

# OCEAN CURRENTS



# All Write Round Robin

G1. What makes up the ocean water?

G2. What is the source of the salt found in ocean water?

G3. How does the water temperature affect the density of ocean water?

G4. How does the salt affect the density of ocean water?

G5. What source of energy warms the ocean water?

G6. What happens when cold ocean water meets warm ocean water?

G7. Why does the beach sand get hotter than the ocean water at mid-afternoon in the summer?

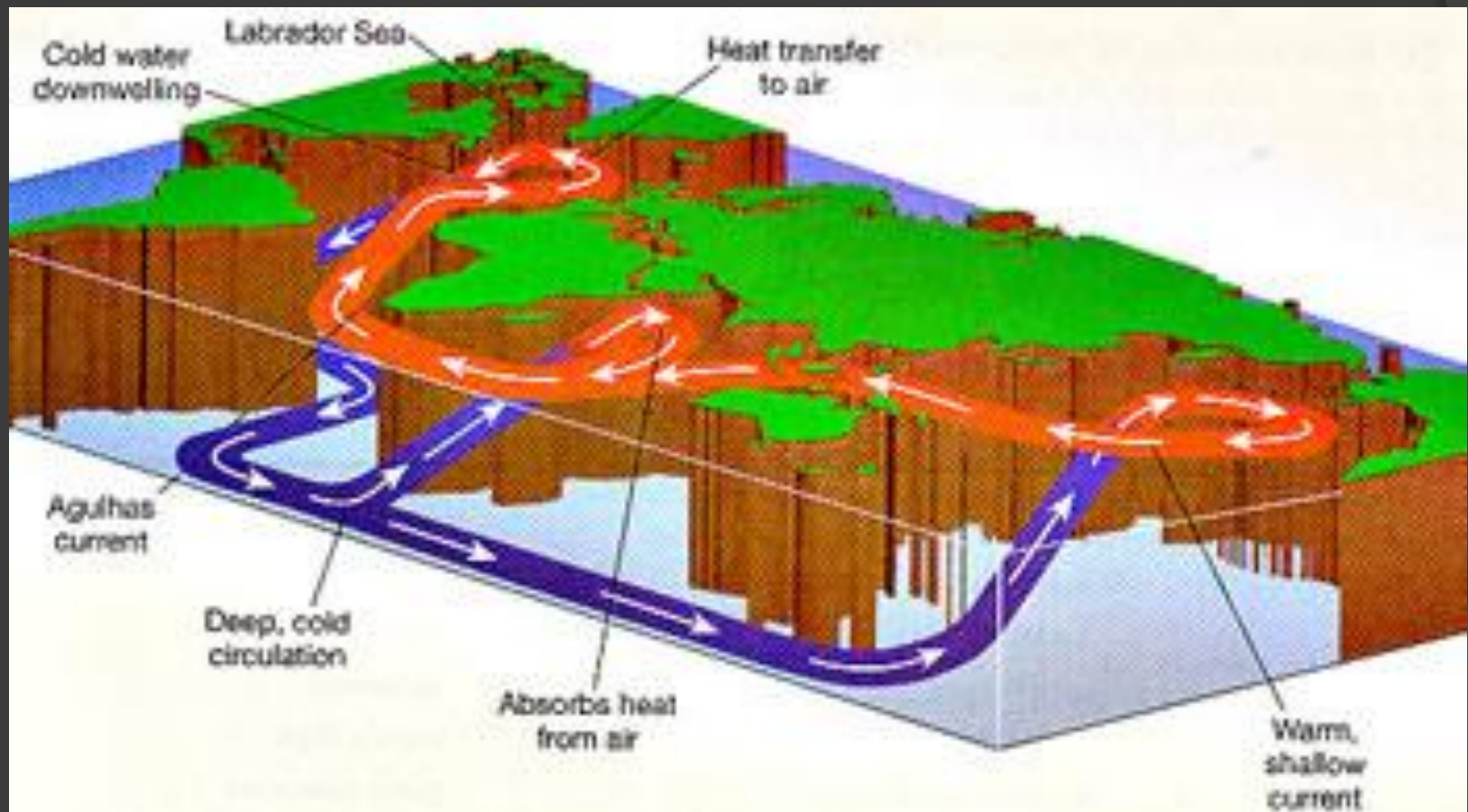
# Ocean Circulation

## ● Surface Circulation

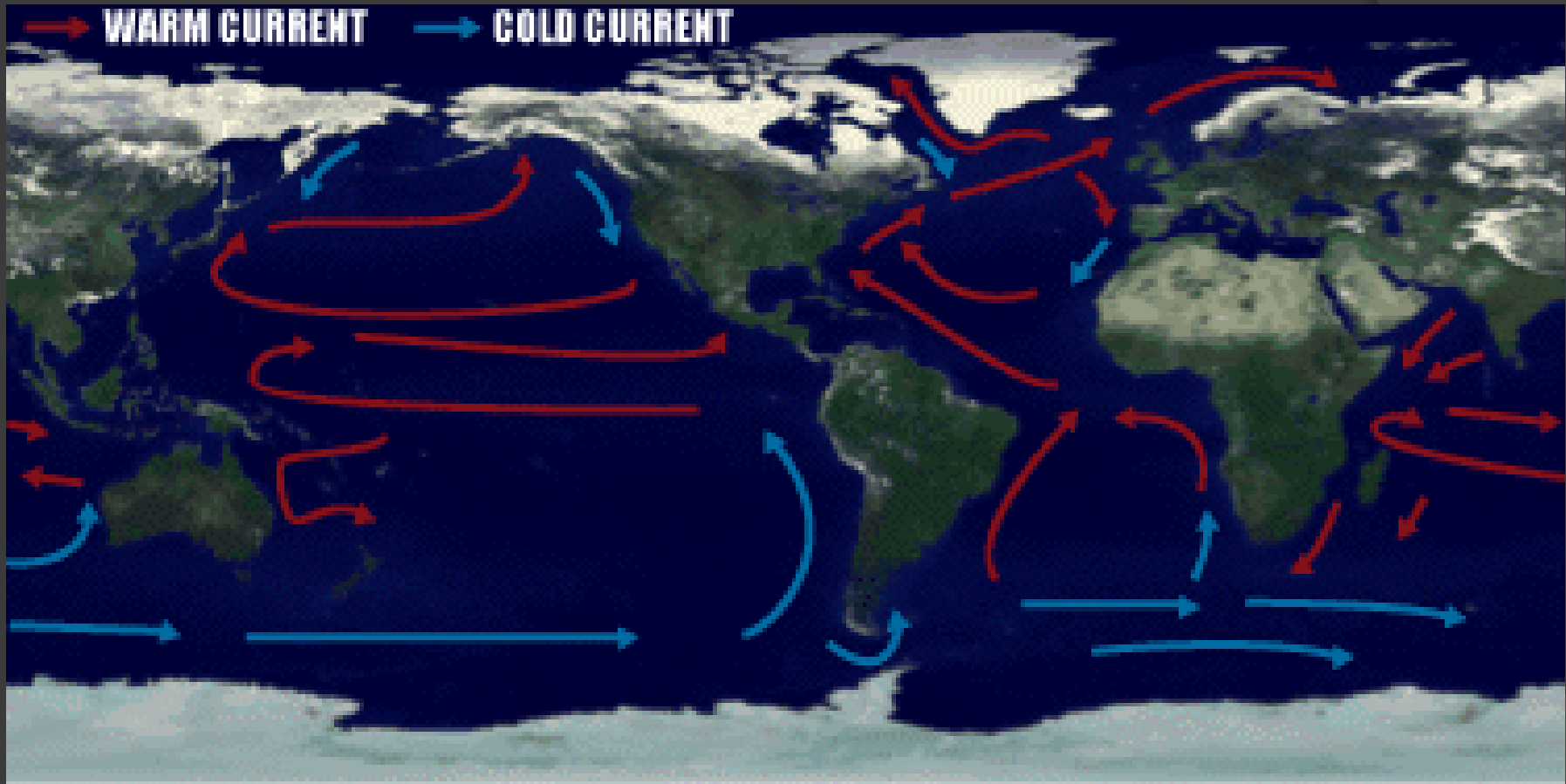
Ocean current is the mass of ocean water that flows from one place to another.

