

Tidal Wetlands

What is a wetland?

What are three types of wetlands?

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What are some characteristics of salt marshes?

What are some characteristics of freshwater marshes?

What are some characteristics of mangroves?

Since the 1700s, the US has lost _____

What are some natural stressors that can affect wetlands?

What are some human stressors that affect wetlands?

What is “shoreline squeeze”?

How do nutrients affect wetlands?

What can help wetlands survive sea level rise?

List three conservation efforts that can help wetlands.

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List four reasons why wetlands are important.

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How do migratory birds use wetlands?

How do wetlands provide storm protection?

What can wetlands filter from water?

What is blue carbon?

Where is blue carbon stored?

Tidal Wetlands

Answer Key

What is a wetland?

A wetland is an area inundated or saturated with water most or all of the time

What are three types of wetlands?

Any three of the following:

- Salt marsh
- Freshwater marsh
- Fens
- Mangroves
- Swamps
- Bogs

What are some characteristics of salt marshes?

Any/all of the following:

- Occur worldwide
- Tidal zone in between land and open saltwater
- Plant life dominated by marsh grasses
- High primary production
- Habitat for >75% of fisheries (blue crab, shrimp, finfish) species

What are some characteristics of freshwater marshes?

Any/all of the following:

- Located upstream of saltwater marshes
- Close enough to the sea that tides still influence them, but not close enough that saltwater can affect them
- All plants here are intolerant to salt

What are some characteristics of mangroves?

Any/all of the following:

- Found in tropics/subtropics
- 3 main types (red, black, white)
- Salt tolerant trees
- Can remove salt from water
- Complex root system
- Habitat for billions of worms, protozoa, barnacles, oysters, and other invertebrates
 - Feed fish and shrimp which feed wading birds, pelicans, and crocodiles

Since the 1700s, the US has lost over 50% of its wetland resources

What is a natural stressor that can affect wetlands?

Storm events

What are some human stressors that affect wetlands?

Any/all of the following:

- Damming
- Mangrove deforestation
- Shoreline squeeze
- Excess nutrients

What is “shoreline squeeze”?

During sea level rise, wetlands can grow taller by accumulating more sediment or they can move inland by taking over newly wet ground

How do nutrients affect wetlands?

Increased fertilizers/nutrients lead to increased aboveground growth and decreased root growth. This leads to creek banks collapsing because there is no structure from marsh plant roots

What can help wetlands survive sea level rise?

With enough sediment supply, wetlands can accumulate sediment and rise with sea level

List three conservation efforts that can help wetlands.

Any/all of the following:

- Restoring water paths
- Restoring degraded wetlands
- Creating new wetlands
- Enhancing current wetlands

List four reasons why wetlands are important.

Any four of the following:

- Flood control
- Food supply
- Cultural value
- Recreation areas
- Refuge for migrating birds
- Clean water
- Shoreline and storm protection
- Materials and medicines
- Vital habitat

How do migratory birds use wetlands?

As “pit stops” on long journeys

How do wetlands provide storm protection?

- They act to slow down inland movement of storm surges
- When a storm surge hits a wetland, it encounters some resistance moving over the wetland, resistance reduces the height of the surge and waves and slow the movement of water

What can wetlands filter from water?

Fertilizers/nutrients, toxins/contaminants

What is blue carbon?

Carbon that is stored in the soils of wetlands

Where is blue carbon stored?

Short term storage – plant biomass (leaves, roots, trunks)

Long term storage - soils

Building a Beach House on a Wetland

You are building a beach house, but it's on a wetland. Determine how large of a beach house you want, and see how much it will cost to build your beach house and what you will have to do to pay for the damages to the environment.

Decide what size beach house you want to build.

Size	Cost
1,000 sq. ft.	\$100,000
2,000 sq. ft.	\$250,000
3,000 sq. ft.	\$500,000

How much land do you want around your beach house?

Size	Cost
1 acre	\$50,000
2 acres	\$100,000
3 acres	\$150,000

Depending on the amount of land you selected, you will destroy a certain acreage of wetland due to construction and clearing.

Size	Wetland Destroyed
1 acre	2 acres
2 acres	4 acres
3 acres	9 acres

For each acre of wetland destroyed, your state government requires that you pay for 2 acres of wetland to be created somewhere else. It costs \$10,000 per acre to recreate a wetland.

Because you removed the wetland, you have to pay to have a company install water treatment so that the runoff from your beach house does not introduce toxins to the water. The company gives you an estimate of this cost based on the size of your house.

