HELLO INVASIVES ~ GOODBYE LAKES

Summary: Students will evaluate the effects of an aquatic invasive species for a simulated lake.

Audience: Grades 5 and up

Time Frame: 30 minutes

Materials:

- two -14”x 1”x 3” clear containers, dishpans or casserole dishes
- 1 pkg of Neon-colored straws, enough to make 70 pieces cut into 1-1/2” strips
- 3 pkgs (50 each) of white straws, cut into 1-1/2” strips
- 7 – quart-sized resealable plastic bags
- 1 small toy boat with double-sided tape on bottom and sides
- Hats or signs for players (biologist, native species, invasive species)
- Classroom: Graph paper and pencils for each student; Event setting: leader creates graph on a flip chart
- 1 pair of forceps or chopsticks (optional)
- 1 small toy plane (optional)

Objectives

Students will be able to:

1. Define invasive species
2. Differentiate between native, introduced and invasive species
3. Identify aquatic native and invasive species
4. Compare the rapid growth of aquatic invasive species in a simulated lake over time with and without control measures.
5. Create and interpret a graph reflecting of the growth rate of an invasive species
6. Identify actions to stop the spread of invasive species

Background

<u>What is an invasive and why should I care?</u>

An invasive species is defined as a species (plant or animal) that is non-native to the ecosystem. It grows, reproduces and spreads rapidly, often out-competing native species. Invasive species typically lack any natural predators and competitors and are disease resistant. The native species is often at a disadvantage because it must deal with disease, parasites and predators that do not affect the exotic. As a result, the invasive species thrives and the native species declines.

Invasive species are also referred to as exotic, alien, or non-indigenous species. The problem with these names is that they only refer to the non-native part of the definition above. Many exotic or alien species do not cause harm to our economy, our environment, or our health. In fact, the vast majority of "introduced" species do not survive and only about 15% of those that do go on to become "invasive" or harmful.

Invasive species are a form of biological pollution. Invasive species decrease biodiversity by threatening the survival of native plants and animals. They interfere with ecosystem function by changing important processes like fire, nutrient flow, and flooding. Invasive species hybridize with native species resulting in negative genetic impacts.

Examples of invasive species include terrestrial plants such as Salt Cedar, Chinese tallow tree or Mimosa trees and many aquatic plants (see sidebar). Invasive animals include several species of insects, fish, shellfish, and some birds. Zebra mussels are small, fingernail-sized mussels native to the Caspian Sea region of Asia. They are believed to have been transported to the Great Lakes via ballast water from a transoceanic vessel. The ballast water, taken on in a freshwater European port was subsequently discharged into Lake St. Clair, near Detroit, where the mussel was discovered in 1988. Since that time, they have spread rapidly to all of the Great Lakes and waterways in many states south. The first adult zebra mussel was discovered in Texas in 2009.

An example of an invasive fish species is the common aquarium fish plecostomus, *Hypostomus plecostomus*, or "algae eater." This species is not native to the United States, but wild populations of at least three species can now be found in Texas. Wildlife biologists are concerned that in the wild these efficient feeders may disrupt the food sources of native fishes and hamper the natives' reproduction by destroying their eggs. These fish are frequently found in the wild at lengths exceeding a foot. At that size and in large numbers, their habit of burrowing into banks to spawn can impact adversely a stream's water quality by releasing substantial amounts of sediment and destabilize banks.

Invasive species spread easily in today's modern global network of commerce and are difficult and costly to control. Invasives impede industries and threaten agriculture and can endanger human health. Invasive species are a significant threat to almost half of the native US species currently listed as federally endangered.

<u>What is an introduction?</u>
When a species ends up in a new ecosystem, it is considered "introduced." Species do naturally change their ranges slowly over time, but it is not these "natural" events that we are concerned with. Most of the introductions that result in invasive species are human caused.