● Surface Currents: are movements of water that flow horizontally in the upper part of the ocean's surface.

\*they develop from friction between the ocean and the wind that blows across its surface.



# Surface Current Circulation Map



[YouTube - The Thermohaline Circulation - The Great Ocean Conveyor Belt](#)

# Surface Circulation

- **Gyres:** are huge circular-moving current systems that dominate the surfaces of the oceans.

Five main ocean gyres

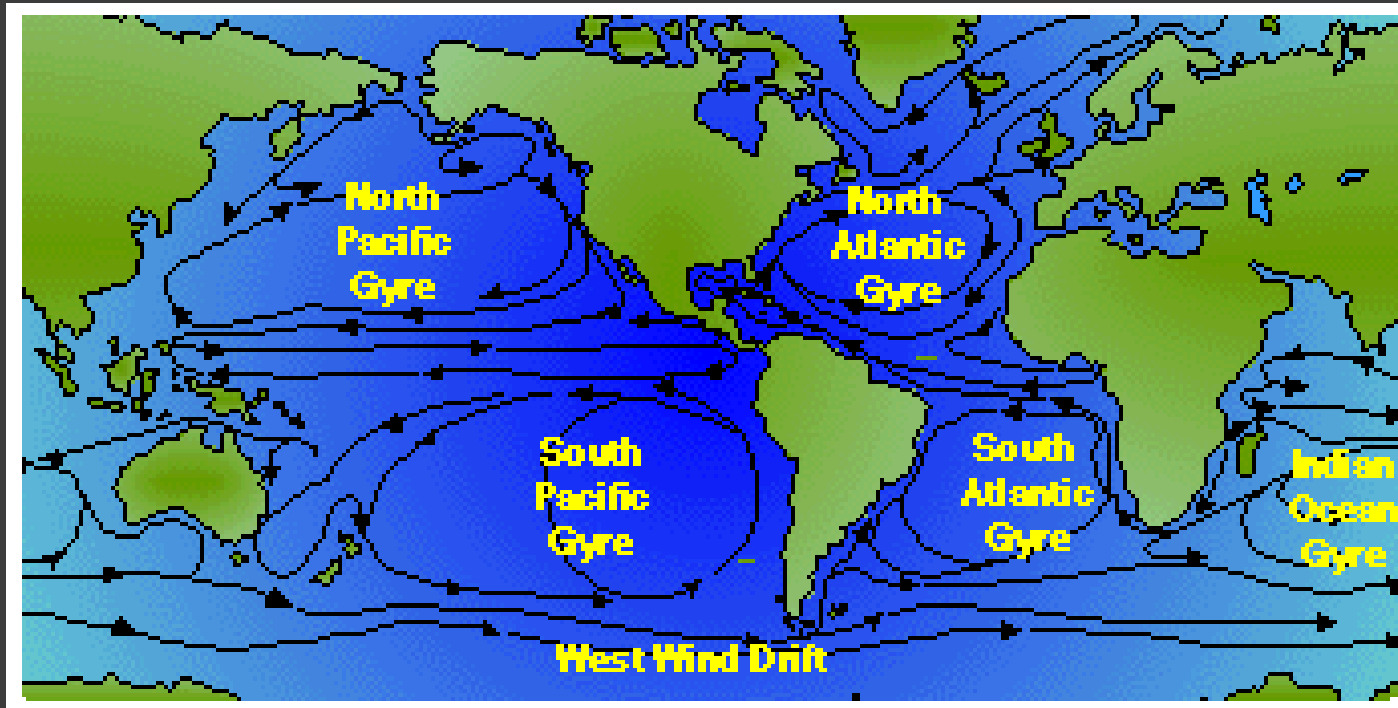
North Atlantic	South Atlantic
North Pacific	South Pacific
Indian	

## 3 Factors That Influence the Path of Currents:

- ▲ Prevailing wind direction
- ▲ Coriolis effect is the deflection of currents away from their original course as a result of Earth's rotation.
- ▲ Continent interference affect current path.

