S6E3d- Explain the causes of waves, currents and tides.

Essential Question- How do currents, waves and tides affect climate?

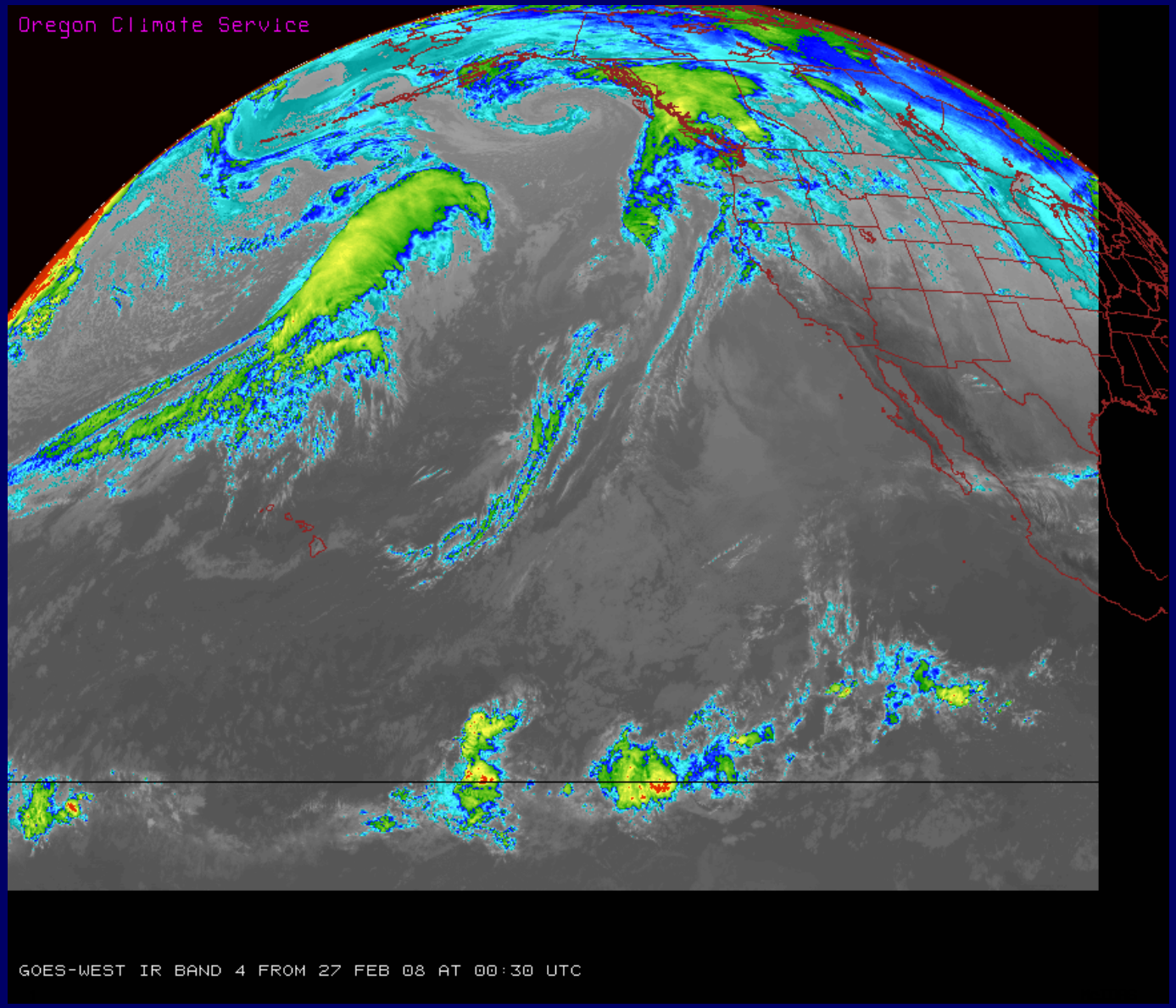
Currents

- Currents- movement or circulation of ocean water

  Surface current- movement of water at or near the surface of the ocean

- Example: The Gulf Stream

Currents on the Move



Currents

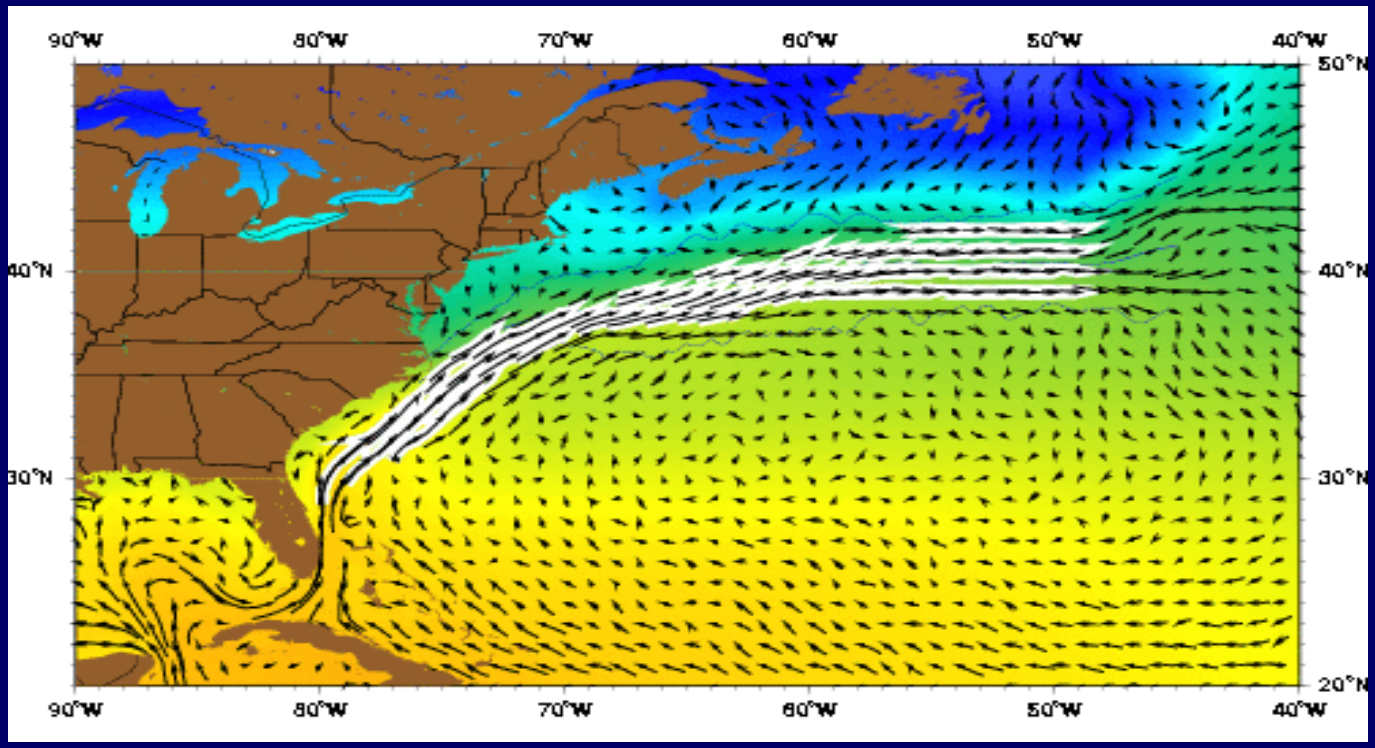
- Example: The Gulf Stream

*The direction of the current depends on the direction of the wind

From Poles= cold-water currents

From Equator= warm-water currents

The Gulf Stream



- Current in N. Atlantic that transports warm water (heat) toward the poles

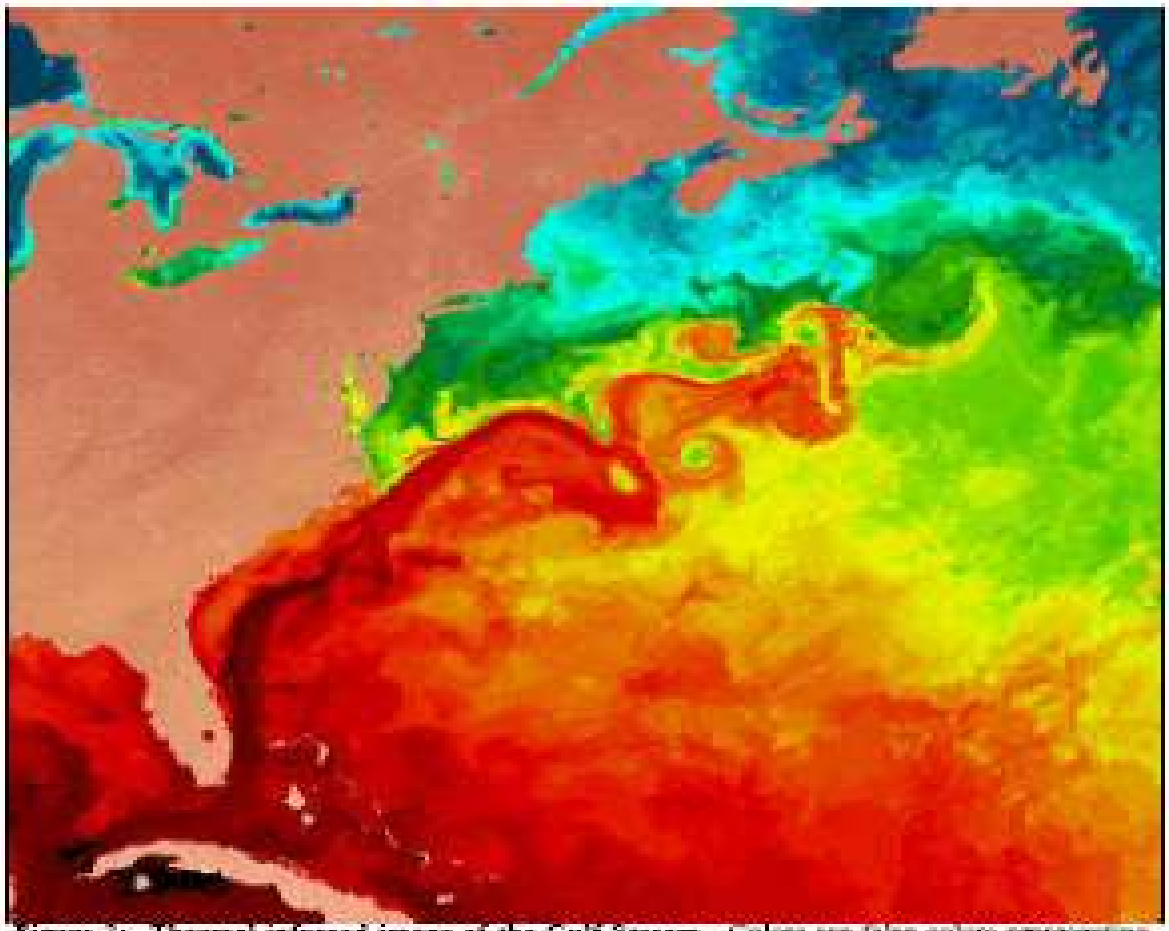


Figure 2: Thermal infrared image of the Gulf Stream. Colors are false colors representing various sea surface temperatures (Table 1).

Table 1: False colors and temperatures for Figure 2.

Color	Temperature (Celsius)
Reds and Oranges	24° to 28°
Yellows and Greens	17° to 23°
Light Blues	10° to 16°
Dark Blues	2° to 9°

Math Break!

$^{o}C \rightarrow {}^{o}F$

$$^{o}F = \left(\frac{9}{5} \times {}^{o}C\right) + 32$$

Math Break!

$^{o}F \rightarrow {}^{o}C$

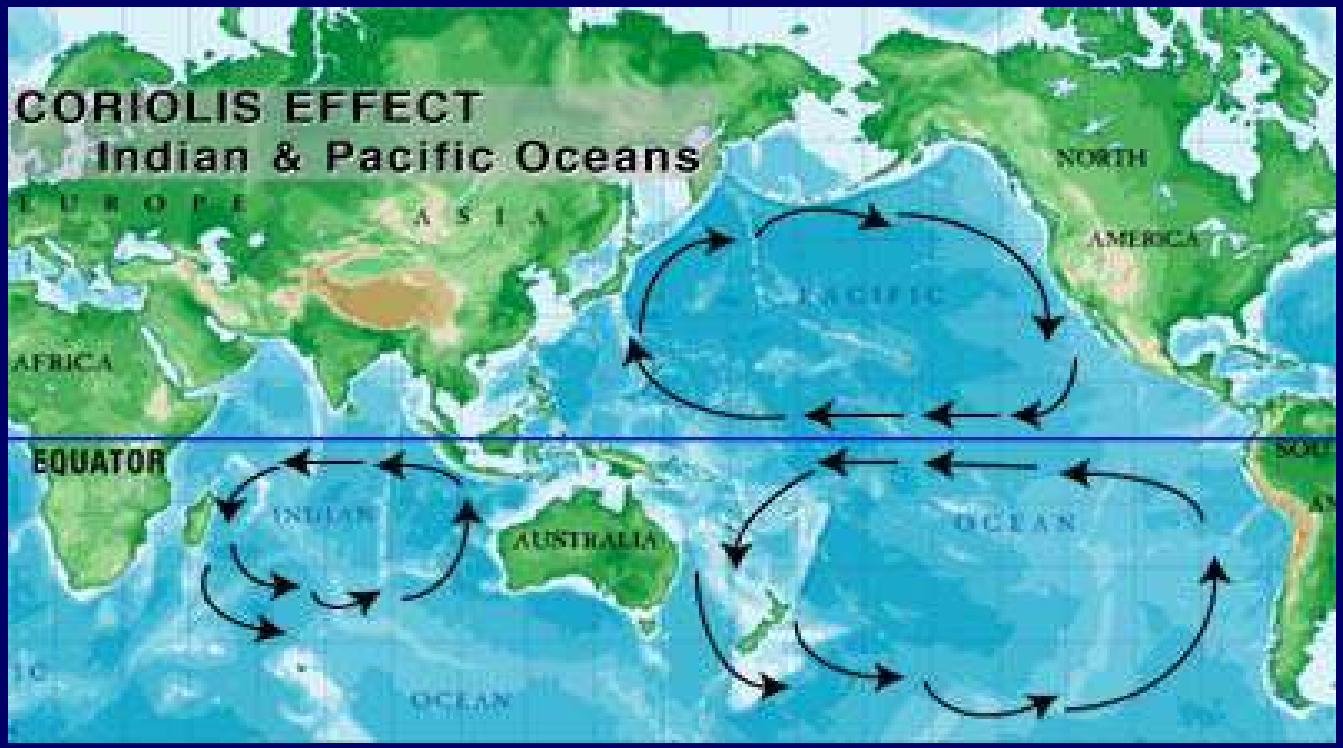
$$^{o}C = \frac{5}{9} \times (^{o}F - 32)$$

Copy the following questions:

1. How does the Coriolis Effect cause currents in the Northern and Southern Hemisphere to turn? Draw this.
2. What is continental deflection?
3. What factors cause water density to increase?
4. Does dense water sink or float?
5. List an example of a current.
6. What is El Nino?
7. What type of damage can El Nino cause?
8. What is an undertow or rip current?
9. What is a tsunami?
10. What are spring and neap tides?
11. When and how often do these tides occur?

The Coriolis Effect

- Moving objects curve (don't move in a straight path) because of Earth's rotation (turning)



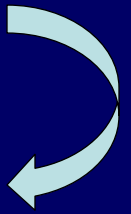
The Coriolis Effect

- Currents in the Northern Hemisphere turn <u>clockwise</u>

- Currents in the Southern Hemisphere turn <u>counter clockwise</u>

Coriolis: Down the toilet!

Northern Hemisphere = clockwise



Southern Hemisphere =counter clockwise

Continental Deflections

- Surface currents meet continents and deflect (change directions)

Figure 4 *If South America were not in the way, the Brazil Current would probably flow farther west.*

Deep Currents

- Currents far below the surface
  - Not controlled by winds or Coriolis Effect
  - Depends on density of water
    - Density depends on temperature and salinity

Decrease temperature (cold)