In some cases, we deliberately introduce species. Examples of this include garden ornamentals, range forage plants for cattle, animals and insects used to control other organisms

INVASIVE AQUATIC PLANTS COMMON IN TEXAS

- Alligatorweed, *Alternanthera philoxeroides*
- Ambulia, *Limnophila sessiflora*
- Brazilian Peppertree, *Schinus terebinthifolius*
- Duck-lettuce, *Ottelia alismoides*
- Eurasian Watermilfoil, *Myriophyllum spicatum*
- Exotic Bur-reed, *Sparganium erectum*
- Giant or Dotted Duckweed, *Landolita punctata*
- Giant Salvinia, *Salvinia molesta*
- Heartshaped False Pickerelweed, *Monochoria vaginalis*
- Hydrilla, *Hydrilla verticillata*
- Lagarosiphon, *Lagarosiphon major*
- Narrowleaf False Pickerelweed, *Monochoria hastata*
- Paperbark, *Melaleuca quinquenervia*
- Purple Loosestrife, *Lythrum salicaria*
- Torpedograss, *Panicum repens*
- Water Spinach, *Ipomoea aquatica*
- Waterhyacinths, *Eichhornia crassipes* (floating waterhyacinth) and *Eichhornia azurea* (rooted waterhyacinth)
- Waterlettuce, *Pistia stratiotes*
- Wetland Nightshade, *Solanum tampicense*

(particularly in agriculture), and plants used for erosion control and habitat enhancement for wildlife.

Other species are introduced accidentally on imported nursery stock, fruits, and vegetables, in ship ballast waters, on vehicles or boat trailers, in packing materials and shipping containers, through human-built canals, and from human travel.

Managing Invasive Aquatic Species

The costs to prevent, monitor and control invasive species are enormous not to mention the costs to crop damage, fisheries, forests, and other resources. Invasives cost the US $137 *billion* annually. Some of the most invasive and harmful species cost in excess of $100 million each annually.

Of course prevention is the preferred method of controlling invasive species. But once an invasive species appears, early detection and rapid response is vital to making progress to control and/or eradicate the invasive species. There are three types of control methods:

Biological control: this method uses the purposeful introduction of organisms that feed on all or part of an invasive plant species. Learning from other's mistakes through history, scientists now use extensive quarantined studies and carefully monitor the organisms to ensure they do not cause harm to other habitat components before introducing them into the wild. Often, this testing may take many years.

Chemical control: Using a chemical application, or herbicide, to combat an invasive species is another method. This method may be less expensive and easier to apply, but may also cause harm to native plant and animal species, to the water, or to people.

Physical or Mechanical control: this method may use hand-pulling or cutting. In areas that are deep and wide, large equipment can be brought in to harvest the invasive plants. Disadvantages to this method are that sediment may get stirred up resulting in murky water and making it difficult for aquatic insects, mussels and fish to survive. Removing invasive species along the banks of the water body may cause erosion if the area is not replanted with native plant species.

There are advantages and disadvantages to each of these methods. Some or all of these methods may be combined to address the most effective way to control the invasive species.

How does this issue affect you?

After habitat destruction, invasive species are the second greatest threat to biodiversity. Invasives threaten the survival of native plants and animals, interfere with ecosystem functions, and hybridize with native species resulting in negative genetic impacts.

Invasive species impede industry, threaten agriculture, endanger human health, and are becoming increasingly harder to control as a result of rapid global commercialization and human travel. Invasive species are a significant threat to almost half of the native species currently listed as federally endangered. As mentioned above, the costs to prevent, monitor and control invasive species combined with the costs to crop damage, fisheries, forests, and other resources is eventually passed on to us, the consumer.

How Can You Help?

There are many things you can do to help stem the tide of invasive species. Here are just a few ways you can take action and get involved:

Join a Citizen Scientist Program

Working out in the field can be a very rewarding way to combat invasive species. Whether you are collecting scientific data to be used by local, state, or national agencies and organizations or actually helping get rid of the invasive plants and animals, you will be able to see up close and personal the impacts of invasive species and the results of your efforts.

Prevention

Most invasive species are introduced by humans accidentally. Learn how to prevent carrying invasive species on your boats, cars, bicycles, motorcycles, fishing equipment, and socks and hiking boots.

While we all want Nemo to find his way back home, encourage your students to retain animals until they die naturally. Do not release plants or animals from classroom aquariums, displays or science experiments. Doing so may introduce disease to native wildlife, disrupt diversity of the habitat, and introduce species that could become invasive.

