Oceans and Estuaries

The Project and Beyond...What you need to know
Why is the Ocean Salty?

- Dissolved chemicals eroded from Earth’s crust washed into the sea
- Solid and gaseous materials from volcanoes swept into the ocean by wind
- Materials dissolved from the ocean floor (hydrothermal vents)
What Affects Salinity?

• **Increased by**
  - Evaporation of ocean water
  - Freezing of ocean water
  - [https://www.youtube.com/watch?v=q7hkdiVuMb0](https://www.youtube.com/watch?v=q7hkdiVuMb0)

• **Decreased by**
  - Rainfall on the ocean
  - Runoff from rivers into the ocean
  - Melting of ice caps/glaciers
Oceans and Global Climate

• **Oceans collect, move and mix water, heat and CO$_2$ in huge amounts** (more than the atmosphere)!

• **Oceans regulate global temperature**
  - Oceans store so much heat in the summer (and release it later when it’s colder), it delays the seasons
  - Because of this, the seasons start later than the length of daylight tells us they should start - how much varies based upon the location
  - Climates near the ocean tend to be milder than the interior of continents.

• **Ocean and atmosphere work together to create complex weather**, like El Niño.
Ocean is Dynamic

• Important source of food and mineral resources
• Used for human recreation and transportation
• Largest reservoir of water on Earth
• Ocean currents distribute large amounts of energy and resources across the planet
Estuaries Mix Fresh and Salt Water

• **Brackish water** = not freshwater, but not as salty as ocean water

• **Trap and mix nutrients and sediment carried by rivers and brought by ocean tides**
Estuaries Support Life

• Fertile place for plant and animal life
  • One of the most biologically active ecosystems on Earth!
  • Fish, shrimp, crabs, clams, oysters, etc.

• Shallow, less than 30 feet deep in NC
  • You can see to the bottom
  • Promotes plant growth

• Rivers deposit sediments rich in nutrients

• Good nurseries
  • Protected environment for hatching and growing
  • Migrate to ocean to live adult life
Lots of Estuaries in NC

- Largest is Pamlico Sound (5 river basins and many marshes, swamps, forests, and grasslands provide water to this estuary).
Benefits of Estuaries

• Control erosion
• Reduce flooding of the mainland
• Sand bars (from sediment deltas) buffer ocean wave impact

• Swamps and marshes
  • Absorb impact of high ocean winds
  • Soak up heavy rain and storm surges
  • Release extra water into rivers and groundwater aquifers
Estuaries as a Filter

- **Plants, animals and bacteria filter pollutants out of the water**
  - Salt marsh plants trap some of the chemicals and pathogens carried by rivers and move them into the soil to be destroyed
  - Oysters filter impurities out of water as they feed (one oyster filters 25 gallons of water per day!)
Threats to Estuaries (thus also to oceans)

- Too much Sedimentation
- Too much Chemical pollution
Ocean’s Diversity

• From the seashore to its greatest depth, oceans have great diversity of life

• All life in the oceans, as on land, depends ultimately on plants
Ocean’s Diversity

- Ocean currents circulate lots of nutrients, making them available to life far from the source of nutrients
- Many, many food webs
Upwelling

• **STEP 1:** Warm surface water near the coast is pushed away by wind.

• **STEP 2:** Cold water at the bottom of the ocean moves up to take its place

![Wind Driven Upwelling Diagram](attachment:image.png)
Upwelling

• **STEP 3:** Cold water carries sediment and nutrients to the surface, where many species live and use them to reproduce.

• Lots of plants attract organisms that eat them, etc.

• **Areas of upwelling are areas of life!**
  • Half the fish caught in the world are from areas of upwelling.
Ocean Dissolves Gases

- Wind and ocean waves dissolve gases from the atmosphere, and vice versa
  - Nitrogen, Oxygen, Carbon Dioxide

- Plants use CO$_2$ for photosynthesis, adding Oxygen to the ocean
## Ocean Dissolves Gases

<table>
<thead>
<tr>
<th>Dissolves More Gas</th>
<th>Dissolves Less Gas</th>
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<tr>
<td>Cold Water</td>
<td>Warm Water</td>
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<tr>
<td>Fresh Water</td>
<td>Salt Water</td>
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<tr>
<td>Deeper Water</td>
<td>Shallow Water</td>
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</table>
Ocean and Carbon Dioxide

- Some CO$_2$ is dissolved in ocean water as gas

- Most reacts to form bicarbonates, which removes extra CO$_2$ from the water.
  - Many organisms use bicarbonate to form their shells
  - When these organisms die, their shells fall to the bottom of the ocean, locking the carbon away for a long time

- The more CO$_2$ in the atmosphere, the more CO$_2$ in the oceans
Oceans as Natural Resources

- **Marine (ocean) Resources**
  - Living things (food, medicine)
  - Minerals
  - Energy
Oceans as Natural Resources

• Human Uses
  • Travel
  • Shipping (literally refers to moving stuff using a ship on the ocean)
  • Recreation
  • Mined for minerals
  • Drilling for oil
  • Tourism
Ocean Minerals Mined

• For Retail
  • Diamonds
  • Gold
  • Silver
  • Manganese

• To Protect beaches from erosion
  • Gravel
  • Sand
Damaging the Ocean

• Mining
  • Pulls up the ocean floor, creating a cloud of sediment that blocks out the sun
  • Puts toxic metals into the water, and therefore our food
Damaging the Ocean

• **Tourism**
  • Overdevelopment of coastal areas destroys entire ecosystems
  • Garbage/sewage ends up untreated in the oceans, causing Eutrophication and disease epidemics
Damaging the Ocean

• Drilling for Oil
  • Ocean creatures lives (i.e. migration and feeding) are disrupted
  • Oil spills
  • Exploratory drilling confirms or denies presence of oil
  • https://www.youtube.com/watch?v=-OVNd6Fa9fg
Oceanic Discovery

• **Technology (Depth)**
  • **Vessels/Ships (all)**
  • **Sonar (all)**
  • **Floats and Drifters (Surface, low)**
  • **Human-occupied submersibles (Medium)**
  • **Satellites (medium)**
  • **Remote-controlled vehicles (High)**
  • **Autonomous robots (High)**

• In 1977, scientists discovered that life could live on the deep ocean floor near hydrothermal vents
  • Extremophiles
  • Revolutionized how scientists thought about how and where life can exist
Hydrothermal Vents

- Places on the ocean floor where chemical-rich, super-heated water flows up from the seafloor.
  - Provides energy to sustain communities of life without the sun
  - No sunlight for photosynthesis, so they use chemicals in water from vents to make energy and food
  - Magma beneath the seafloor heats water, causing it to rise and pick up chemicals

https://www.youtube.com/watch?v=D69hGvCsWgA