Size	Cost
1,000 sq. ft.	\$2,000
2,000 sq. ft.	\$5,000
3,000 sq. ft.	\$10,000

Sea level is rising rapidly along the coast where you built your new beach house. Your flood insurance company is requiring you to either rebuild the wetland that you destroyed or raise your house by 10 feet. Decide which option you will go with based on either the size of your house (if you decide to raise it) or the wetlands you will need to recreate.

Size	Cost
1,000 sq. ft.	\$15,000
2,000 sq. ft.	\$20,000
3,000 sq. ft.	\$30,000

Original Size of Wetland	Cost to Reclaim
2 acres	\$10,000
4 acres	\$15,000
6 acres	\$25,000

Add it up!

Item	Cost
Cost of House	
Cost of Land	
Cost to pay to recreate wetlands elsewhere (acres of wetland x \$10,000)	
Cost of Water Treatment	
Cost of Sea Level Rise Fix	
Total:	

How much would you have saved if you did not destroy the original wetland? Subtract the cost to recreate wetlands, the cost of water treatment, and the cost of the sea level rise fix.

Do you think it's better to leave wetlands alone or build over them and deal with the consequences later? Why?

Wetland in a Jar – Teacher’s Guide

Background

Students will have just completed the lesson on wetlands and the “Build a Beach House” activity. This activity is designed to help students think about the different parts of wetlands as well as the services they provide. The goal of this activity is for students to demonstrate what a wetland is and what a wetland is not and to demonstrate the services that wetlands can provide. *Please read through the entire set of instructions to determine what will be most beneficial for your class in terms of separating students and supplies needed.*

Also, some information on this worksheet should not be shared with students unless absolutely necessary, such as the examples given for the activity. If a student is struggling, then the teacher may decide whether or not to share some of these examples.

Materials

- Mason Jars and lids (at least the ring that screws on the top)– 1 per team (see below)
- Beakers or measuring cups – 1-3 depending on the class and how it is split
- Cheesecloth – enough to have one piece for each mason jar lid
- Colored water (i.e. water with some food coloring) – enough so each team has 200 mL or 1 cup
- Student Worksheets (“Wetland in a Jar”)
- *Materials to fill mason jars* – will depend on class, and not all supplies are necessary and these are just suggestions. Feel free to add other supplies that you may already have!
 - Sponges
 - ****This one is necessary, be sure to cut up sponges into pieces that can fit into the jars****
 - Pipe cleaners
 - Soil
 - Foil
 - Small rocks
 - Cotton balls
 - Beads
 - Beans
 - Paper scraps
 - Sand
 - Fabric scraps

Instructions

The class should be split in half (Group A and Group B) and each group should be split into smaller teams, no larger than 3 people per team. Each team gets a mason jar.

Group A (the “What is an Estuary” Group) –

- This group will use their mason jars to demonstrate what a wetland is. They will be able to pick through all the materials to determine what to put in their mason jar. Everything that is put in their mason jar must be explained as either what part of the wetland it represents or as what service it provides (or both).
 - Examples:
 - A student may decide to use sponges to demonstrate the ability of a wetland to filter the water.
 - A student may use pipe cleaners to represent mangrove/marsh grass roots.
- Each item that is used in the mason jar must be recorded on the worksheet as follows (instructions also on worksheet)
 - Item type (ex: sponge)
 - Service provided (ex: water filtration) OR part of wetland represented (ex: roots)
 - ***Students may wish to put both service provided and part of wetland represented for some parts*

Group B (the “What is an Estuary Not” Group) –

- This group will use their mason jars to demonstrate everything a wetland is not. They will be able to pick through all the materials to determine to put in their mason jar. Everything that is put in their mason jar must be explained as to why it does not represent an estuary, and/or what kind of coastal (natural or man-made) environment it may instead represent.
 - Examples:
 - A student may use foil because foil does not absorb anything. This may represent a parking lot where water and pollutants are not absorbed and instead become runoff.
 - A student may use rocks to represent a rocky coastline with no wetland plants.
- Each item that is used in the mason jar must be recorded on the worksheet as follows (instructions also on worksheet)
 - Item type (ex: beans)
 - Why does it not represent an estuary? (ex: Foil ≠ estuary because it does not absorb water/toxins) OR coastal environment represented (ex: beans represent agricultural farmland)

All Teams/Groups

- When each team is finished filling their mason jar, they will be asked to add exactly 200 mL (or 1 cup if classroom does not use metric) of the colored water.
- Each team will then *carefully* put a piece of cheesecloth on top of their jar and secure it with the screw-top ring (do not use the top of the lid). This is to ensure that the materials the students put in their jars remain in the jar, but water can still escape.

