

Texas Estuary Food Web Jenga

Food Web Jenga Lesson Plan

Adopted from New Jersey Sea Grant's Education Program -njseagrant.org

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Learning Objectives: Grades 6-12

- Understand the difference between a food chain and a food web
- Understand what ecosystems, food chains and food webs are
- Understand that humans are part of ecosystems and food webs
- Connect human actions with changes in the ecosystem

Materials:

- Either traditional Jenga game or a labeled set of [Lewo Wooden Board Games Tumbling Tower Building Blocks for Kids](#).
- If you buy Jenga you can color the ends of (3) blocks purple, (3) blocks in red, (6) blocks in pink, (6) blocks in yellow, (9) blocks in blue, and (9) blocks in green.
- Labels for organisms

Per Group of 2 to 4

- Players Cards
- One set of Jenga / Lewo game

Overview:

This lesson plan models an estuarine food web, and the effect human impacts can and could have on the health of the system at various trophic levels. Student's will discover the many problems estuaries face today and how important estuaries are. Some impacts included are already having a negative effect on estuarine foods webs such as excess use of fertilizers. During major storm events, excess fertilizers will run off into the estuary causing eutrophication of water resulting in excessive algal blooms that can cause hypoxia resulting in fish kills. Actions people can take to prevent possible impacts from becoming problems are included as it is important to realize once an impact becomes a problem and populations and biodiversity declines, it is more difficult to stop or reverse the damage than to prevent a problem in the first place. We can make a difference by handling problems before they get worse, and the future depends on decisions and plans we make today.

Teacher Instructions:

Before Playing the game

- Go through the vocabulary terms with the students.
- Maybe draw a food chain on the board and go through the difference between producers and consumer
- Explain what trophic levels are
- Explain the difference between food chains and food webs.
- Have students set up their Jenga Games and go through what the layers represent on the game.

What do the layers represent?

The different colored blocks represent different animals found in different trophic levels of the food web in an estuary as follows:



- **Green Blocks**- represent the **1st trophic level**. These are **primary producers** that convert sunlight into energy, which is phytoplankton and submerged aquatic vegetation in an estuary. They are the base of food web.
- **Blue Blocks**- represent **primary consumers and 2nd trophic level** such as zooplankton. They are on lower part of food web and many are herbivores that obtain their energy by feeding on phytoplankton.
- **Yellow Blocks**- represent the **3rd trophic level** or **secondary consumers** such as small fish, shrimp, and oysters. These organisms are at the center of the food web or chain and get their energy by feeding on phyto- and zooplankton.
- **Pink Blocks**—represent the **4th trophic level** or **tertiary consumers** such as crabs, and medium sized fish. They are the middle or upper parts of food web and eat mostly secondary consumers.
- **Red Blocks** – represent the **5th trophic level** or **quaternary consumers** such as turtles or large fish such as striped bass or bluefish. These consumers are carnivorous predators, eating many different species. They are near the top of food web.
- **Purple Blocks** - The **6th trophic level** is the top consumer or **apex predator** such as the Osprey. In an estuary, these animals are at the top of a food web since no other animal's prey upon on them.

Players Cards

<p>The excess carbon dioxide from fossil fuels has caused climate change issues. The rise in temperature has caused a shift in nutrients in our primary consumer zooplankton. Some zooplankton may starve.</p> <p>Remove 1 blue block</p>	<p>In a very nice neighborhood, many of the landowners is not reading the labels on the fertilizer bottle. They used too much fertilizer on their lawns that is running off in the estuary nearby. Fertilizer entering the estuary caused an algae bloom blocking the sunlight from reaching the sea grasses below. The sea grasses begin to die off.</p> <p>Remove 1 green block.</p>
<p>Texas received a Tropical storm causing an excess of fertilizers from nearby neighborhoods, golf courses, and farms to run off in the estuary bay. The fertilizer caused an algae bloom. As the algae dies it uses up the oxygen at the bottom of the estuary needed by many benthic animals (shrimp and crab).</p> <p>Remove (1 yellow) and (1 pink) block</p>	<p>Texas received an above average rainfall from April to June, causing an excess amount of pollutants to enter the waterways. This caused some species of phytoplankton too unsuitable as food for the zooplankton and other animals.</p> <p>Remove 1 green block.</p>
<p>Many scientists at Texas A&M Galveston are concerned about the recent increase in acidity in the ocean by the ocean's uptake of carbon dioxide from the atmosphere. Some species of zooplankton are unable to grow properly.</p> <p>Remove 1 blue block.</p>	<p>A group of school kids put on a play for their school and community about climate change and its effects on the local estuary. They informed everyone on how to reduce the use of fossil fuels people can slow the impacts of climate change.</p> <p>ADD 1 block of any color</p>
<p>Climate change is causing the sea surface temperatures of the ocean to rise. Warmer water temperatures increase storm intensity. As a fierce storm blows through the estuary, it rips apart an oyster reef.</p> <p>Remove 1 blue block.</p>	<p>A forest was cleared to build new homes along the estuary. After rain storm sediments from the land now flow into the water, preventing sunlight from penetrating the water. Submerged aquatic vegetation (sea grasses) are unable to grow.</p> <p>Remove 1 green block</p>

