader.

Ocean Literacy Principles

These activities support:

- Essential Principle #5 – The ocean supports a great diversity of life and ecosystems
- Essential Principle #6 – The ocean and humans are inextricably interconnected

Materials:

- Flip chart/poster paper
- Scrap paper for note taking
- Color Markers

Handouts/Transparencies:

Handout A – Aquatic Invader Investigator
Handout B – Structures and Functions of Your Ultimate Invader

2009 SMILE Summer Teacher Workshop High School Club Activities
Aquatic Invaders: Invasive Species

Teacher Resources: Economics of Invasive Species
You Can Stop the Spread of Aquatic Invasive Species (AIS)
100 Most Dangerous Invaders to Keep Out of Oregon in 2009

Preparation

It is useful to gain some familiarity with invasive species topics before teaching this lesson. For more information, see the AIS Resource Guide or the Web site of the Union of Concerned Scientists (www.ucsusa.org/invasive_species/). Additionally, check out the book "On the Lookout for Aquatic Invaders: Identification Guide for the Pacific Northwest" developed by Scott Wiedemer and Sam Chan, published by Oregon Sea Grant.

There are also some great examples of variations of this type of project on the Oregon Sea Grant Website. Check out Invasive Species 101 at: http://invasivespecies101.wordpress.com/ and click on the drop down menu on the right side of the page to look at different student projects.

Part A: Design the Ultimate Invader

1. Introduce aquatic invasive species to the class. Provide some examples of different invasive species that are found in the Pacific Northwest, using some of the provided resources and/or have students watch the "You Ought to Tell Somebody Videos" on marine invasive species at: http://seagrant.oregonstate.edu/video/index.html#yotts. Discuss some of the traits that make these organisms effective invaders.

2. Divide students into teams (three to five students per team) and ask them to design, draw, and describe the characteristics of the *ultimate* invasive species. The species must be an aquatic species, or a combination of aquatic and another environment. Encourage students to be creative, unleash their imaginations, and use whatever knowledge they have about invasive species. If students need help getting started, here are a few questions they might consider:

   - What are the characteristics of this species?
   - What are the characteristics of its native habitat?
   - How did it get here?
   - How does it reproduce?
   - Why was it brought into the United States?
   - Who or what brought it to the United States?
   - What is it capable of doing to make it invasive?
   - What does it look like? (Draw a sketch.)
   - Where does it live?
   - What social setting does it live in?
   - What does it consume?
   - What consumes it?
   - Where does it come from?
   - What would you name it?
   - As its designer, can you control it?
   - What might others try to do to control and compete or co-exist with it?

- Did any policies help to promote this invasive species?

Students can use Handout A, Aquatic Invader Investigator, to help address these topics.

Part B: Redesign the Ultimate Invader

1. After students have completed part A, have them gather into the same teams as before. Allow teams 15 minutes to redesign the ultimate invasive species. Students should:
   - Apply any additional knowledge they acquired and experiences they had with invasive species since designing their species the first time
   - Use a different approach to describe an invasive species.

2. Have each team make a three-minute presentation to the class. Teams should talk about why their invader is unique and discuss, when appropriate, some elements of sociology, culture, economics, geography, math, engineering, science, transportation, and vocational skills in describing their ultimate invader.

3. During their presentations, have each team address the questions posed in Handout A.

Wrap Up

Questions for the students to consider:

1. *What was your team's design process?* For example, what did the team consider first? Did the team first make a list, or did you start drawing right away?

2. *Can you list or describe the structure and function of each of the characteristics that make their organism the ultimate invader?* For example, an ultimate invader that can live in aquatic and terrestrial habitats may have special lungs that can function as gills. The structure might be called gill-lungs, and they would enable the organism to invade aquatic and terrestrial habitats.

   Handout B, Structure and Functions of Your Ultimate Invader, will assist students with answering question 2, as well as their presentation.

Extensions:

1. Have the students take a look at a more specific example of Chinese Mitten Crabs, an invasive species found in California. These crabs hold much controversy as they are a harmful invader for North America, yet also prized and valuable food crabs. A lesson plan centered on these crabs (developed by Oregon Sea Grant for the Oregon Invasive Species Council) is available at: http://oregon.gov/OISC/calendar_january_activity09.shtml#Printable_format_of_activities

2. Have the class take part in an Invasive Species Watch, where students can help find and report on locations of different invasive species across Oregon. Oregon

Invasive Species Hotline has lots of information on finding and reporting potential invaders: http://oregoninvasiveshotline.org/

3. Have students investigate aquatic invasive species further by using the Sea Grant website "Nab the Aquatic Invader!" at: http://www.sgnis.org/kids/.

