Marginal Marine Environments
Delta: discrete shoreline protuberances formed where rivers enter oceans, semi-enclosed seas, lakes or lagoons and supply sediment more rapidly than it can be redistributed by basinal processes. Deltas are categorized by sediment size and influence of tidal power and/or wave power.
The shape of the delta is controlled by the relative effect of tides and waves.
Fluvial Dominated:
This type of delta has minor influences from tides and waves. The primary factor controlling the shape and size of the delta is sediment input from a river source. The freshwater input to basin waters is either, homopycnal, hyperpycnal or hypopycnal.

Mississippi River Delta
Idealized Gilbert-type delta formed under homopycnal conditions with fluvial dominated river deltas. Smaller sediments tend to flocculate prior to deposition.
Fluvial-dominated Mississippi River
Tidal Dominated

These type of deltas form when the tidal currents are stronger than river outflow. Bidirectional currents can redistribute river mouth sediments, producing sand-filled, funnel-shaped distributaries. Linear tidal ridges replace mouth bars and extend from within the channel mouth out into the subaqueous platform.
Strong waves cause rapid diffusion and deceleration of river outflow and produce constricted or deflected river mouths. Distributary-mouth deposits are reworked by waves and by longshore currents to form beaches, barrier bars, and spits.
**Mixed process deltas** are transitional between fluvial, tidal and wave type deltas.

Copper River Delta
**Fan Deltas**: coastal prism of sediments delivered by and alluvial-fan system and deposited, mainly or entirely subaquaeously, at the interface between the active fan and a standing body of water.

Think alluvial fan depositing into water instead of a desert floor...
How does the construction of a dam, upstream, affect the deltas of rivers?
Beach and Barrier Island Systems
Wave and tidal influence on shore landforms
Beach Profile

- Eolian dunes
- Beach
- Foreshore
- Shoreface
- Oscillatory wave zone
- Shoaling wave zone
- Surf zone
- Breaker zone
- Offshore transition
- Offshore
- Mean fairweather wave base at ~10-15 m depth
- Mean storm wave base

MHW
MLW
Wave-induced Currents

- Swash
- Backwash
- Beach
- Longshore current direction
- Incoming waves
- Longshore Currents
- Swash Zone
- Rip Current
- Breaker Zone
- Wave Crests
- Wave approach
Estuarine Systems
Principal types of estuaries based on physiographic characteristics.
A: salt wedge  
B: Partially Mixed  
C: Vertically Homogenous  
D: Fjord
Wave-dominated Estuary
Tide-dominated Estuary
A **coastal lagoon** is a shallow stretch of seawater—such as a sound, channel, bay, or saltwater lake—near or communicating with the sea and partly or completely separated from it by a low, narrow elongate strip of land, such as a reef, barrier island, sandbank, or spit.

Principal kinds of coastal lagoons based on the degree of water exchange with the adjacent coastal ocean.
What is a seiche?

A seiche is a standing wave forming in an enclosed or partly enclosed body of water by strong winds, atmospheric pressure jumps, landslides or distant earthquakes. Seiches produce regular, periodic fluctuations of lake waters as the standing waves race between opposing shores within the lake basin, diminishing in height with each transit, like those sloshing waves you can produce in the bathtub.
where $T$ is the longest natural period, $L$ is the length, $h$ the average depth of the body of water, and $g$ the acceleration of gravity
Tidal-flat: marshy and muddy to sandy areas partially uncovered by the rise and fall of the tides
Global classification of coastlines based on tidal range
Bay of Fundy
The range in water levels between high and low tide is as high as 15m (50ft). The bay of Fundy is known to have the greatest fluctuation levels of tides on the planet.
Tidal zones within a tidal-flat environment
Development of reactivation surface owing to alternation of a dominant tide phase with a subordinate phase.
Wave Action

Rip Currents – Narrow currents of water flowing through gaps in sandbars lying just offshore.

Rip currents are caused by variations in the surf zone such as sandbars and channels.

• Do you see a location in the picture at right that might be dangerous if you were swimming there? Do you think you could see it from the beach?

• Rip currents cause ~100 deaths in the U.S. each year

• If you get caught in one – let it sweep you out past the structure that is causing it. Once past it, swim parallel to the beach and then back toward shore.
Wave Action

- Irregularities in the shoreline or changes in seafloor can change shape and direction of the waves
- Can cause bending of the waves toward the shore (refraction)
Coastlines can be rocky (where resistant rock meets the shore) or sandy. Rocky coastlines are often found near active plate boundaries.
Shoreline Features

What do waves do to coastlines?

• Cause erosion (wearing away headlands and filling in bays – straightens out coastline)

• Transport material

• Deposit sand and other materials

Twelve homes in Pacifica, Ca were condemned when the cliff retreated 33 feet.
Erosion rates of the coastlines along the Atlantic shore and Gulf coast are 3.3 ft per year on average.

Erosion is worst on loose, unconsolidated sediments, and can be accelerated by surges caused by storms.
Shoreline Features

Shorelines can also be experiencing deposition

- Shoreline grows in width with deposition of sediment
- Head on currents carry sediment onto and off the beach, and may deposit sand in sand bars off shore during storms
- *Longshore currents* transport sediment parallel to the beach in the surf zone

Sand was moved left to right during a storm.
Shoreline Features

- **Spit** – sand bar partially blocking a landform
- **Baymouth Bar** – sand bar that completely blocks a channel

The bay at Puget Sound, Washington. This narrow spit may become a baymouth bar.
Shoreline Protection

Natural Features that protect coastal residents of Florida from erosion:

- Tall dunes behind beaches protect against large storms
- Wide, stable beaches absorb wave energy
- Exposed offshore sand bars absorb the force of breaking waves

These features are not found at all beaches.

Humans can erect artificial barriers to help slow erosion, but these features may speed up erosion in other coastal locations.
Shoreline Protection

The sediment budget = the balance between material deposited on the shore and material eroded from the shore.

Humans can influence the sediment budget, and coastline features, by their actions.

Damming on major rivers can result in sediment starvation because sediment that would have been deposited along the shoreline is trapped upstream.

Humans can also build structures to try to combat dangerous erosion processes.

Seawall - Rock wall built to try and slow erosion of a cliff north of Monterey, Ca.
Shoreline Protection

Groins – wall-like structures built perpendicular to the shoreline as barriers to longshore currents

- Causes deposition on upcurrent side, but erosion on downcurrent side
Shoreline Protection

Breakwaters – barriers built offshore to protect part of the shoreline

• Slow the waves and allow the beach to grow behind them

Unprotected parts of the shoreline often erode more quickly.
Shoreline Protection

Compare and contrast seawalls and breakwaters.
Shoreline Protection

Examine the figure to the left and explain why the shoreline erosion/deposition process at the site of Cape Hatteras required the lighthouse to be moved.