- Each team will then *carefully* pour the colored water back out of their jar into a container that can be used to measure volume (beaker, measuring cup)
- The members of the team will then determine how much water came out of the jar and how much water stayed in the jar. This can also be a chance for students to determine the percent water remaining.
 - For example: A team filled their jar with 200 mL of colored water. When they pour the water back out, they collect 150 mL of colored water. 150 mL came out, 50 mL is still in the jar.
 - Therefore, the jar retained 25% of the water. 75% of the water escaped.
- Teams should then record their results on the board as the amount of water retained in their wetland jars as either a volume (ex: 25 mL) or as a percent (ex: 60%)

Wrap Up Points

(some possible answers listed with each question, but these are not the only answers possible)

- Which jars retained more water? The wetland or not-wetland jars?
 - In theory, the wetland jars should retain more water, but in some circumstances this may vary.
- Why did those jars retain more water? *(Multiple answers possible)*
 - Wetlands can act to filter water (so the water removed can be thought of as toxins/fertilizers)
 - Wetlands are always inundated with water (so they always retain some water)
 - This water could represent a storm, the water could be part of the storm surge that is lessened by the existence of this wetland
 - This water could be thought of as carbon (the water that is retained is blue carbon stored in the wetland)
- What parts of the jars retained water? Look to see if any of your materials changed color with the colored water.
 - This could represent some of the concepts in the previous question
- What kinds of environments did the non-wetland jars represent? *(Multiple answers possible)*
 - Rocky coastline
 - Man-made dyke
 - Sandy beach
 - Parking lot
 - Farm
- Are these non-wetland areas inherently bad? *(i.e., should all coastal environments be wetlands?)*
 - No, each coastal environment serves a different purpose
 - Rocky coastline – home to a wide array of marine life; important in areas where wetlands cannot live
 - Sandy beach – provide sediment storage and transport, wave dissipation, some water filtration, nursery for some aquatic species, etc.
 - Farms – use the nutrient rich soils to make food

Name: _____

Team Members Names: _____

Wetland in a Jar – Group A

Objectives

- You and your team will use the materials provided to demonstrate both the different parts of the wetland and what services they provide.
- Your jar will demonstrate that you understand the importance of wetlands and how they can benefit coastal ecosystems.

Instructions – Part 1

- You and your team will be given 1 mason jar, 1 piece of cheesecloth, and 1 screw-top ring for your mason jar.
- You will collect items from the materials your teacher has provided.
 - Each item should be used to represent a service that a wetland provides AND/OR a part of the wetland.
 - Example: pipe cleaners – mangrove roots
 - Each item should be recorded below with a description of why you used it.
 - You must use at least 3 items (if you use more than 3 items, use the back of the page to describe them)
- Once you have finished this and completed page 2, follow the instructions on page 3

ITEM 1

Type of material: _____

What part of the wetland does it represent?

What wetland service does it represent?

ITEM 2

Type of material: _____

What part of the wetland does it represent?

What wetland service does it represent?

ITEM 3

Type of material: _____

What part of the wetland does it represent?

What wetland service does it represent?

Instructions – Part 2

- Once you have filled your jar with “wetland” materials, measure exactly 200 mL of colored water using a graduated cylinder or a beaker.
- *Carefully* pour this water into your mason jar with your materials.
- *Carefully* put a piece of cheesecloth over the top of your jar and secure it with a screw-top ring.
- *Carefully* pour the water out of your mason jar into a beaker or graduate cylinder.

1. How much water came out of your wetland jar? _____

2. How much water is left in your wetland jar out of the 200 mL you put in? _____

3. What percentage of water is still in your wetland jar? _____

4. What percentage of water came out of your wetland jar? _____

5. What parts of your jar retained more water? (Look to see where any color may have been retained from the dyed water)

REPORT OUT:

Write your results to questions #3 and #4 on the board to compare with your classmates.

How did your jar compare with other jars in Group A? With Group B?

Why do you think you got different (or similar) results?

WRAP-UP QUESTIONS

Why did the jars retain different amounts of water?

What parts of the jars retained more water? Why?

What kinds of coastal environments did Group B represent with their jars?

Are these other non-wetland coastal environments bad? What services could they provide?