+

increase salinity

Increase density= water sinks to the ocean floor

= ***deep current***

Deep Current

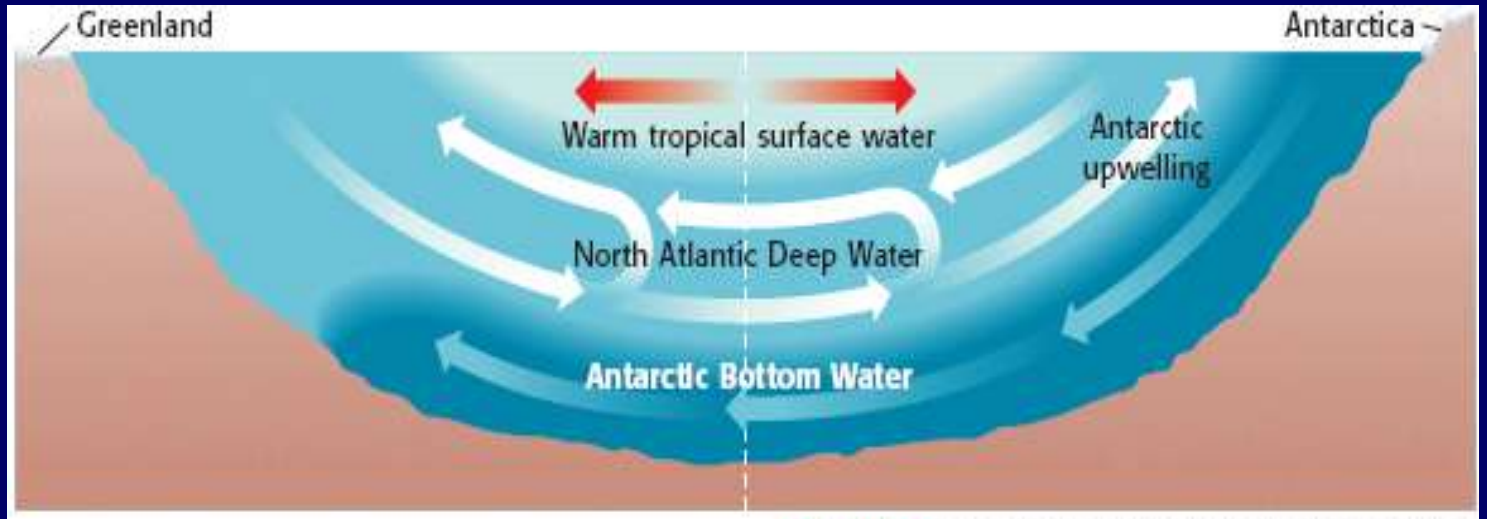
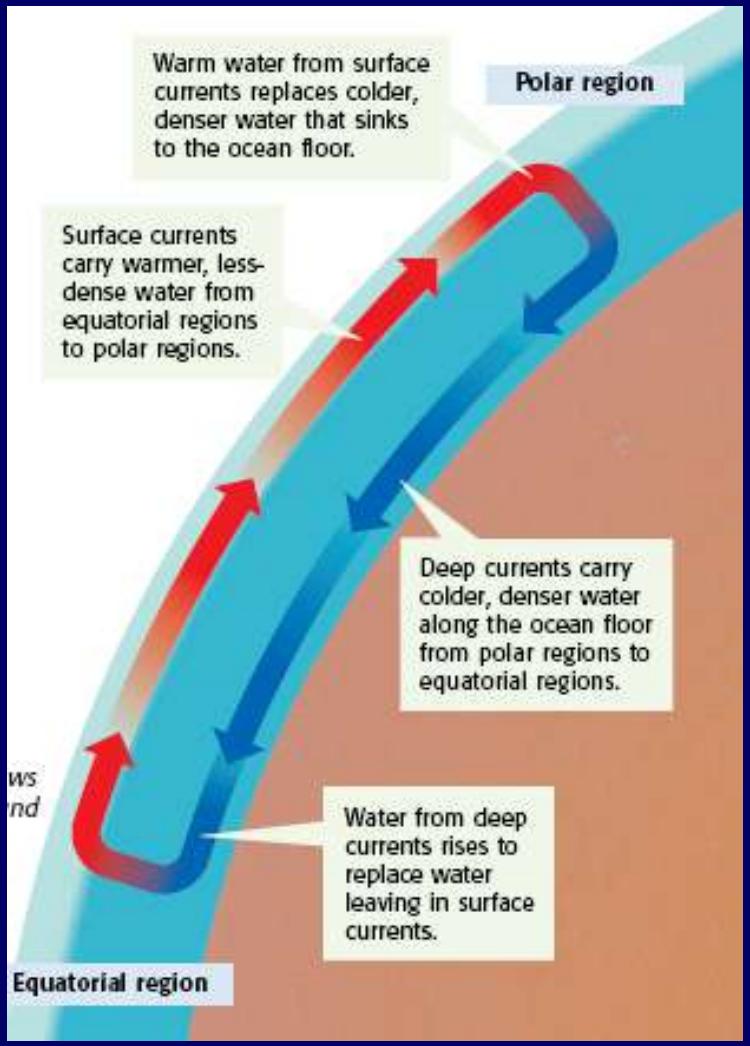


Figure 6 *Less-dense water always flows on top of denser water, as shown in this cross section.*

