



# Survival and Climate Change Game

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## Overview:

This lesson is based on the IL/IN Sea Grant Rival for Survival Game. Changes have been made on the game board to reflect expected impacts related to climate change in the Great Lakes. Although no one can truly predict the future, many scientists believe that climate change impacts in the Great Lakes may include lower water levels, increases in water temperature, declines in cold water fish species, increases in warm water fish species, increased storm activity and increases in new invasive species.

## Objectives:

At the conclusion of the lesson, students will be able to:

- Provide examples of potential impacts caused by climate change
- Discuss various interpretations of the role that climate change can play in the establishment and spread of invasive species in the Great Lakes
- Recognize some common native and invasive species in the Great Lakes

## Duration:

This lesson can be completed in 1 class period if the activity is played once. Ideally it should be played multiple times so students can observe different outcomes depending on students knowledge, the cards used and their distribution.

## Standards:

- Share ideas about science through purposeful conversation.
- Communicate and present findings of observations.
- Identify the impact of climate change on native and invasive species
- Describe helpful or harmful effects of humans on the environment (Climate change, habitat destruction, land management, renewable, and non-renewable resources).
- Predict how changes in climate might affect species survival and distribution.
- Describe how humans are part of the Earth's system and how human activity can purposefully, or accidentally, alter the balance in ecosystems.

## Prerequisite Teacher Knowledge:

Aquatic invasive species (AIS) are species that are found outside of their native habitat and cause harm to their new environment. They are highly competitive and persistent. There are over 185 non-native species in the Great Lakes, and the trend has been one

new species every 6-8 months. As the climate continues to warm, and the Great Lakes experience additional stressors, AIS may become an even bigger problem as warming temperatures, changing water quality, and disturbance may allow new AIS to expand their ranges and make their home in the Great Lakes. This illustrates the need to be vigilant and step-up efforts to prevent AIS introductions into the country. Most of those responsible for fighting AIS infestations realize that it is less expensive to prevent their introduction in the first place than to try to control or eradicate them once an infestation has occurred.

To prevent future invasions it would be helpful to know the answers to a few questions: Are there characteristics that are common between different invasive species? How can we tell which habitats are most at risk?

Aquatic invasive species have certain characteristics that tend to make them successful:

- Rapid growth and reproduction: tend to grow quickly and produce a lot of offspring; many reproduce multiple times in one season.
- Asexual reproduction: some species need only one individual to reproduce; especially plants, which may need only a small plant fragment to start a completely new population.
- Adaptability: typically hardy and able to tolerate a wide range of environmental conditions, including degraded and polluted habitats and rapidly changing conditions that native species can't tolerate.
- No predators: Since these species are non-native, they often lack the natural predators that would keep their population numbers in check.

Global climate change may make conditions more suitable for invasive species.

Warming temperatures, increased precipitation, and other climate change impacts predicted by scientists presents a whole new challenge to invasive species management. While it is unknown exactly how AIS may respond to a changing climate, it is predicted that many species will benefit from these changes, expand their ranges, and have exacerbated negative impacts. Due to the characteristics that allow AIS to become successful, these species will most likely have the upper hand at trying to adapt to changing conditions, which may allow them to further outcompete existing native species.

- Ask the students about their prior knowledge about climate change and invasive species.
- Can they name any invasive species? Do they know the issues caused by those species or what people are doing to control them?
- Ask students how they think a changing climate might impact these species? What changes are expected? What kind of species will do better after these changes? What kinds of species might do worse?

- Tell students that they will now participate in a game to learn about the impacts of climate change on the environment and invasive species in particular.

### Materials:

Game board

Game cards

Score paper

Die

Pen or pencil Movable pieces (coins, buttons or pieces from other games.)

**Game Objective:** To have the most points when all players have reached the “Finish” position

### Directions:

1. Each player rolls the die, and the player with the highest number goes first.
2. Player 1 rolls the die and moves the playing piece the number of spaces shown on the die. Player 1 chooses a question card and hands it to the player on the left, who reads the question aloud. Player 1 chooses the best answer.
3. Points received are based on the player’s answer and are recorded on the score sheet.
4. When landing on a space that requires the player to move ahead or backward, the player moves the game piece before picking a question card.
5. Some answers will cause a player to lose points. If the player has no points, however, he or she cannot go below zero, even if told to subtract a point.
6. Play continues in a clockwise direction until all players reach the finish region or the time limit is reached. The player with the most points is the winner—not the player who reaches the finish first. Finishing first may not necessarily be a good thing in this game!