Name: _____

Team Members Names: _____

Wetland in a Jar – Group B

Objectives

- You and your team will use the materials provided to demonstrate what a wetland is not and why these materials do not represent the services that wetlands provide.
- Your jar will demonstrate that you understand the importance of wetlands and how they can benefit coastal ecosystems.

Instructions – Part 1

- You and your team will be given 1 mason jar, 1 piece of cheesecloth, and 1 screw-top ring for your mason jar.
- You will collect items from the materials your teacher has provided.
 - Each item should be used to represent something a wetland is not or something you wouldn't find in a wetland or a coastal environment that is not a wetland
 - Example: foil – non-porous surface, does not absorb anything OR it may represent a parking lot
 - Each item should be recorded below with a description of why you used it.
 - You must use at least 3 items (if you use more than 3 items, use the back of the page to describe them)
- Once you have finished this and completed page 2, follow the instructions on page 3

ITEM 1

Type of material: _____

Why does it not represent an estuary?

What coastal environment could it represent?

ITEM 2

Type of material: _____

Why does it not represent an estuary?

What coastal environment could it represent?

ITEM 3

Type of material: _____

Why does it not represent an estuary?

What coastal environment could it represent?

Instructions – Part 2

- Once you have filled your jar with “non- etland” materials, measure exactly 200 mL of colored water using a graduated cylinder or a beaker.
- *Carefully* pour this water into your mason jar with your materials.
- *Carefully* put a piece of cheesecloth over the top of your jar and secure it with a screw-top ring.
- *Carefully* pour the water out of your mason jar into a beaker or graduate cylinder.

1. How much water came out of your non-wetland jar? _____

2. How much water is left in your jar out of the 200 mL you put in? _____

3. What percentage of water is still in your jar? _____

4. What percentage of water came out of your jar? _____

5. What parts of your jar retained more water? (Look to see where any color may have been retained from the dyed water)

REPORT OUT:

Write your results to questions #3 and #4 on the board to compare with your classmates.

How did your jar compare with other jars in Group B? With Group A?

Why do you think you got different (or similar) results?

WRAP-UP QUESTIONS

Why did the jars retain different amounts of water?

What parts of the jars retained more water? Why?

What kinds of services and parts of wetlands did Group A demonstrate?

Are other non-wetland coastal environments bad? What services could they provide?

National Park Ranger

Introduction to your role:

Your job is to conserve the natural resources of national parks. Some other groups have suggested removing a wetland on the edge of the national park and building houses or a tourist waterfront recreation area to boost local taxes and overall add to the appeal of the area.

Your goal today is to listen to everyone's point of view about what to do with this wetland and to provide a thoughtful argument as to why we should not remove the wetland. With so many shareholder groups, this may be a difficult task, but you know that this wetland is valuable to the local community and environment.

At the end of each round, you will be able to offer a recommendation to the mayor about what you think is best for this wetland/waterfront area. You need to be able to explain your point of view in a way that ensures that the whole community benefits from this wetland, not just the national park.

What does the park official do?

The duties of a park ranger often include:

- Management of the natural habitat using known habitat conservation and restoration techniques
- Educating the park visitors and local community about the park, local wildlife, environmental issues, and at times, controversial issues
- Creating public education and informational materials such as brochures
- Leading tours and hikes
- Patrolling waterways

Remember:

You know that maintaining natural environments such as wetlands will make the park a desirable place for people to visit. In addition, in order to maintain the cultural and natural history contained in your national park, it is important to maintain and not disturb all natural environments, unless there is some threat to these areas which would affect their environmental and cultural value. If this wetland is removed, your park will lose some of its appeal, and your visitors may not like having a commercial tourist spot so close to where they come enjoy nature.

Construction Company

Introduction to your role:

Your job is to build beach houses and commercial areas to increase the appeal of waterfront areas and to attract visitors to your town. You think the best use of this land will be to build rental beach houses, a boardwalk, and expand the land into a small beach. Some other groups have suggested that removing this wetland will be harmful to the environment and that it should remain undisturbed.

Your goal today is to listen to everyone's point of view about what to do with this wetland and to provide a thoughtful argument as to why we should not remove the wetland. With so many shareholder groups, this may be a difficult task, but you know that this area could be transformed into an area that is valuable to the community as a way of encouraging tourism.

At the end of each round, you will be able to offer a recommendation to the mayor about what you think is best for this wetland/waterfront area. You need to be able to explain your point of view in a way that ensures that the whole community benefits from this construction endeavor.