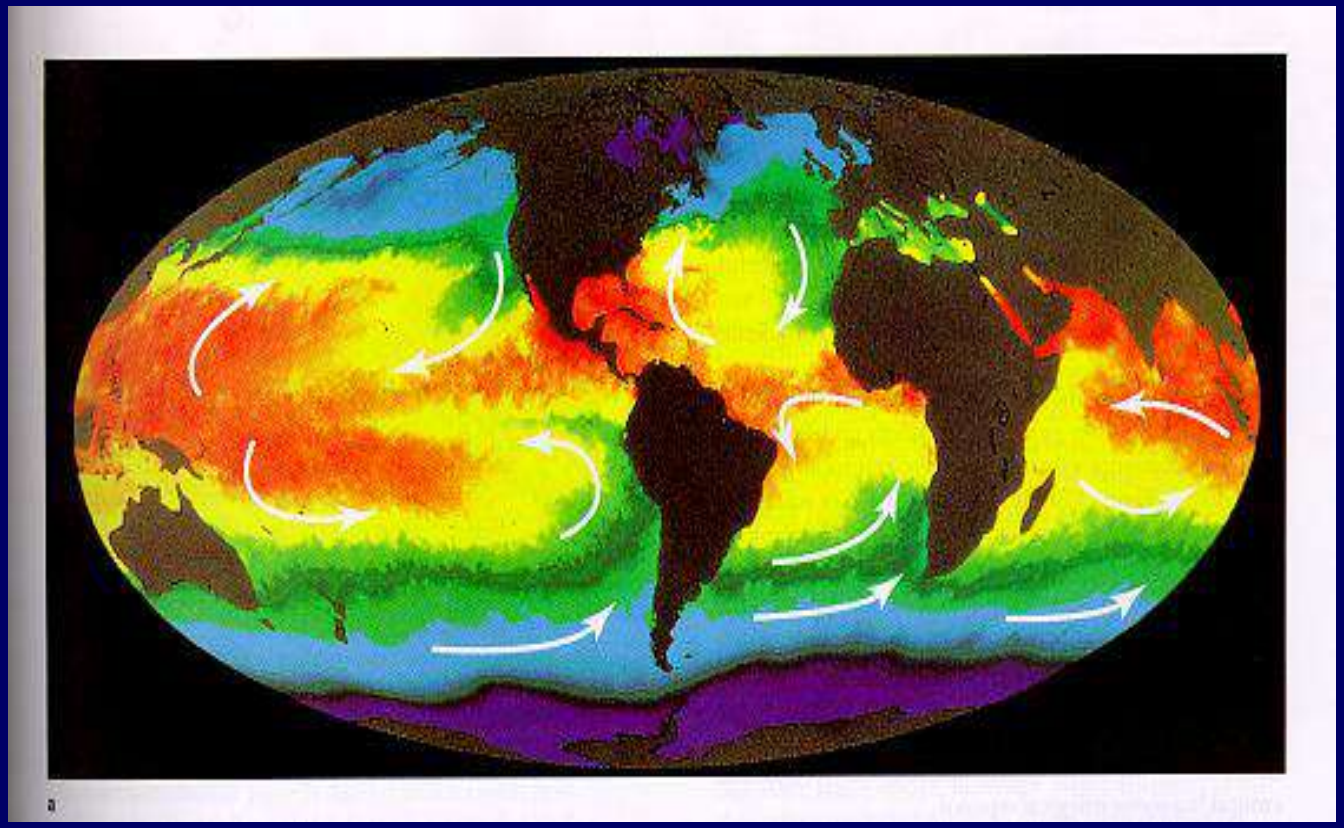
Movement of Deep Currents The ocean

Deep Current

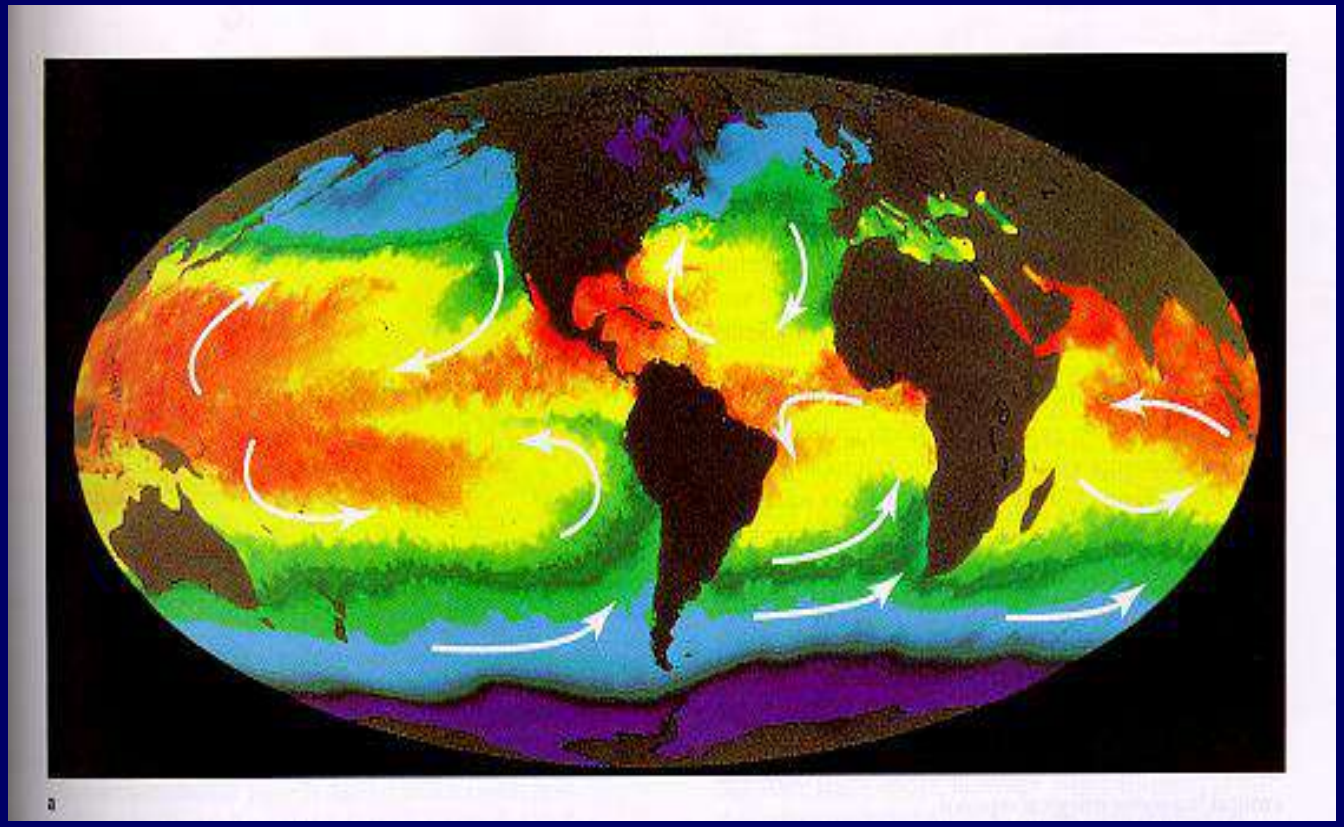


Surface Currents & Climate

- Surface currents affect the climate of the world
  *warm-water currents or cold-water currents



Surface Currents & Climate



- warm-water currents create warm climates in coastal areas (continent borders)

East coast= Gulf Stream West Coast= cold-water current

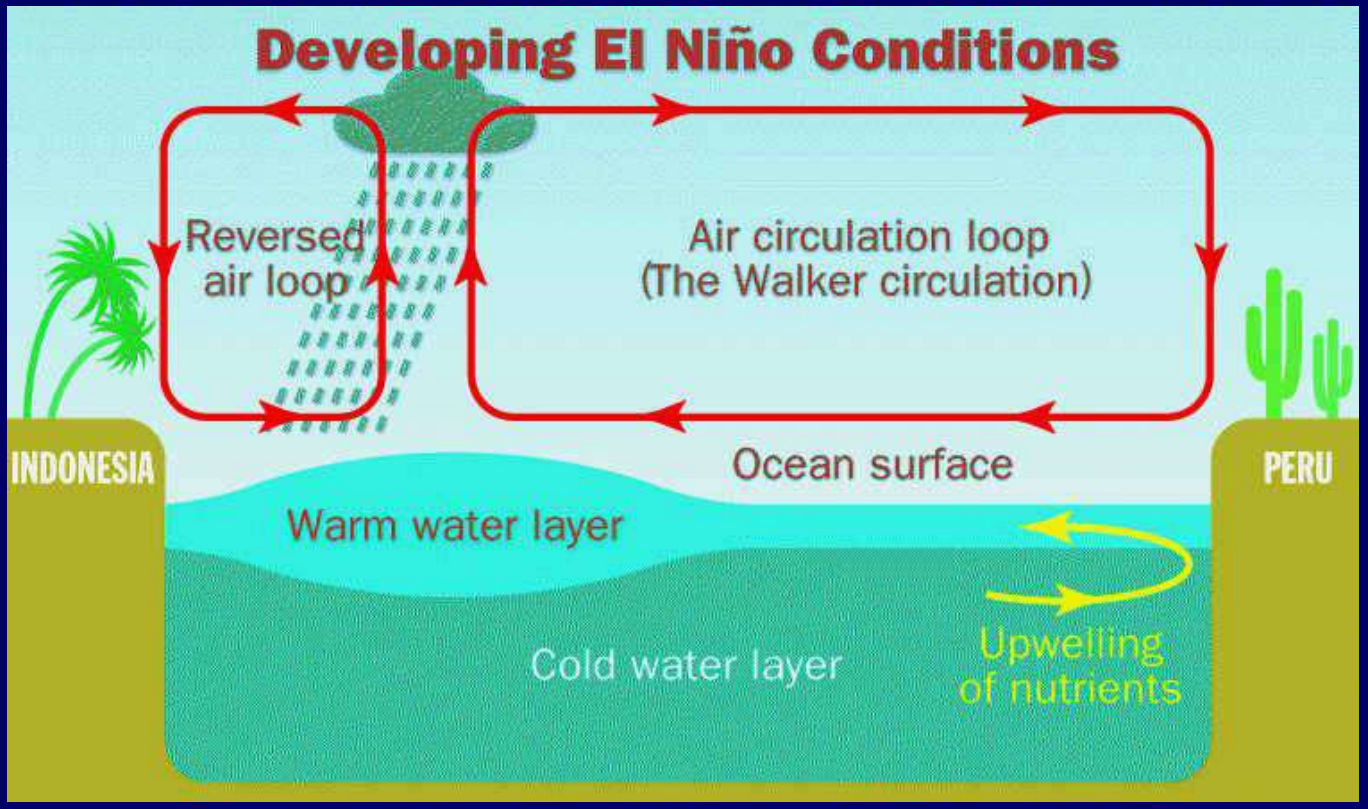
El Nino

- Upwelling- Cold water from deep ocean rises and replaces warm surface water
- The warm water is blown out to sea by prevailing winds

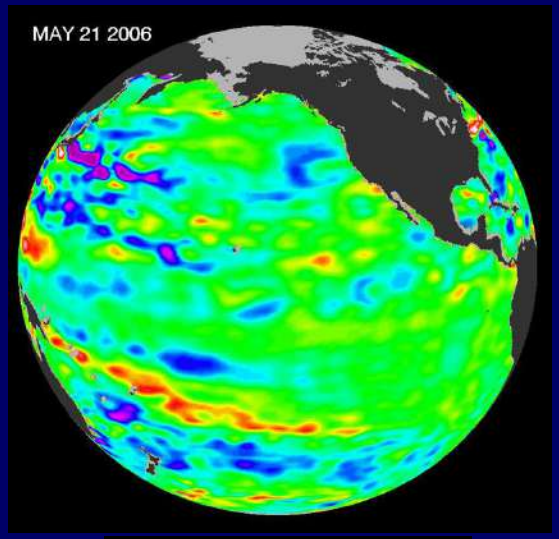
- El Nino is the change in location of warm and cool surface water in the Pacific Ocean
- This changes the surface water and weather patterns

El Nino

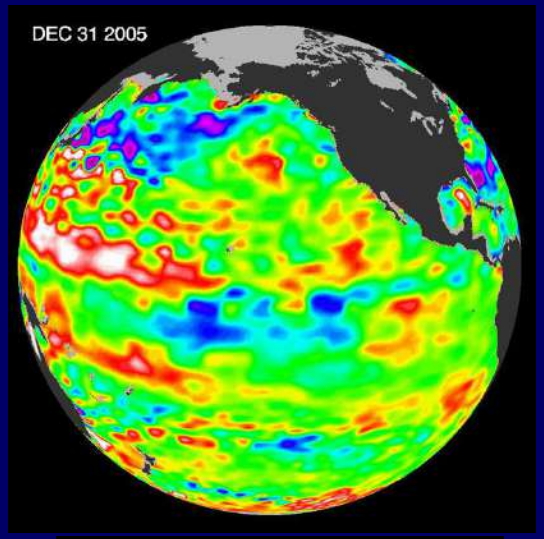
- Change in location of warm and cool surface water in the Pacific Ocean
  - Cold water from deep ocean rises and replaces warm surface water



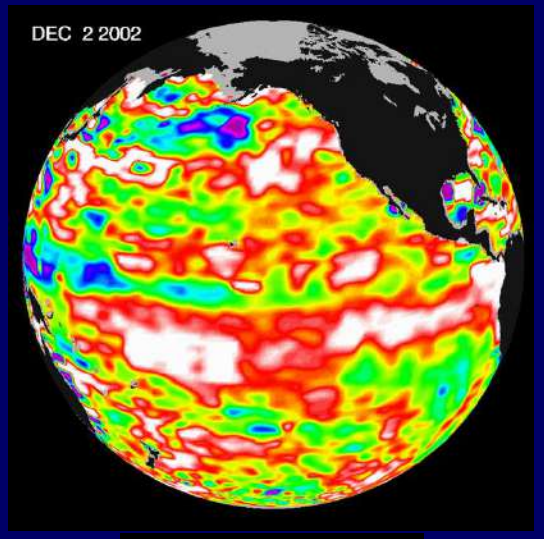
El Nino



Pacific is calm



Continues to grow



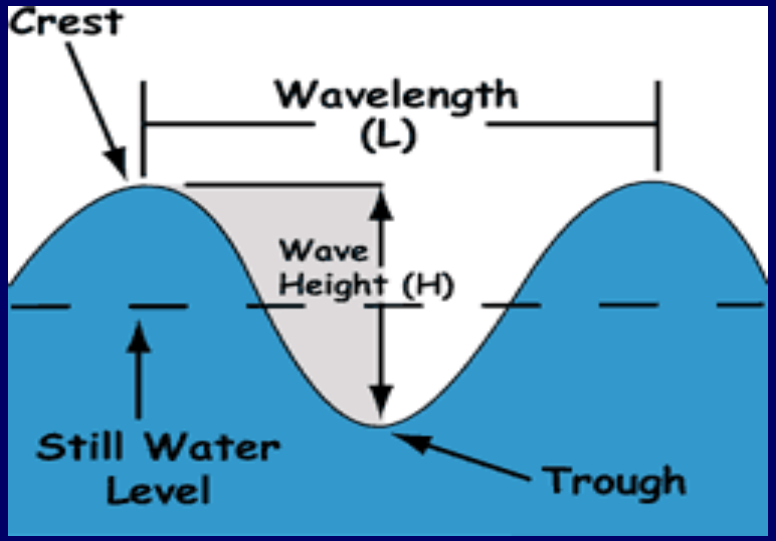
Developing

El Nino

- This changes the weather patterns
  - Causes disasters such as floods and mudslides or droughts (periods without rainfall)