This lesson is one of 10 lessons that focus on climate change and invasive species prepared by the Pennsylvania and New York Sea Grant programs as part of a larger Great Lakes Sea Grant Network initiative funded by the Great Lakes Restoration Initiative.



# Survival and Climate Change Game

(Based on Rival for Survival Game - IL/IN Sea Grant)

Lake levels drop and you cannot reach your spawning grounds - go back 3 spaces.



Coldwater fish you feed on decline. Go back 2 spaces.



New predators invade. Go back 2 spaces.



Your range expands due to warmer winters. Move ahead 2 spaces.

Heavy ice cover blocks your spawning run. Go back 2 spaces.



Waters warm and reduce oxygen levels. Go back 4 spaces.



Warm water fish you feed on increase. Go ahead 2 spaces.

Invasive species move up from the south. Go back 4 spaces.



START

FINISH

## Game Cards—Front a

- Q** Your aquarium is no longer functioning. You decide to get rid of the fish. You should
- flush them.
  - find them a new home in another aquarium.
  - drop them in the local pond.

- Q** To prevent the transfer of exotic species from one lake to another, you should
- pull your boat quickly from one lake to another.
  - inspect your boat trailer and equipment.
  - wash your boat in cold water.

- Q** How many of these species are exotic: goldfish, purple loosestrife, sea lamprey, starling?
- one
  - three
  - four

- Q** Bringing in natural predators may be the way to handle exotic species such as purple loosestrife. Choose a potential problem with the above idea.
- Purple loosestrife would decrease.
  - Predators may not die out after plants are gone.
  - Native plants would repopulate area.

- Q** Some exotic species can be a nuisance. How many of these are nuisance species: carp, alewife, purple loosestrife, zebra mussels, sea lamprey?
- two
  - three
  - five

- Q** You find a beautiful plant while on vacation in Mexico. Do you
- take a picture?
  - dig it up and transplant it in your garden?
  - pick the flowers off of it?

- Q** The role an organism has in its environment is its niche. Exotic species
- try to take over the niche of another organism in an ecosystem.
  - have no niche in an ecosystem.
  - are not organisms.

- Q** Zebra mussels each filter about
- 0.25 liter of water per day.
  - 0.50 liter of water per day.
  - 1.0 liter of water per day.

- Q** How could you gain information about exotic species in your area of the country?
- Contact the Wildlife Service.
  - Complete an Internet search on the topic.
  - Both a and b.

- Q** The sea lamprey is an exotic species in Lake Erie. Why is it so damaging to other fish?
- It eats their eggs.
  - It carries a large number of diseases.
  - It sucks out the blood and body tissues of other fish through its suckerlike mouth.

- Q** In any ecosystem, there is a limited amount of resources. If an exotic does well in a new ecosystem, that usually means native species are
- getting more resources than before.
  - getting the same amount of resources than before.
  - getting less resources than before.

- Q** Exotic species are
- rare organisms.
  - organisms brought into an environment not their own.
  - worth a lot of money.

## Game Cards—Back a

**A** a = 0 pts. No! You might transfer species from one body of water to another.  
b = 3 pts. Good decision! You ensure there are no organisms transported on your boat.  
c = 1 pt. You're trying to remove all organisms—use 140°F water.

**A** a = 0 pts. Not a good choice!  
b = 3 pts. This is the best thing to do.  
c = -1 pt. Take a point away. You could be introducing a new species to the pond and upsetting the ecosystem!

**A** a = 0 pts. This is what we would want to happen!  
b = 3 pts. Could be a very real problem. You'd just be trading one exotic species for another.  
c = 0 pts. This is a positive effect of introducing a natural predator; the question asked for negative effect.

**A** a = 1 pt.  
b = 2 pts. All four are exotic!  
c = 3 pts.

**A** a = 3 pts. Correct! You can enjoy the plant without damaging it or carrying it into an ecosystem not its own.  
b = -1 pt. Take a point away. You risk creating an invader species that could damage the ecosystem back home.  
c = 0 pts. This could damage the plant.

**A** a = 1 pt. True, but not the best food answer.  
b = 2 pts. You are getting closer.  
c = 3 pts. This is right! All are nuisances!

**A** a = 0 pts. Not right!  
b = 0 pts. Closer, but still not right.  
c = 3 pts. You got the right answer!

**A** a = 3 pts. They try to do this.  
b = 0 pts. No.  
c = 0 pts. All living things are organisms.

**A** a = 0 pts. Not true.  
b = 0 pts. Not the problem.  
c = 3 pts. Gross, but true.

**A** a = 1 pt. Good choice, but not the best!  
b = 1 pt. Good choice, but not the best!  
c = 3 pts. This is the best choice!