What does the construction company do?

Your construction company specializes in building waterfront communities. Your buildings are designed to be LEED certified (they are resource efficient, use less water and energy, and produce lower emissions) and are designed with the community in mind. The buildings you create are often for rental beach houses, small local businesses, and family parks. In addition, your company can also redesign waterfront areas to include small, sandy beaches that are used by the members of the community for family get-togethers, surfing, sunbathing, etc.

Remember:

You know that installing the boardwalk, rental houses, and small business will be of high economic value to the small town. This waterfront area will bring in tourists to your small town, which will boost sales for businesses all over town and increase tax revenue for your town. Higher tax revenue allows your town to make improvements and maintain the small town charm your area is known for.

Small Business Owner

Introduction to your role:

You own a town-favorite restaurant with local souvenirs in the heart of town. Everyone loves coming to your store, but you are running out of room. You think it might be a good idea to have a second location and heard that some new beachfront property might be available on a new boardwalk. This would be a great place to put your second location to reach the most customers.

Your goal today is to listen to everyone's point of view about what to do with this wetland/waterfront and to provide a thoughtful argument as to why we should not remove the wetland. With so many shareholder groups, this may be a difficult task, but you know that this area could be transformed into an area that is valuable to the community as a way of encouraging tourism.

At the end of each round, you will be able to offer a recommendation to the mayor about what you think is best for this wetland/waterfront area. You need to be able to explain your point of view in a way that ensures that the whole community benefits from this construction endeavor.

What does a small business owner do?

Owning a small business is no small task. You have to provide the best services and products to the community, maintain your five-star reputation, and provide safe and enjoyable working conditions for your employees. Your business offers local food and souvenirs and is well-known as a place where high school students can have their first job where they can learn valuable skills that they can take to college and other jobs.

Remember:

You know that small businesses are the heart of the economy of your town. A secondary location would boost revenue (which would increase tax revenue to the town), allow you to hire more local students, and enable you to provide your services to a wider array of people. If your town attracts more tourists who visit your business, then you can become one of the "must-visit-locations" which will encourage tourists to return to your town multiple times.

Environmental Scientist

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What does the construction company do?

Your construction company specializes in building waterfront communities. Your buildings are designed to be LEED certified (they are resource efficient, use less water and energy, and produce lower emissions) and are designed with the community in mind. The buildings you create are often for rental beach houses, small local businesses, and family parks. In addition, your company can also redesign waterfront areas to include small, sandy beaches that are used by the members of the community for family get-togethers, surfing, sunbathing, etc.

Remember:

You know that installing the boardwalk, rental houses, and small business will be of high economic value to the small town. This waterfront area will bring in tourists to your small town, which will boost sales for businesses all over town and increase tax revenue for your town. Higher tax revenue allows your town to make improvements and maintain the small town charm your area is known for.

Mayor

Introduction to your role:

Your job is to build beach houses and commercial areas to increase the appeal of waterfront areas and to attract visitors to your town. You think the best use of this land will be to build rental beach houses, a boardwalk, and expand the land into a small beach. Some other groups have suggested that removing this wetland will be harmful to the environment and that it should remain undisturbed.

Your goal today is to listen to everyone's point of view about what to do with this wetland and to provide a thoughtful argument as to why we should not remove the wetland. With so many shareholder groups, this may be a difficult task, but you know that this area could be transformed into an area that is valuable to the community as a way of encouraging tourism.

At the end of each round, you will be able to offer a recommendation to the mayor about what you think is best for this wetland/waterfront area. You need to be able to explain your point of view in a way that ensures that the whole community benefits from this construction endeavor.

What does the construction company do?

Your construction company specializes in building waterfront communities. Your buildings are designed to be LEED certified (they are resource efficient, use less water and energy, and produce lower emissions) and are designed with the community in mind. The buildings you create are often for rental beach houses, small local businesses, and family parks. In addition, your company can also redesign waterfront areas to include small, sandy beaches that are used by the members of the community for family get-togethers, surfing, sunbathing, etc.

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National Park Ranger



Environmental Scientist

State University

Townville Lab of the
Environment

Go statesmen!

Mayor of Townville



Small Business Owner



Construction Company

A blue diamond-shaped logo with a thin black border. Inside the diamond, the text "Townville Construction" is written in a white, monospace-style font. Below this, the text "Since 1925" is written in a smaller, white, serif font.

Townville
Construction

Since
1925