Garden Wisely

Avoid plants that self seed and show up outside of your garden. Do not use weedy volunteers from parks and abandoned lots. Make informed decisions when choosing plants for a garden project, selecting native plants vs exotics or introduced species. There are many resources to help with creating low-maintenance and colorful native plant gardens such as the Lady Bird Johnson Wildflower Center Native Plant Information Network or Texas Parks and Wildlife.

Educate Yourself and Others

Learn more about invasive species by exploring the TPWD website and the related links.
Tell your friends and family what you have learned and let your local nursery grower know your concerns if they are selling invasive species.

Tips from The Nature Conservancy

- Verify that the plants you are buying for your yard or garden are not invasive. Replace invasive plants in your garden with non-invasive alternatives. Ask your local nursery staff for help in identifying invasive plants.
- When boating, clean your boat thoroughly before transporting it to a different body of water.
- Clean your boots before you hike in a new area to get rid of hitchhiking weed seeds and pathogens.
- Don't "pack a pest" when traveling. Fruits and vegetables, plants, insects and animals can carry pests or become invasive themselves. Don't move firewood (it can harbor forest pests), clean your bags and boots after each hike, and throw out food before you travel from place to place.
- Don't release aquarium fish and plants, live bait or other exotic animals into the wild. If you plan to own an exotic pet, do your research and plan ahead to make sure you can commit to looking after it.
- Volunteer at your local park, refuge or other wildlife area to help remove invasive species. Help educate others about the threat.

Activity Preparation

1. Make signs or use other props to designate the following helpers: Biologist (cap); Native Species (Texas flag/bandana); Invasive Species (hat made of wild plastic plants)
2. Cut straws into 1 to 1-1/2 inch strips (Will need a total of approximate 440 pieces)
3. Label and fill resealable plastic bags as follows:

   (Note: if planning to demonstrate more than one time at an event, you may want to make multiple sets of the bags of straw pieces.)

Bag name	**# of straw pieces and colors**	**# of bags**
Native species (starter bag)	50 mixed colors	2
Native species (addition bag)	20 mixed colors	1
Invasive species, week 1	10 white	1
Invasive species, week 2	10 white	1
Invasive species, week 3	20 white	1
Invasive species, week 4	40 white	1
Invasive species, week 5	80 white	1
Invasive species, week 6	160 white	1

4. Place double-stick tape on the toy boat (folded duct tape works well too.)

Activity Procedure

1. Distribute graph paper and pencils to each student OR use flip chart for large group viewing.

2. Discuss the components of a lake habitat (fish, frogs, plants, birds, snakes, insects, crayfish, mussels, people, etc).