# Surface Current Flow

The first five are gyres because the water flows around the edge of an ocean basin. The West Wind Drift, also called the Antarctic Circumpolar Drift, is an oceanic current that flows around the Antarctic continent.



Six major circulation cells in the global ocean (modified from Garrison, 1995).

# Surface Circulation

## ● Climate Influence

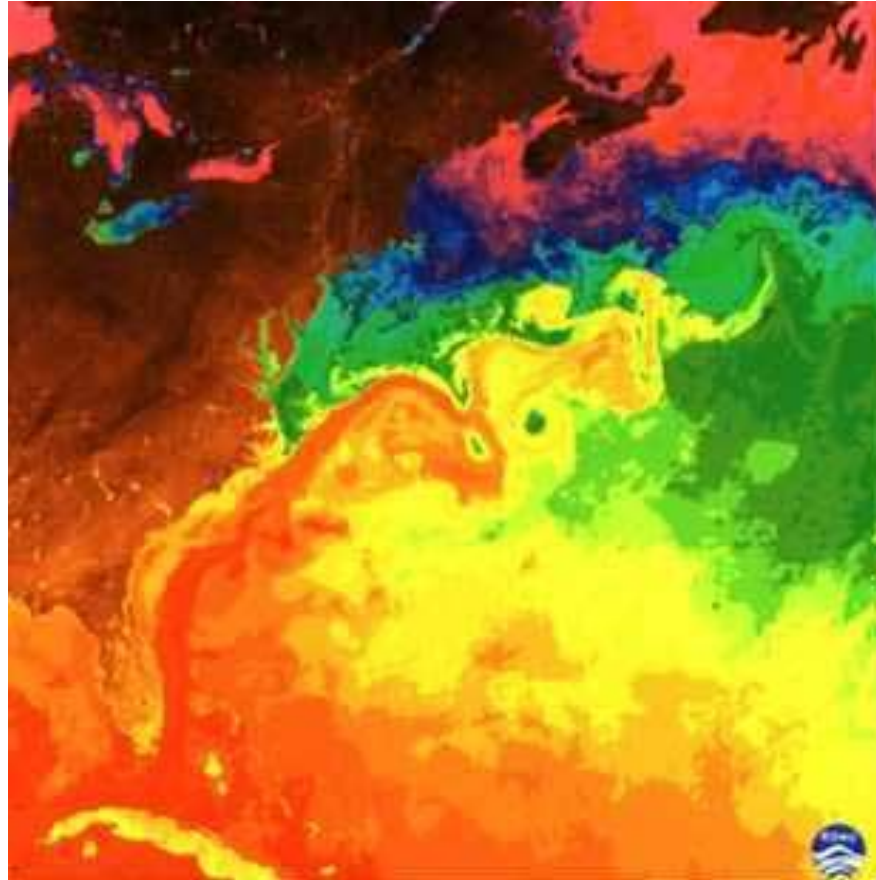
\* When currents from low-latitude regions move into higher latitudes, they transfer heat from warmer to cooler areas on Earth.

\* As cold water currents travel toward the equator, they help moderate the warm temperatures of adjacent land areas.

[YouTube - Ocean Currents](#)



# Satellite Image of the Gulf Stream Current



# Heating of Water and Land

- Continents are warmer than nearby ocean waters during summer. In winter, the same continents are colder than the water.
- Why does the temperature of land vary more than the temperature of water?
- Land and water warm up and cool off at different rates.

# Heating of Water and Land

- ⦿ Water warms up much more slowly than land does for many reasons.
- ⦿ On land, insolation warms only the top few centimeters of soil, but the sun's rays penetrate to a depth of many meters in water.
- ⦿ In water, some solar energy is used in the process of evaporation.
- ⦿ Water requires more energy than land to raise its temperature the same amount (about three times more than land).