<p>Climate change is causing the estuary to warm. Some species of carnivorous fish will move northward or into deeper, cooler areas in the estuary to avoid the warmer water. The fish then find more small prey that are no longer able to avoid the larger carnivorous fish by hiding in cooler waters</p> <p>Remove 1 pink block</p>	<p>As the climate changes, seasonal changes in temperatures also change. Ospreys who prey on larger fish remain in area longer than usual.</p> <p>Remove 1 red block</p>
<p>As ocean surface temperatures rise, storms become more severe. A severe storm winds blows through the estuary, tearing apart a large bed of mussels.</p> <p>Remove 1 blue block</p>	<p>Salt marshes provide essential habitat for wildlife in an estuary. They are great absorbers of carbon dioxide, and can absorb excess storm water, protecting areas from flooding, and sea level rise. The community decides to restore 20 acres of a salt marsh in the estuary.</p> <p>Add 1 block of any color</p>
<p>Excess carbon dioxide from the many vehicles on the road is absorbed by marine waters causing the water to be more acidic. Some species of zooplankton are unable to grow due to the acidic conditions.</p> <p>Remove 1 blue block</p>	<p>A garden club turns an abandoned paved area along the watershed into a native plant garden to educate residents. The native plants can trap excess nutrients and carbon dioxide before they enter the water. A native garden is also more tolerant of pests, requiring no pesticides, and with proper care will not require herbicides.</p> <p>Add 1 block of any color</p>
<p>Ocean Acidification, caused by excess carbon dioxide in the atmosphere that is absorbed by marine waters, creates conditions that cause some small species of fish to be confused by their surroundings, making them easy targets for predators.</p> <p>Remove 1 yellow block</p>	<p>Sea level rise is creating continuous floods in the estuary that kill off plants in parts of the salt marsh where many small fish and shrimp sought refuge and a place to reproduced.</p> <p>Remove 1 yellow block</p>
<p>A large oil spill happened in the estuary!</p> <p>Remove one block of each color EXCEPT purple.</p> <p>1 Green 1 Blue 1 Yellow 1 Pink and 1 red</p>	<p>A ship from another country enters the estuary and empties its ballast water that contains an invasive crab species. The invasive crab competes with other native crabs and fish for resources.</p> <p>Remove 1 pink block</p>

<p>Many Texas Schools participate in the living shoreline's projects adding marsh grass and oysters to the estuary. This provides habitat, prevents shoreline erosion, and absorbs more carbon dioxide and filters pollutants.</p> <p>Add 1 block of any color</p>	<p>Many homes along the river have leaking sewage systems that is running off in the watershed, some species of phytoplankton are unable to grow properly due to the excess algae bloom this is causing</p> <p>Remove 1 green block.</p>
<p>As sea levels rise, saltier water intrudes into previously freshwater areas of the estuary. The rise in salt levels causes some species of phytoplankton to decline in growth.</p> <p>Remove 1 green block</p>	<p>The community decides it wants the storm protections oyster reefs provide by buffering against waves, currents, and erosion. Oysters also filter and clean water. An oyster reef along part of shoreline is restored in the estuary.</p> <p>Add one block of any color</p>
<p>Texas anglers or fishermen ignore the laws about using foreign shrimp to fish with. This introduces a new virus into the estuary causing the shrimp population to decline.</p> <p>Remove 1 yellow block.</p>	<p>With a changing climate, water temperatures are reaching extreme highs that are killing off sea grasses, which are a primary breeding ground for crabs. This causes the crab population to decline.</p> <p>Remove 1 pink block</p>
<p>The laws banning CFC's for commercial use are lifted, causing harmful ultraviolet (UV) rays from the sun to reach the earth and kill some species of phytoplankton.</p> <p>Remove 1 green block</p>	<p>As sea levels rise, more ocean water is entering the estuary, causing some of the upper reaches of an estuary to become saltier. Some species of fish are unable to find spawning areas that are suitable for their young.</p> <p>Remove 1 red block</p>
<p>Oysters and other shellfish are expected to suffer from weaker, slower-growing shells due to acidic water conditions caused by the estuary absorbing more carbon dioxide from the burning of fossil fuels.</p> <p>Remove 1 yellow block</p>	<p>A neighborhood installs rain barrels to catch run off water from rain showers to later use to water their lawns. This slows down the amount of run off pollution entering the watershed.</p> <p>Add 1 block of any color.</p>