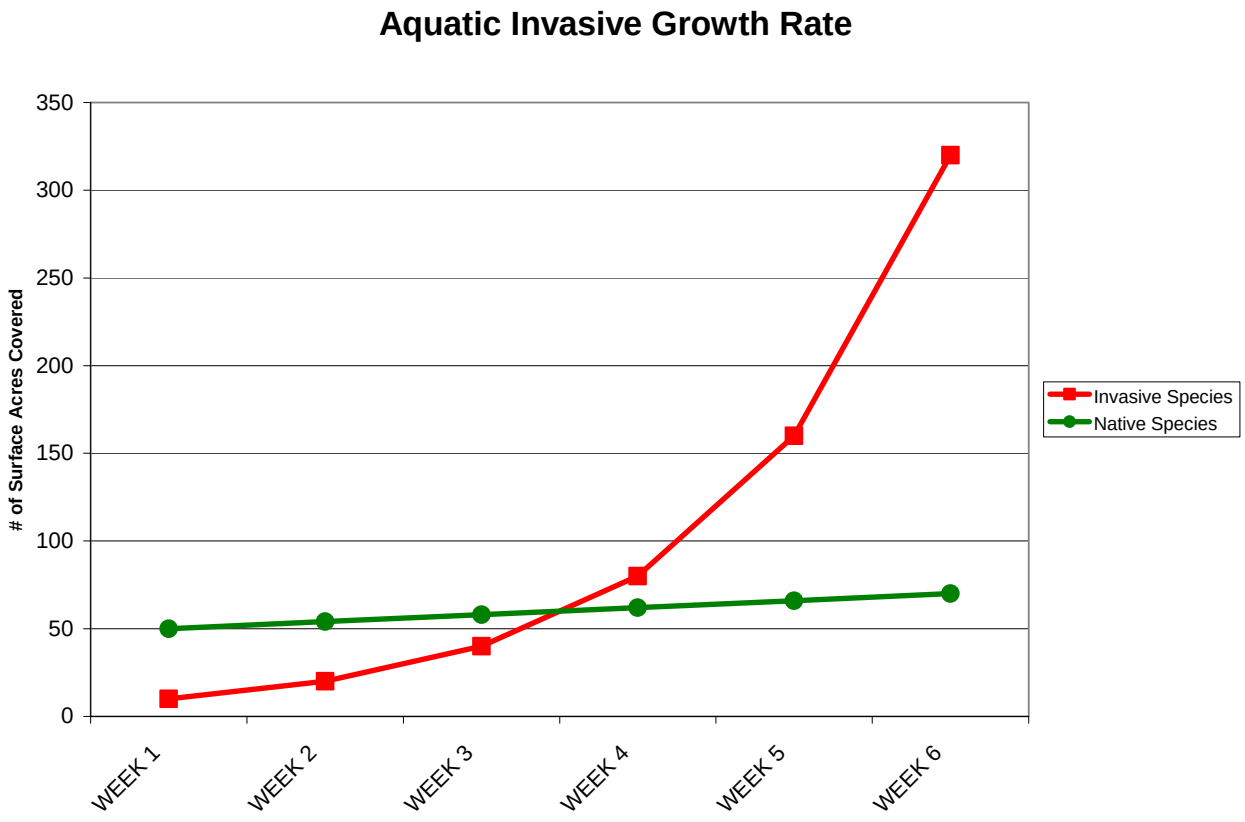
3. Discuss with the students the definition of an invasive species and what the differences are between native species and invasive species. A healthy habitat has a diversity of native species. In this activity, the mixed colors of straws represent that diversity.

4. Discuss how invasive plant species grow rapidly and out-compete the native plant species, and degrade the habitat for fish and other animals living in the lake. In this activity, the invasive species doubles its growth every week. (Show bags in order of week progression-each straw piece represents one acre.)

5. Ask student to create a graph for Lake One with time periods: week 0, 1, 2, 3, 4, 5, & 6 and plant growth (in surface area -- # of acres) marked in integrals of 20 (from 0 to 340).

Use a circle to indicate native plants, and an “X” to represent invasive plants on the graph.

Example:



6. Ask for 4 volunteers/helpers: Biologist, Native species, Invasive species, and Boater. Give the toy boat to the boater; give hats, signs or other props to the remaining volunteers.

7. Place the two pans/containers on table for group to see. Instruct the native species person to <u>add 50 straw pieces to each of the two lakes</u> (pans). Have each student record data on their graph for lake one.

8. On the leader’s designated signal, have each of the volunteers act concurrently:
   - Have the native species person slowly add 1 straw piece (mixed colors) at a time to each lake (keep count of how many pieces they add to lake one.)