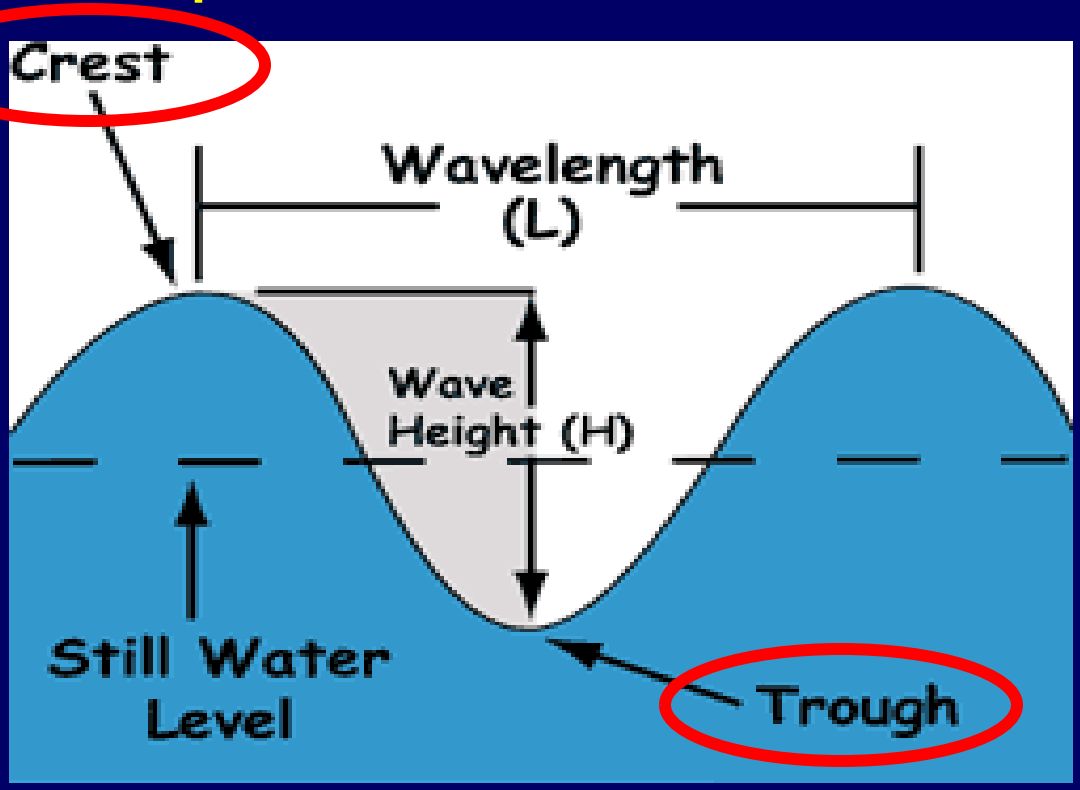
Waves

- Movement of energy across the ocean surface
  - Caused by wind blowing across the surface