<p>The school becomes a “sustainable” school by adding solar panels, rain barrels. They encourage other districts to do the same.</p> <p>Add 1 block of any color.</p>	<p>An environmental club in a community in the estuary’s watershed creates a campaign to educate people about how pet waste is toxic to the estuary.</p> <p>Add 1 block of any color</p>
<p>Not cleaning up after your pet outside causes nutrients and bacteria to run off into the estuary’s watershed after rain- storms. This creates algal blooms that kill off some species of young marine life.</p> <p>Remove 1 blue block</p>	<p>The schools in the estuary’s watershed decide to educate their students about the affect’s humans can have on an estuary and encourages students to take the message home to their family and friends.</p> <p>Add 1 block of any color</p>
<p>A group of citizens in the estuary’s watershed decides to raise awareness about the proper use of fertilizers, and encourages people to plant native plants, trees, and shrubs that soak up excess rainwater, nutrients and prevent run off.</p> <p>Add 1 block of any color</p>	<p>A new roadway is constructed along the estuary. After rainstorms, the oil and other toxic contaminants from cars and trucks run off into the estuary. The runoff from roadways affects the growth of many small plants and animals.</p> <p>Remove 1 green block and 1 blue block</p>
<p>A community encourages local officials to protect the nearby maritime forest in the estuary’s watershed. The forest is now labeled as “Green Acres” and no one will be able to develop the area.</p> <p>Add 1 block of any color.</p>	<p>Due to the warming of the estuary, Striped Bass are moving to estuaries further north to lay eggs. Because of the lack of this predator in TX’s estuaries the populations of small fish and shrimp rise. The food they feed upon, zooplankton and phytoplankton are preyed upon too heavily and their populations decline.</p> <p>Add 1 Yellow block (if possible) and Remove 1 Green Block and 1 Blue Block</p>

<p>As salt marshes flood, due to sea level rise, red drum are finding more areas in the estuary to populate. Their populations increase however they are preying upon more crabs. Crab populations start to decline.</p> <p>Add 1 Red Block (if possible) Remove 2 Pink Blocks</p>	<p>A pesticide used on a nearby area washes into the estuary. Animals in the estuary absorb the pesticide, the pesticide is toxic to osprey and their populations decline. Red fish populations are able to increase, however these fierce predators cause a decline in crab and fish populations.</p> <p>Add 1 Red block, Remove 1 yellow and 1 pink block</p>
<p>Blue crab populations decline because of overharvesting. This causes small fish and shrimp populations to increase, however this also increases the consumption of phytoplankton and zooplankton.</p> <p>Add 1 pink block (if possible) Remove 1 blue block and 1 green block</p>	<p>Crab Traps are trapping sea turtles causing their populations to decline. This causes an increase in snail populations; the snails are destroying eelgrass beds and salt marsh grasses.</p> <p>Remove 1 red block Add 1 yellow block Remove 2 green blocks.</p>
<p>A collection of scientists and citizens work together to restore eelgrass in the estuary. Eelgrass can absorb excess carbon entering the estuary from the burning of fossil fuels (coal, oil, and gas). This helps the animals that enjoy hiding and laying eggs in the eelgrass and helps slow climate change impacts.</p> <p>Add 1 block of any color</p>	<p>A decline in pH and increase in temperatures causes a decline in clam and oyster populations. This causes phytoplankton populations to increase however they start to block sunlight, decreasing the growth of sea grasses that blue crabs use to hide from predators.</p> <p>Remove 1 blue and 1 pink block</p>
<p>As salt marshes flood, due to sea level rise, stingrays are finding more areas in the estuary to populate. Their populations increase however they are preying upon more crabs. Crab populations start to decline.</p> <p>Add 1 Red Block (if possible) Remove 2 Pink Blocks</p>	<p>An increase in use of fertilizers causes some species of phytoplankton (algae) to bloom, however only jellyfish feed on these algae, jellyfish populations increase dramatically. They out compete many species of zooplankton, small fish and shrimp for food.</p> <p>Remove 1 blue Block and 1 yellow block</p>

Name _____

Food Web Jenga

Student Worksheet

This game is a representation of how human caused changes can potentially impact the stability of a whole ecosystem. In this game, the ecosystem is an estuary. In a food chain there tends to be more organisms available lower on the food chain because they are needed to provide energy for animals higher up on the food chain. As you move up a food chain, the animals tend to be larger and need more energy. For example, an average adult flounder is 24 inches long, compared to its prey, a shrimp, which only grows up to 2 inches long. Since the flounder is much larger than a shrimp, it needs many shrimp to provide it with enough energy to survive.