- Have the invasive species person add week one pieces (white) to lake one only (add all at once).
  [Leader will stop activity after each round and allow time for students to graph results for lake one. Ask students to record data on their graph (native species person will have to tell group how many pieces they added; invasive species amount is listed on the bag—add to amount from previous week, then subtract the amount the biologist removes.]
- Leader stops activity and shows the group each lake and discusses how many native plants (mixed colors) vs invasive species (white) are in lake one and two. *[Record data for lake one.]*
- Leader begins activity again, native plants continue adding one piece at a time to both lakes, while the invasive species person adds week two pieces (white) to lake one only. Leader stops activity after all the week two invasives are added. Leader shows the group the lakes and discusses the number of invasive species (white) vs native species (mixed colors) in each lake. *[Group records data.]*
- Leader begins activity again, native plants continue adding one piece at a time to both lakes, while the invasive species person adds week three pieces (white) to lake one only. Leader stops activity after all the invasives are added. Leader shows lake one to the group and discusses with the group. *[Group records data.]*
- Leader asks the group**, "Is it time to call a biologist to come take a look at the lake?"** If group agrees, the leader calls for the biologist. The biologist arrives at the lake *(looking very concerned and thoughtful)* and determines yes, we must start acting now to remove the invasive species!
- Leader begins activity again, native plants continue adding one piece at a time to both lakes, while the invasive species person adds week four pieces (white) to lake one only. Meanwhile, using one hand, the biologist begins removing the invasive species using forceps, chopsticks or one finger and thumb. Leader stops activity after all the invasives are added. Leader shows lake one to the group and discusses with the group. Leader asks: **How is the biologist doing? Are the invasive species still causing a problem in the lake? What about lake two?** *[Group records data.]*
- Leader then introduces the boater. The boater takes the toy boat with two-sided tape on the bottom and sides, and goes for a ride in the lake (picking up as many invasive straw pieces as he can with the sticky bottom). The boater then goes boating in lake

two, depositing the straw pieces (will have to use hand to brush off pieces into the lake.) Leader discusses with group what just happened. **How could the boater prevented the spread of the invasives? What do you think will happen to lake two?**

- Leader asks players to resume activity for lake one: the native plant person, biologist and invasive species person to continue activity. Invasive species person empties week five (white) into lake one. Leader stops activity after all the invasives are added. Leader shows lake one to the group and continues discussion. *[Group records data.]*
- Leader asks native plant person, biologist and invasive species person to continue activity. Invasive species empties week six (white) into lake one. Leader stops activity after all the invasives are added. Leader shows lake one to the group and continues discussion. *[Group records data.]*

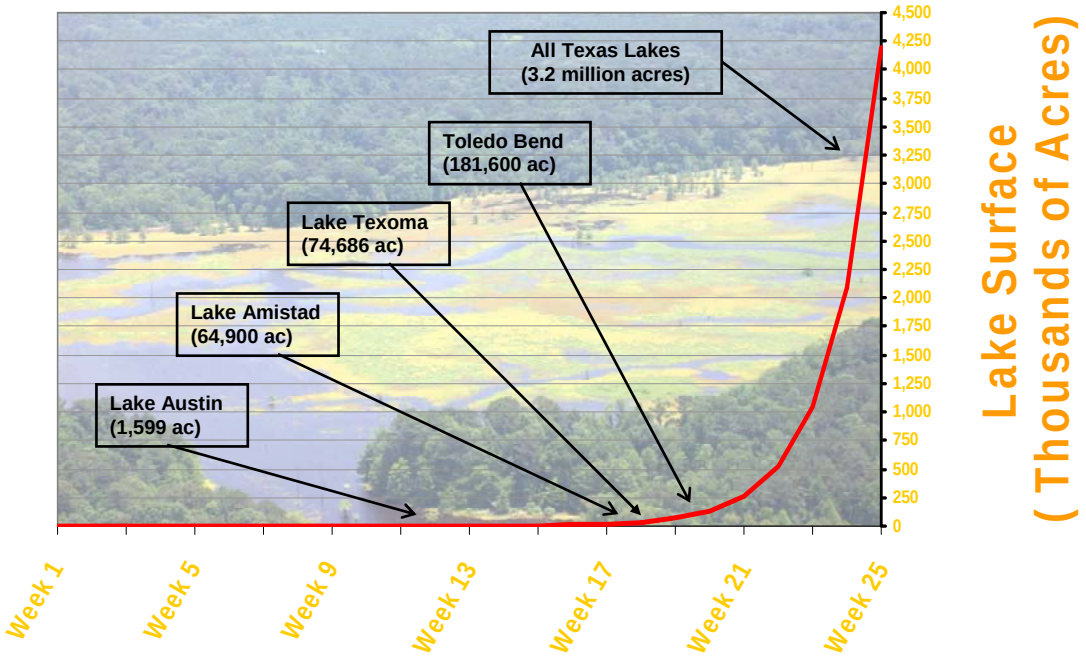
Discussion questions:

- Review the graph. How does the growth rate of the invasive species compare to that of the native species?
- How effective was the biologist at removing the invasives (mechanically)? How could the invavise removal process be improved? If the biologist arrived during the first week, would it have made a difference? Why or why not?
- How do you think the growth of invasives affected the fish and other wildlife (wading birds, ducks, reptiles like turtles, aquatic insects, etc.) living in or near the lake?
- How do you think the growth of invasives affected people who like to swim, boat or fish on the lake? Would this problem affect the property values of the people's homes or affect the visitation to a park on the lake?
- What would happen if a crop-duster plane came in and sprayed the entire lake with a herbicide?
- Identify and discuss ways to prevent the spread of invasive species.