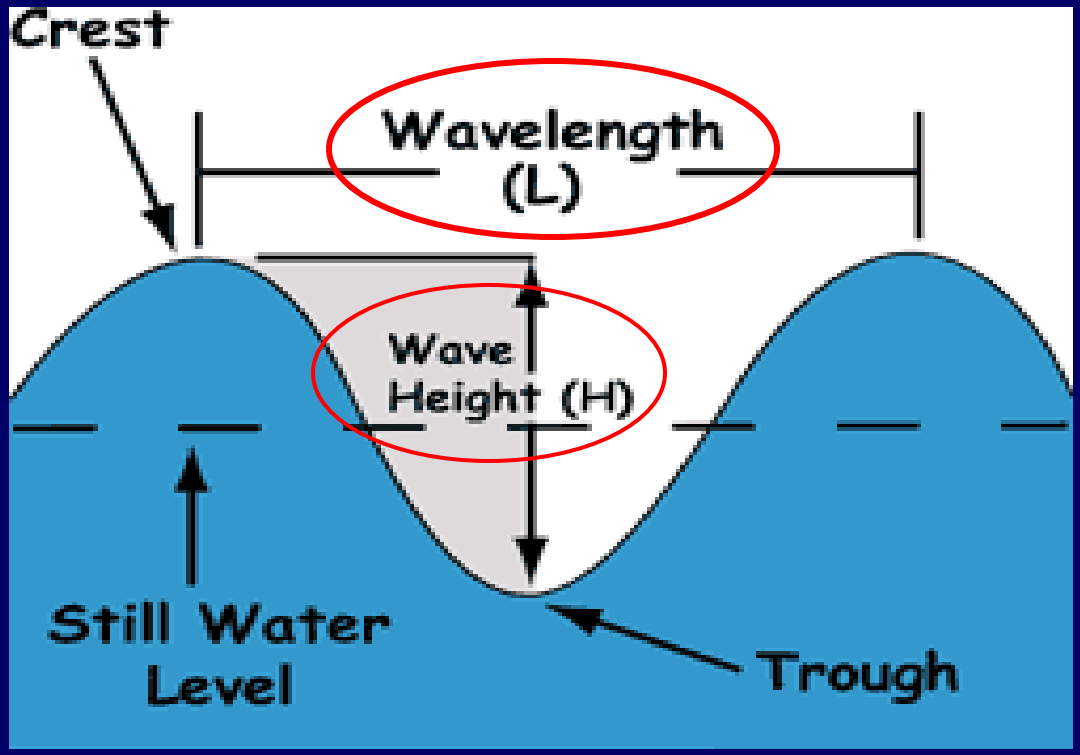
Parts of a Wave

- Crest- highest point of wave
- Trough- lowest point



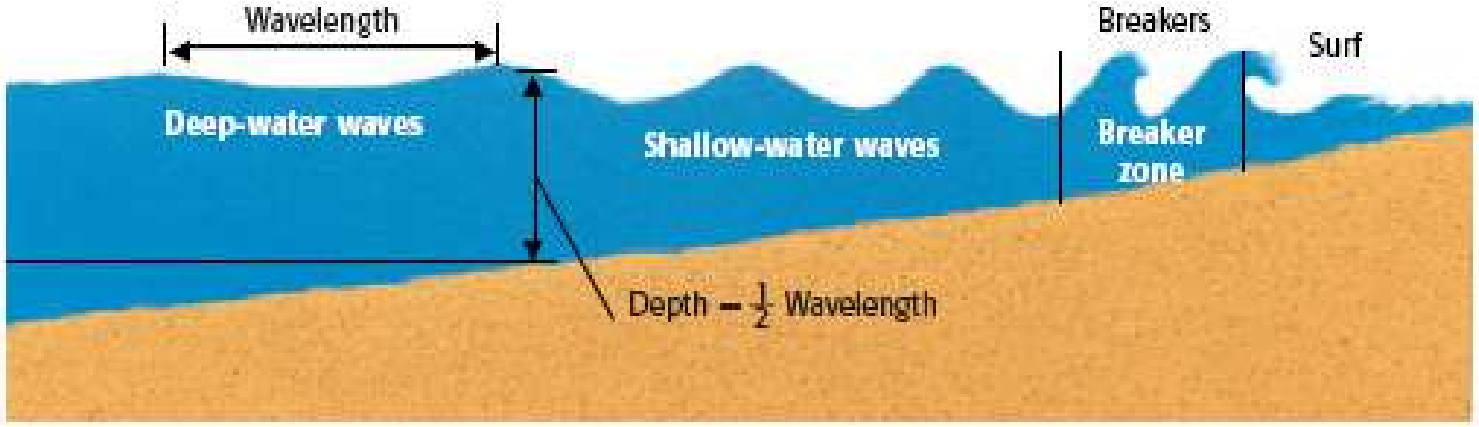
Parts of a Wave

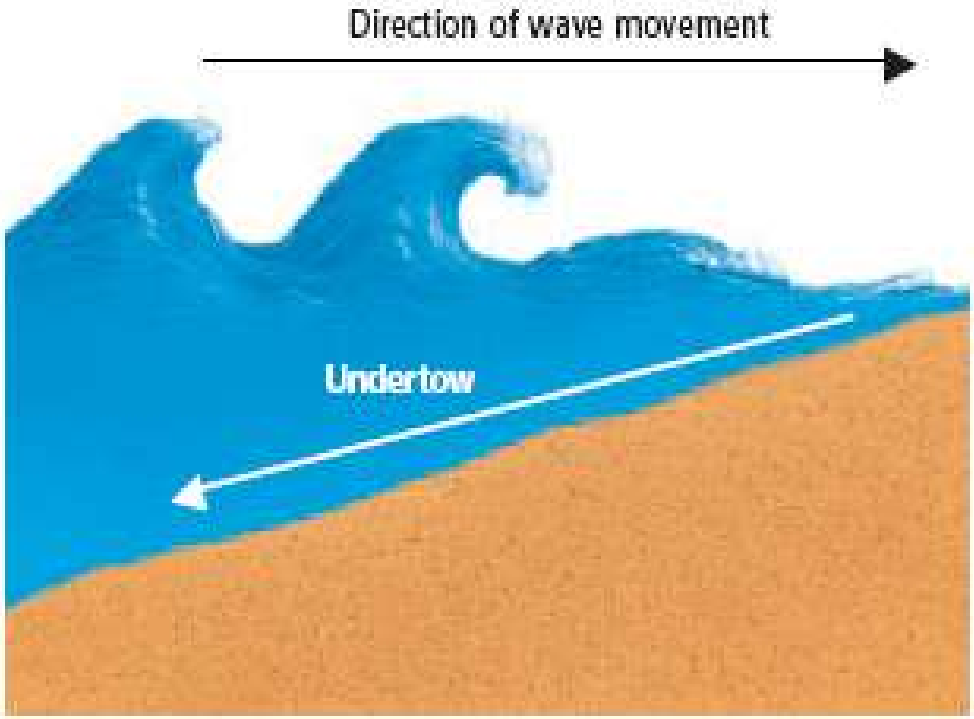
- Wave length- distance between wave crests or wave troughs
- Wave height- vertical distance between the crest and trough



As deep-water waves become shallow-water waves, the water particles slow down and build up. This forces more water between wave crests and increases wave height. Gravity eventually pulls the high wave crests down, causing them to crash into the ocean floor as **breakers.** The area where waves first begin to tumble downward, or break, is called the *breaker zone.* Waves continue to break as they move from the breaker zone to the shore. The area between the breaker zone and the shore is called the **surf.**

Figure 12 *Deep-water waves become shallow-water waves when they reach depths of less than half of their wavelength.*





When waves crash on the beach head-on, the water they moved through flows back to the ocean underneath new incoming waves. This movement of water, which carries sand, rock particles, and plankton away from the shore, is called an *undertow*. **Figure 13** illustrates the back-and-forth movement of water at the shore.

Figure 13 *Head-on waves create an undertow.*

Longshore Currents

- Longshore currents are responsible for most sediment transport in beach environments.
- This movement of sand and other sediment both tears down and builds up the coastline.
- Unfortunately, longshore currents also carry trash and other types of ocean pollution, spreading it along the shore.

Figure 14 *Longshore currents form where waves approach beaches at an angle.*

Figure 15 *Whitecaps, shown in the photo at left, break in the open ocean, while swells, shown in the photo at right, roll gently in the open ocean.*

Whitecaps are white, foaming waves that break.

Swells are rolling waves that move across the ocean.

Tsunamis

- Tsunamis- waves that form when a large volume of ocean water is suddenly moved up or down
  - Caused by: earthquakes, volcano eruptions, landslides or underwater eruptions

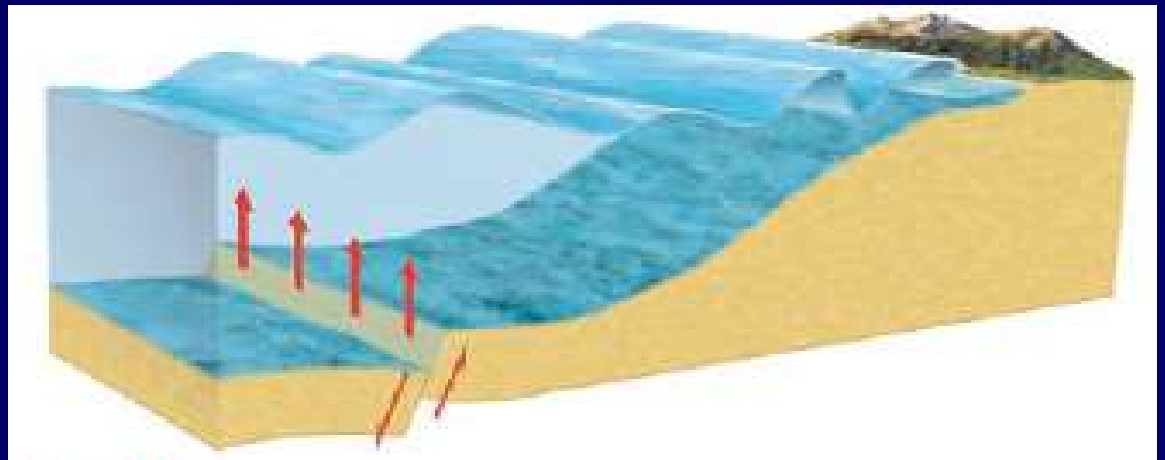
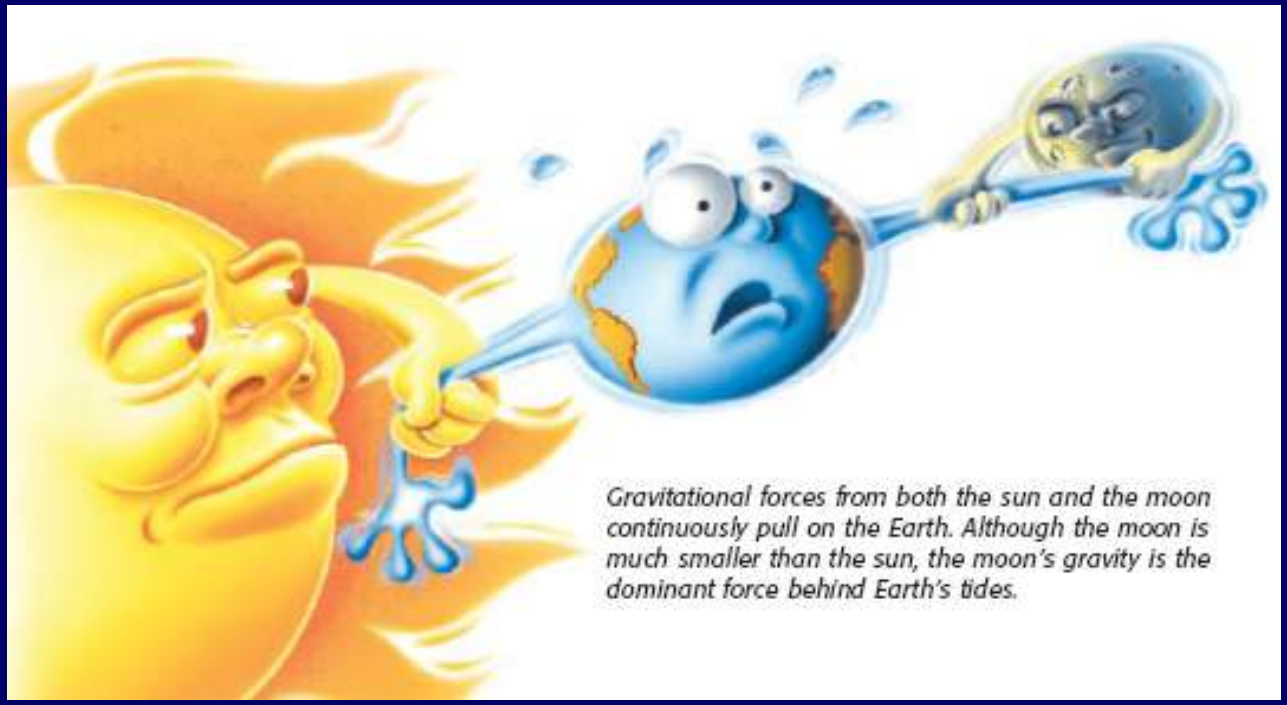


Figure 16 *An upward shift in the ocean floor creates an earthquake. The energy released by the earthquake pushes a large volume of water upward, creating a series of tsunamis.*