Vocabulary:

1. **Estuary** – where the river meets the sea
2. **Producer** – can convert sunlight or chemicals into energy. Always starts the beginning of a food chain.
3. **Consumer** – An organism that generally obtains food by feeding on other organisms to obtain energy. There are three or more levels of consumers: primary consumer, secondary consumer, tertiary consumer, and quaternary consumer
4. **Apex Predator** – the top consumer in a food chain
5. **Eutrophication**- is the excessive richness of nutrients in a body of water, frequently due to runoff from the land, which causes a dense growth of algae and death of animal life from lack of oxygen.
6. **Ocean Acidification** - Acidification is the lowering of the pH of the ocean over an extended period of time, caused primarily by uptake of the rampant carbon dioxide (CO₂) in the atmosphere caused by the burning of fossil fuels such as oil, coal and gas.
7. **Predator**- An organism that captures and feeds on other organisms
8. **Prey**- An organism that is hunted and eaten by other organisms
9. **Trophic levels** - Each of several levels in an ecosystem, each comprising of organisms that share the same function in the food chain and the same nutritional relationship to the primary sources of energy.

10. **Watershed**- An area of land where water, sediments, nutrients, and other materials runoff the land and drains into a common body of water after a rain event. Watersheds may drain into ponds, rivers, lakes, estuaries, or ocean.
11. **Sea level rise** - The rise of water levels in the ocean and connecting waterways such as estuaries due to human induced climate change. The two major causes of global sea level rise are thermal expansion caused by warming of the ocean (since water expands as it warms) and increased melting of land-based ice, such as glaciers and ice sheets. Also, in some areas on earth, including the east coast of the United States, land subsidence (sinking of land) due to natural processes is adding to the rise in sea levels.
12. **Climate Change**- is a change in earth's average temperatures and weather patterns over at least a span of 30 years, often more. Today's climate change refers to ongoing and recent rising of the global average temperatures of the earth due to human's use of fossil fuels, such as oil, coal and gas, emitting rampant carbon dioxide into the atmosphere

How to set up the game:

1. Place 3 green blocks side by side. Place 3 more layers of green blocks in alternating directions and on top of the first set. You should have a total of 4 layers of green blocks. This represents the base of the food web and 1st trophic level of primary producers.
2. As you did with the green blocks, next stack 3 layers of blue blocks on top of the green blocks. This represents the next trophic level known as primary consumers.
3. Stack 2 layers of yellow blocks and 2 layers of pink blocks on top of the stack. These represent secondary and tertiary consumers
4. Next, stack 1 layer of red blocks on your stack. These represent quaternary consumers or carnivorous predators
5. Lastly, top your stack with 1 purple block. This layer represents the apex or top predator in our model.
6. Congratulations! You have built a model of a food web in an estuary!
7. Cut apart and shuffle playing cards included in this lesson plan. Stack them face down.

Directions:

1. The first player picks a card, reads it aloud, and follows the instructions written on the card. Only the block being removed or returned may be touched. Player is not allowed to hold the rest of the stack together while removing the block(s).
2. If adding a block, player may return any block of their choice however they **MUST** return it to the same color layer it corresponds to. They may gently hold onto the stack while adding the block, but if other blocks fall while returning a block, they may not put them back. Not putting fallen blocks back represents the hardships that sometimes occur when trying to resolve a problem.
3. Once played, used cards should be put into a discard pile.
4. Removed wood blocks should also be placed into a discard pile off to the side.
5. Have students continue to take turns until the tower falls and the food web collapses.
6. Reset to play again using the directions above.
7. If time permits, discuss some of the threats an estuary faces and answer the following questions relating to the trophic levels represented in this game.

Questions:

1. Who are the primary producers in this game?
2. Who are the primary consumers in the game?
3. Name some other consumers in the game.
4. Who is the apex predator in this game?
5. How many trophic levels are represented in this Jenga© game?
6. Explain why there are more green blocks representing primary producers than any other colored blocks?

7. Do you think all organisms are important in the estuary?
8. What happens to other organisms when one organism is removed?
9. Describe two ways humans can impact the food web in an estuary.
10. Where would you locate humans in the food chain?
11. How do you think the collapse of an ecosystem, such as an estuary might impact humans?
12. How do changes in the food web or chain affect the estuary's health?
13. Name at least 2 ways people can help protect the life in an estuary and keep it healthy.
14. What do you think you could personally do to help keep our estuaries healthy?