Extension

1. Have students mathematically continue the computation and graph through week 25 (approximately six months) using the knowledge that the invasive species doubles in size every week. Using the TPWD web site to look at various lake sizes, compare the unchecked aquatic invasive species coverage on their extended graph to the sizes of various lakes in Texas (use popular lakes or lakes near your location that students may be familiar with.)

Example:



2. Have students or small work groups research and report on different types of invasive and native aquatic plants and animals in Texas.

Additional Resources

Aquatic Plant Management Society: Understanding Invasive Aquatic Weeds, download student workbook or use online interactive book, with games, puzzles, movie clips and more, http://www.apms.org/activity.htm

HabitattitudeTM is a national initiative developed by the ANS Task Force and its partner organizations: The U.S. Fish and Wildlife Service; the pet and aquarium trade and the nursery and landscape industry; the National Sea Grant College Program and state fish and wildlife agencies. http://www.habitattitude.net/

Protect Your Waters, www.protectyourwaters.net

Texas Parks & Wildlife, www.tpwd.state.tx.us

Texas Invasives, www.texasinvasives.org

A Guide to Freshwater Ecology published by Texas Commission on Environmental Quality, http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/gi/gi-034.html/at_download/file

University of Florida, Center for Aquatic and Invasive Plants, http://plants.ifas.ufl.edu/

Vocabulary

Acre: unit of measure about 15% bigger than a football field (208ft. x 208 ft)

Aquatic plant: any plant that lives, grows, or reproduces in water

- **Floating plant:** plants that float freely on the surface and plants that are rooted on the bottom with their leaves floating on the surface. (example: Native: Common duckweed, Water lily, American lotus; Invasive: Water Hyacinth,)
- **Submerged plant:** plants that are generally rooted at the bottom and are completely underwater except for seed heads or flowers (example: Native: Coontail, Pondweed; Invasive: Hydrilla)
- **Emergent plant:** Plants that are rooted to the bottom and grow above the water along shorelines and in shallow water areas (example: Native: Cattail, Spike rush, Arrowhead; Invasive: Alligator weed)

Biodiversity: a term used to represent the variety of life forms in a given area

Habitat: the arrangement of food, water, shelter or cover, and space suitable to animals' needs

Herbicide: a substance or preparation for killing plants

Introduced species: a species that was brought into an area intentionally by humans or unintentionally by humans or other means such as wind, weather or wildlife.

Invasive species: a plant or animal that has the ability to significantly displace desirable species or to reduce the yield of growing crops.

Native species: a plant or animal that was produced, grew or originated in a certain region. Generally, a species is considered native if it grew unaided in a region before European colonization.

Science TEKS Correlations

5th Grade- (a)(b), 1(A)(B), 2(A)(B)(C)(D)(E), 6(A)(C), 9(A)(B)(C), 11(A)

6th Grade- (a) 4(A)(i)(ii)(iii), 4(B)(iii), 4(E);
Knowledge and Skills: 1(A)(B), 2(A)(B)(C)(D)(E), 4(A)(B), 5(B), 12(A)(C)(D)(E)(F)

7th Grade- 4(A)(i)(ii)(iii),(E)(i)(ii)(iii); Knowledge and Skills: 1(A)(B),2(A)(B)(C)(D)(E), 3(A)(B)(C), 4(A), 8(A)(B)(C)10(A)(B)(C), 12(A)(B)(C),13(A)(B)

8th Grade- 4(A)(i)(ii)(iii)4(E)
Knowledge and Skills: 1(A)(B), 2(A)(B)(C)(D)(E), 11(A)(B)