Tsunami Damage

Tides

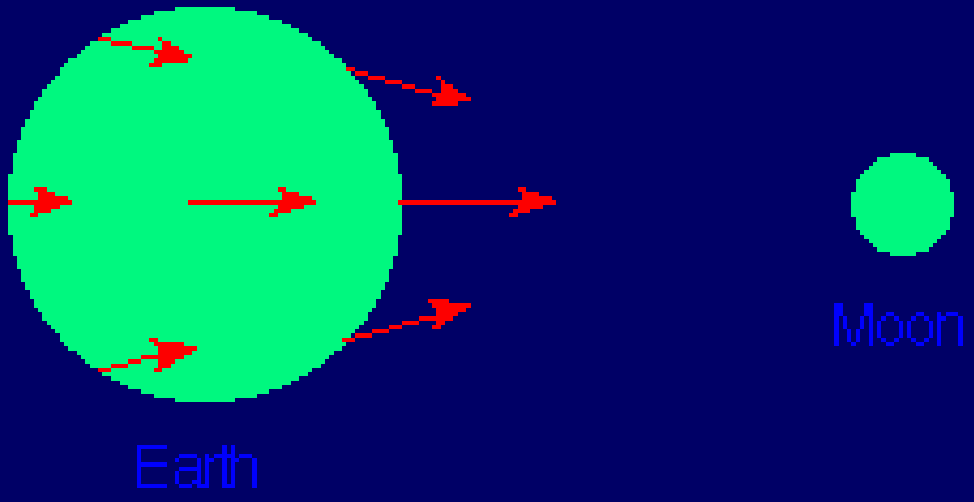
- Tides- daily change of the level of the ocean's surface
- Tides are influenced by the sun and the **moon**

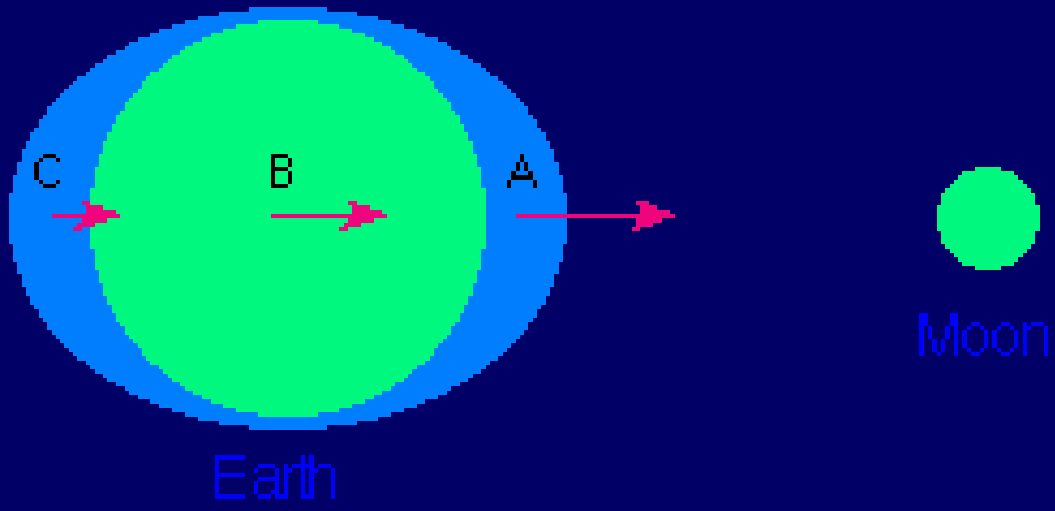


Gravitational forces from both the sun and the moon continuously pull on the Earth. Although the moon is much smaller than the sun, the moon's gravity is the dominant force behind Earth's tides.

Gravitational Pull

Tides- daily change of the level of the ocean's surface





High Tide & Low Tide

- The moon revolves (circles) around the Earth
- The moon's pull is strongest on the part of Earth directly facing the moon
  - The ocean bulges toward the moon
  - Water at the opposite side bulges

Bulges= high tides

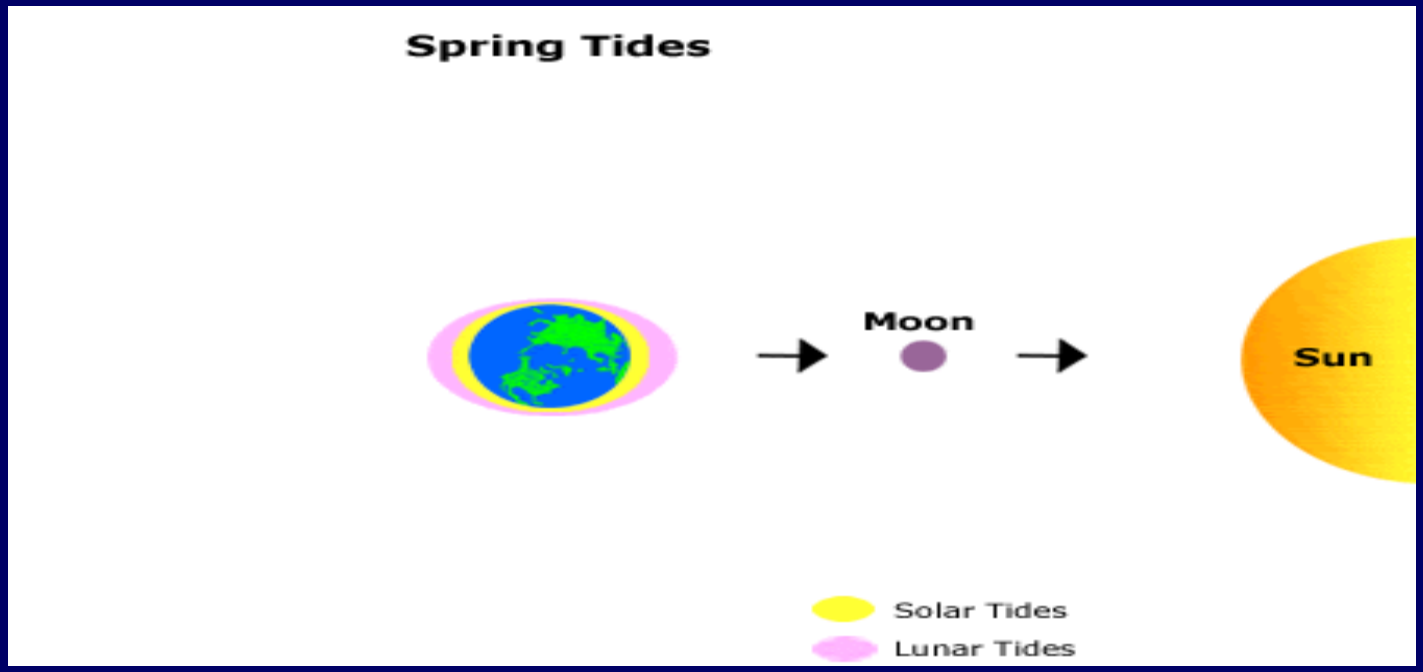
- Water is drawn away between high tides= low tides

High Tide & Low Tide

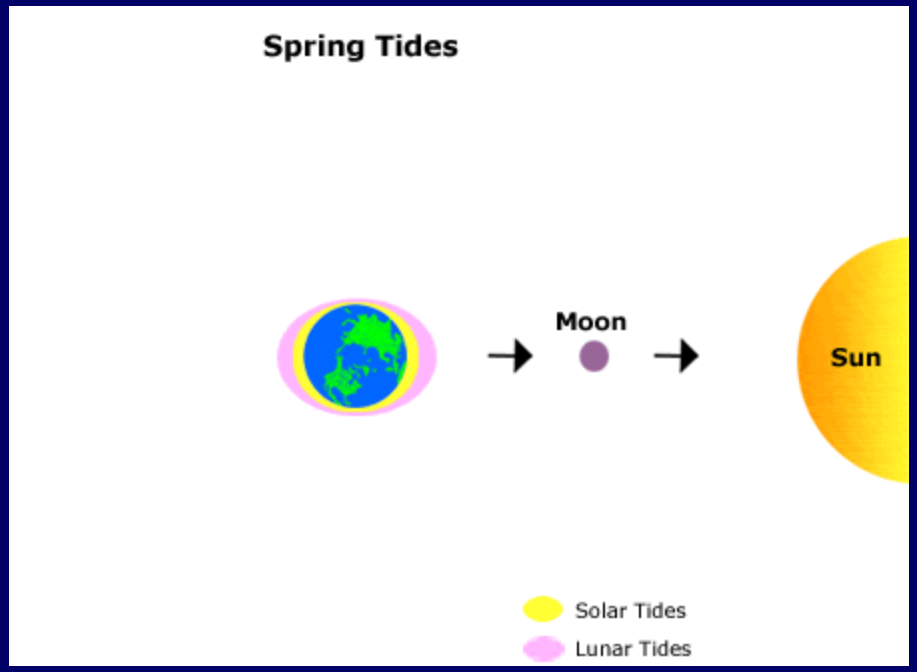
Figure 18 *High tide occurs on the part of Earth that is closest to the moon. At the same time, high tide also occurs on the opposite side of Earth.*

Timing Tides

- Tides occur at different spots on Earth
  - The moon revolves around the Earth more slowly than Earth rotates