**A** a = 0 pts.  
b = 3 pts. This is the correct answer.  
c = 0 pts. b is a much better choice.

**A** a = 0 pts. Have new competition for and usually get less.  
b = 0 pts. No! If there are more organisms trying to eat the same food, they won't get as much.  
c = 3 pts. Correct, because there are more species competing for the resources.

## Game Cards—Front b

- Q** You find some zebra mussels on a beach. You should
- leave them where they are.
  - take them home.
  - put them in a pond near your home.

- Q** Exotic species are
- plants.
  - animals.
  - both.

- Q** Zebra mussels are believed to have entered the Great Lakes
- by traveling in the ballast water of commercial freighters.
  - by attaching to large fish.
  - because people brought them here to increase the mussel population.

- Q** Purple loosestrife was brought into the United States to
- beautify wetlands.
  - be used in landscaping.
  - feed large herbivores.

- Q** While traveling through another part of the country, you encounter a small tortoise. Do you
- put it in your aquarium?
  - sell it to a pet store?
  - leave it alone?

- Q** Purple loosestrife is an exotic species that is invading North American
- deserts.
  - forests.
  - wetlands.

- Q** Indigenous plants and animals are those
- that are naturally found in an ecosystem.
  - are imported into an ecosystem.
  - make you sick if you eat them.

- Q** Exotic species
- are good for the environment they enter.
  - are bad for the environment they enter.
  - can be either good or bad, and some have no effect.

- Q** The effect zebra mussels have on water intake pipes is to
- help rebuild them.
  - clog them.
  - clean them.

- Q** Round gobies can eat up to
- five sea lampreys per day.
  - 1 pound of purple loosestrife per day.
  - 78 zebra mussels per day.

- Q** How are yellow perch affected by aquatic invaders?
- The round goby eats yellow perch eggs.
  - The fishhook flea competes for the same food as the yellow perch.
  - The yellow perch swallows zebra mussels that get stuck in its digestive system.

- Q** The fishhook flea keeps from being eaten because
- its long tail, shaped like a fishhook, makes it difficult for larger fish to swallow.
  - it latches on to fishhooks and escapes when fishermen pull their poles out of the water.
  - it stays away from fishhooks and thus is not eaten by fish.

## Game Cards—Back b

**A** a = 1 pt. True, but not the best choice.  
b = 1 pt. Also true, but not the best choice.  
c = 3 pts. Exotic species can be plants or animals.

**A** a = 3 pts. This is the best choice.  
b = 0 pts. You risk spreading them to new locations.  
c = -1 pt. Take 1 point away. This is a very poor choice because you may infest the pond.

**A** a = 0 pts. Not true.  
b = 3 pts. This was why people brought purple loosestrife into the United States.  
c = 0 pts. Purple loosestrife has no natural enemies in the United States.

**A** a = 3 pts. True. Ballast water is used by freighters to keep the ship evenly weighted.  
b = 0 pts. Sea lampreys attach to fish; zebra mussels do not.  
c = 0 pts. Not true.

**A** a = 0 pts. Wrong.  
b = 0 pts. Wrong.  
c = 3 pts. Purple loosestrife is a wetland plant.

**A** a = 0 pts. While this wouldn't hurt the environment, it could be an endangered species and should be left alone.  
b = 0 pts. Same reason as choice a.  
c = 3 pts. Best choice. Allows the animal to remain in its ecosystem; wouldn't negatively affect another ecosystem.

**A** a = 1 pt. Might be true, but unlikely.  
b = 1 pt. True often, but not always.  
c = 3 pts. This is the best choice.

**A** a = 3 pts. This is the correct definition of indigenous.  
b = 0 pts. This is the definition of nonindigenous.  
c = 1 pt. Some may make you sick, others may not. Not the best choice.

**A** a = 0 pts. This would be helpful, but it is not true.  
b = 0 pts. This is also incorrect.  
c = 3 pts. This is correct.

**A** a = 0 pts. No, zebra mussels do not help rebuild pipes.  
b = 3 pts. Yes! Zebra mussels cause problems because they clog water intake pipes.  
c = 0 pts. This is also incorrect. They clog pipes, not clean them.

**A** a = 3 pts. Exactly! This is why it is called the fishhook flea.  
b = 0 pts. Sorry, this is incorrect.  
c = 0 pts. This is also a wrong answer.