Vocabulary:

Abiotic
A non-living component of an ecosystem.

Adaptation
An alteration or adjustment in structure or habits, often hereditary, by which a species or individual improves its condition in relationship to its environment.

Allelopathy
The inhibition of growth in one species of plants by chemicals produced by another species.

Autotroph
An organism capable of synthesizing its own food from inorganic substances, using light or chemical energy. Green plants, algae, and certain bacteria are autotrophs.

Biotic
Components of an ecosystem associated with or derived from living organisms. The biotic factors in an environment include the organisms themselves as well as such items as predation, competition for food resources, and symbiotic relationships.

Ecosystem
A community of organisms together with their physical environment, viewed as a system of interacting and interdependent relationships and including such processes as the flow of energy through trophic levels and the cycling of chemical elements and compounds through living and nonliving components of the system.

Endangered
(Of a species of animal) in danger of becoming extinct.

Extinct
(Of an animal or plant species) having died out.

Food web
A complex of interrelated food chains in an ecological community.

Heterotroph
An organism that cannot synthesize its own food and is dependent on complex organic substances for nutrition.

Hybrid
An animal or plant resulting from a cross between two different types of animal or plant.

Introduced species
An organism that is non-native to a given region or ecosystem and has been accidently or deliberately transported to this new location by human activity.

Invasive species
A non-native (or alien) species to an ecosystem whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary means of invasive species introduction.

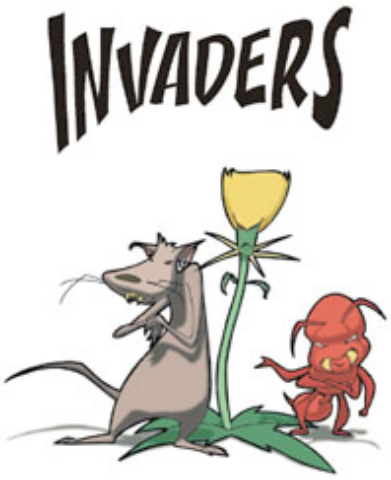
Native species
An organism that is indigenous to a region or ecosystem.

Non-native species
An organism that is not indigenous to a region or ecosystem.

Zebra mussels *(Dreissena Polymorpha)* on native Unionid mussel. Native mussel population have been eliminated in many areas of the Great Lakes by Zebra mussel colonization such as shown here. Zebra mussels are called the "poster child" for aquatic invasive species because their invasion of the Great Lakes in the late 1980s led to major policy initiatives and legislation at the national level in the United States.

Handout A: Aquatic Invader Investigator

Design the Ultimate Invader!



WHAT DO YOU KNOW?

Instructions: Use your knowledge of biology, ecology, and evolution to answer the following questions about your ultimate invader. Your teacher may also have additional resources for you to refer to.

1. If an invader is not outwardly aggressive, what novel characteristics allow it to outcompete other species? For example, some "novel weapons" might include allelopathy, multiple hosts or vectors, size (small has advantages), adaptations for multiple modes of transport, cute, attractive, etc.

2. What biotic or abiotic factors may limit the growth of your population of invaders?

3. What might happen when two different invasive species hybridize? What might happen when an invasive species and a non-invasive species hybridize? Can the two species hybridize?

4. What role does your invader play in the food web?

5. Is your invader an autotroph or a heterotroph?

6. Some invaders could be too successful for their own good. The invader may reproduce at such a rapid rate that it eats itself out of house and home. Is this a good characteristic for an ultimate invader?

7. Why is eradication of a species almost impossible with biological control?

8. Other species your invader interacts with may have to adapt to the presence of your invader to survive. Choose a characteristic of your invasive species that will affect native species and describe the process by which a native species could evolve to live with your invader. (For example, if an invader outcompetes a native species that is a specialist by eating the entire sole food source for the native species, the native species may evolve to become a generalist rather than a specialist).

9. Pretend that a subset of your invader evolves into a new species that is even more invasive than before. Describe the process by which this evolution occurs. What characteristic evolved with the new species? (Invent the characteristic!)

Handout B: Structures and Functions of Your Ultimate Invader

Instructions: Fill out the following table according to your Ultimate Invader!

Characteristic of your Ultimate Invader!	Physical Structure	Function in the Environment	How it helps your invader to successfully invade