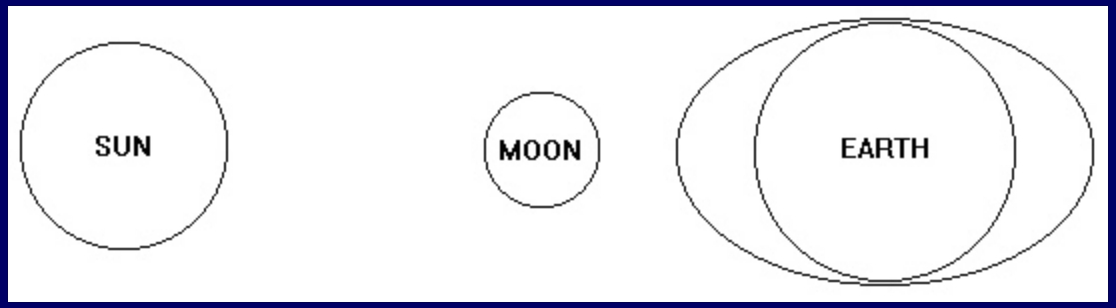


- It takes 24 hours and 50 minutes for a spot Earth that is facing the moon to rotate and face the moon again



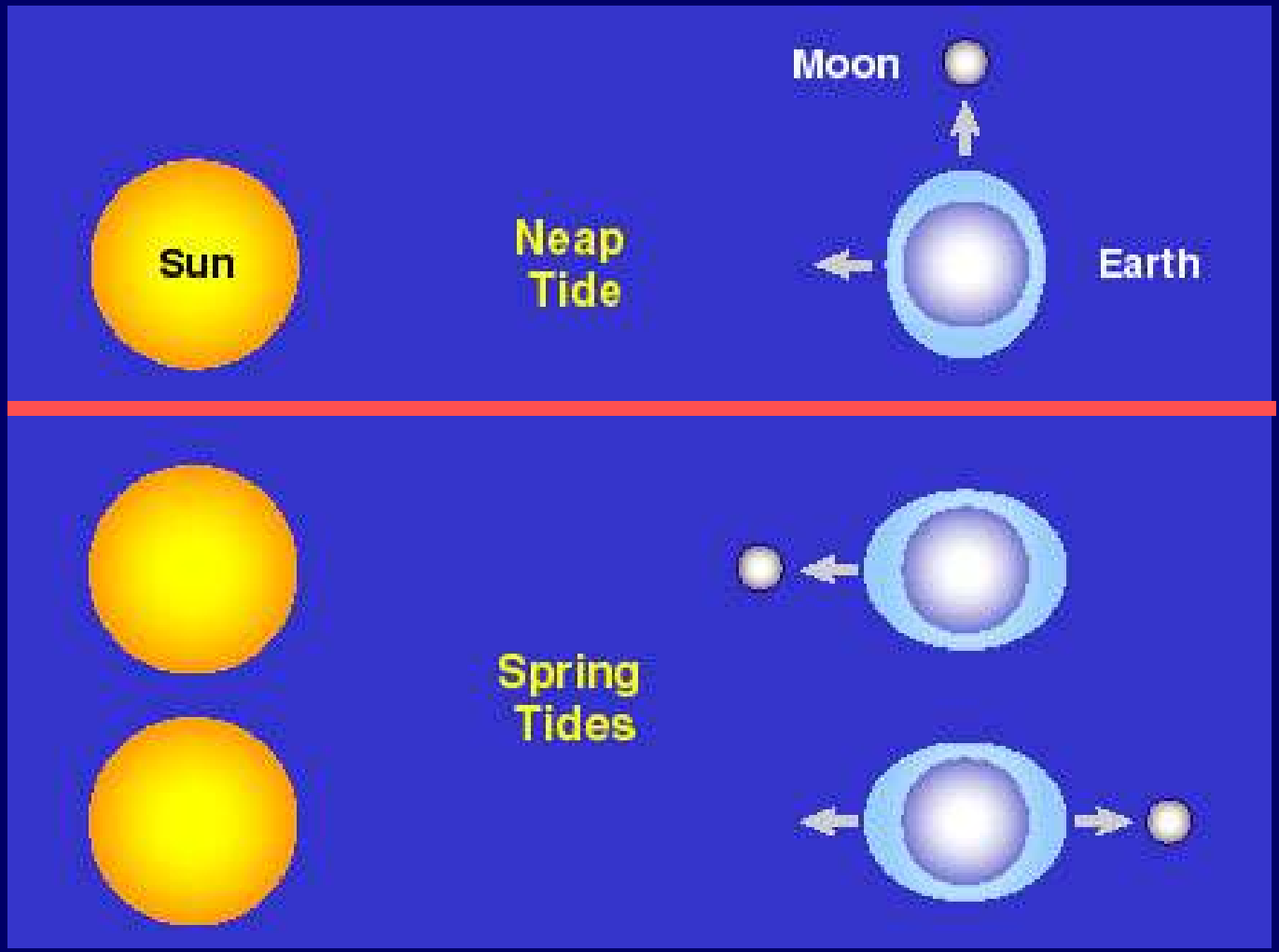
Spring Tides & Neap Tides

- Spring tides- tides with the greatest difference between ocean levels at high tide and low tide
  - Every 14 days (sun, Earth and moon all aligned)



- 1st time – moon between the sun and Earth

- 2nd time – Earth between the sun and moon


Moon
Sun
Neap
Tide
Earth
Spring
Tides

Neap Tides

- Neap tides- tides with least difference between ocean levels at high and low tides
  - Occur halfway between spring tides
  - (sun, Earth, and moon form a 90° angle)

- Gravitational pull of the sun and moon work against each other

Paw Point Review!!

- Use your notes to answer the Paw Point questions.

1. How does the Coriolis Effect cause currents in the Northern and Southern Hemisphere to turn? Draw this on the board.
2. What is continental deflection?
3. What factors cause water density to increase?
4. Does dense water sink or float?
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Paw Point Review!!

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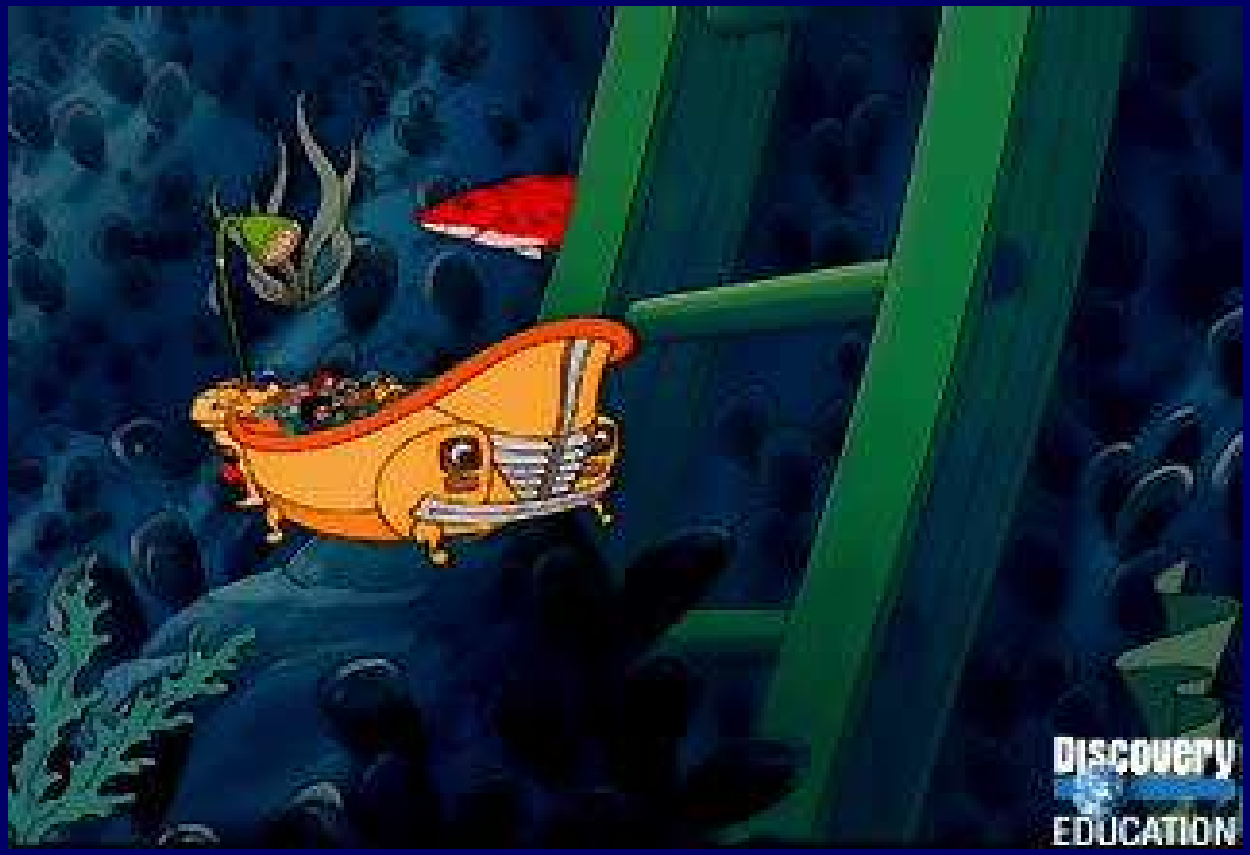
1. What is El Nino?
2. What type of damage can El Nino cause?
3. What is an undertow or rip current?
4. What is a tsunami?
5. What are spring and neap tides?
6. When and how often do these tides occur?

Magic School Bus Goes to Mussel Beach



- Discuss two things you learned today.
  - 1.
  - 2.