**A** a = 3 pts. Good answer!  
b = 3 pts. This is also a correct answer!  
c = 0 pts. The yellow perch do not eat zebra mussels.

## Game Cards—Front c

**Q** Boaters or anglers can prevent the spread of zebra mussels by

- wearing gloves while they are fishing.
- emptying their bait buckets on land only.
- washing their boat, tackle, trailer, and other equipment in 104° F water.

**Q** A sea lamprey can grow

- up to 6 inches long.
- up to 36 inches long.
- up to 18 inches long.

**Q** The fishhook flea most likely traveled to the United States

- attached to other fish migrating toward the United States.
- because it got lost.
- in the ballast water of freighters.

**Q** How might a native brown trout be killed by an aquatic invader?

- Round gobies could eat brown trout eggs.
- A sea lamprey could carve a hole in the side of the brown trout and suck out its bodily fluids.
- The brown trout could try to swallow a fishhook flea and get it stuck in its digestive system.

**Q** A female zebra mussel can produce up to

- 10,000 eggs a year.
- 100,000 eggs a year.
- 1 million eggs a year.

**Q** What do round gobies do to make fishermen angry?

- They eat all the eggs of the native fish, leaving no more fish to catch.
- They tease them that they can't catch fish.
- They aggressively take bait from hooks used by fishermen.

**Q** Climate change in the Great Lakes should result in the following

- An increase in coldwater fishes.
- A decrease in coldwater fishes.
- No change in fish populations or species.

**Q** Could new invasive species be introduced into the Great Lakes if climate change occurs?

- Yes, new species can move up from the south.
- No, climate does not impact invasive species.
- Yes, warmer water could allow warm water species to flourish in the Great Lakes.

**Q** Due to expected climate change in the Great Lakes, water levels should

- rise due to more precipitation.
- decrease due to higher temperatures and evaporation.
- Water levels should remain the same.

**Q** An impact of climate change in the Great Lakes is forecast to be

- storms of greater intensity.
- fewer and less intense storms.
- no changes in the amount or duration of storms.

**Q** How might native species be impacted by climate change?

- Unable to compete with new invaders.
- Impacts from physical changes to their environments, like temperature fluctuations.
- Native species will adjust without harm.

**Q** How would wetlands be impacted by climate change?

- greater fluctuations in water levels.
- more chance of plants drying out from drought.
- water chemistry could change the nutrients and temperature.

## Game Cards—Front c

**A** a = 0 pts. Sea lampreys can get bigger than that!  
b = 0 pts. Wow, that would be one giant sea lamprey.  
c = 3 pts. That is correct.

**A** a = 2 pts. This is close. Round gobies eat the eggs of the lake trout.  
b = 3 pts. Exactly, this is why the sea lamprey is so dangerous!  
c = 1 pt. That might be possible.

**A** a = 1 pt. This is a possibility.  
b = 0 pts. This is unlikely  
c = 3 pts. That's right!

**A** a = 3 pts. Yes, species could migrate.  
b = 0 pts. Climate change will impact invasives.  
c = 3 pts. Yes, new warmwater species could find the Great Lakes habitable.

**A** a = 3 pts. Yes, intense storms are predicted.  
b = 0 pt. Probably more storms will occur.  
c = 0 pt. Climate change will bring about the changes in storms.

**A** a = 3 pts. Low water levels could dry out plants.  
b = 3 pts. Plants would die out in droughts.  
c = 3 pts. Changes in water chemistry and nutrient levels would impact plants.

**A** a = 0 pts. Unfortunately, wearing gloves has nothing to do with it!  
b = 3 pts. Good job! This will help prevent the spread of zebra mussels.  
c = 3 pts. This too will aid in the prevention of zebra infestation.

**A** a = 0 pts. No, it is the sea lamprey that attaches to fish.  
b = 0 pts. This is incorrect.  
c = 3 pts. You got it!

**A** a = 0 pts. This isn't even close.  
b = 1 pt. This is getting closer.  
c = 3 pts. Yes, this is correct.

**A** a = 0 pts. Some coldwater species may not survive if water temperature increases.  
b = 3 pts. Coldwater fish will decline.  
c = 0 pt. Fish species are expected to be impacted.

**A** a = 0 pts. Lake levels should decrease.  
b = 3 pts. High temperature should cause levels to decline.  
c = 0 pt. Water levels should change.

**A** a = 3 pts. New invaders could challenge natives.  
b = 3 pts. Temperature increases could impact native species.  
c = 0 pt. Native species could have difficulty adjusting to climate change..