# Heating of Water and Land

## Albedo - Reflection rating of surfaces

- Dark surfaces absorb more energy than light surfaces. Low albedo versus high albedo
- Rough surfaces absorb more energy than smooth surfaces.
- Dry ground absorbs more energy than wet ground.
- Snow and ice reflect sunlight and remain cold. High albedo
- So, the higher the albedo the more reflection of light, the lower the albedo the less reflection of light. Remember the sun provides thermal energy too.

# Composition of Ocean Water

## Deep-Ocean Circulation

- ◎ Density currents are vertical currents of ocean water that result from density differences among water masses.
  - \* An increase in seawater density can be caused by a decrease in temperature or an increase in salinity.

[YouTube - Bill Nye The Science Guy on Ocean Currents \(oceanography \(Full Clip\)\)](#)

[YouTube - Ocean Odyssey - Density Current](#)

Salinity – concentration of salt to pure water. Average  $35\text{‰}$

( 35 parts salt to 1000 parts pure water.

# Deep-Ocean Circulation

## High Latitudes

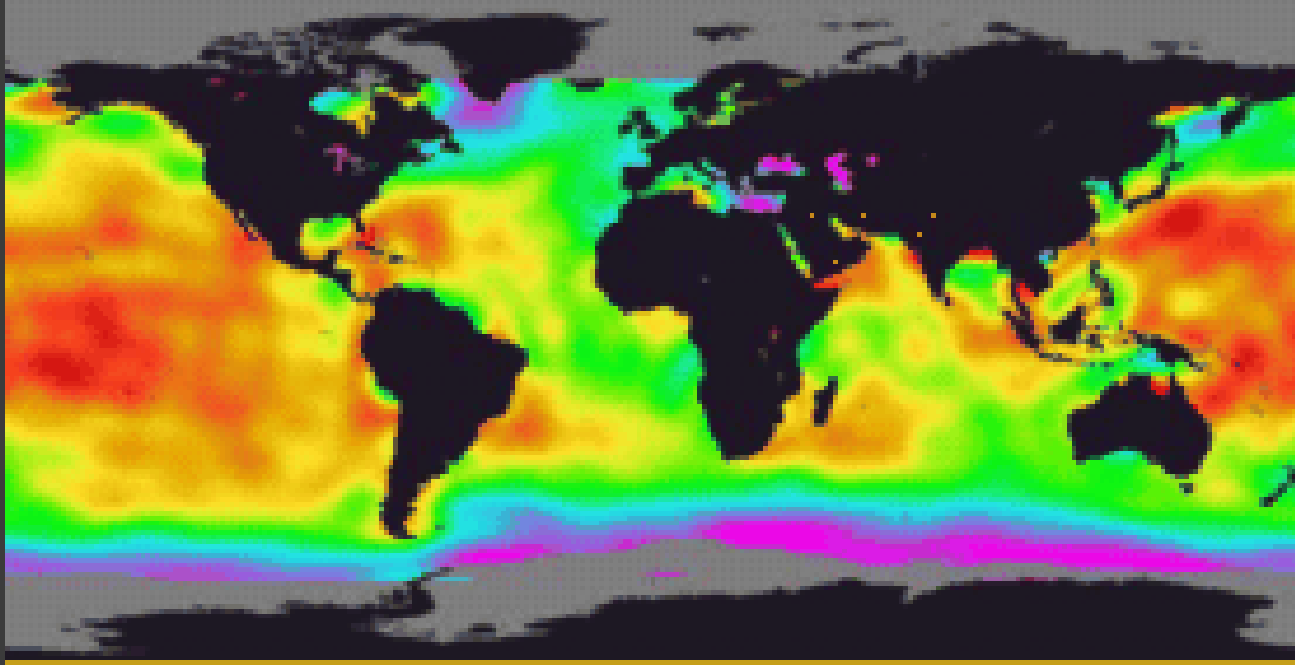
Most water involved in deep-ocean currents begins in high latitudes at the surface.

## Evaporation

Density currents can also result from increased salinity of ocean water due to evaporation.

## Freshwater of Ocean Freezes

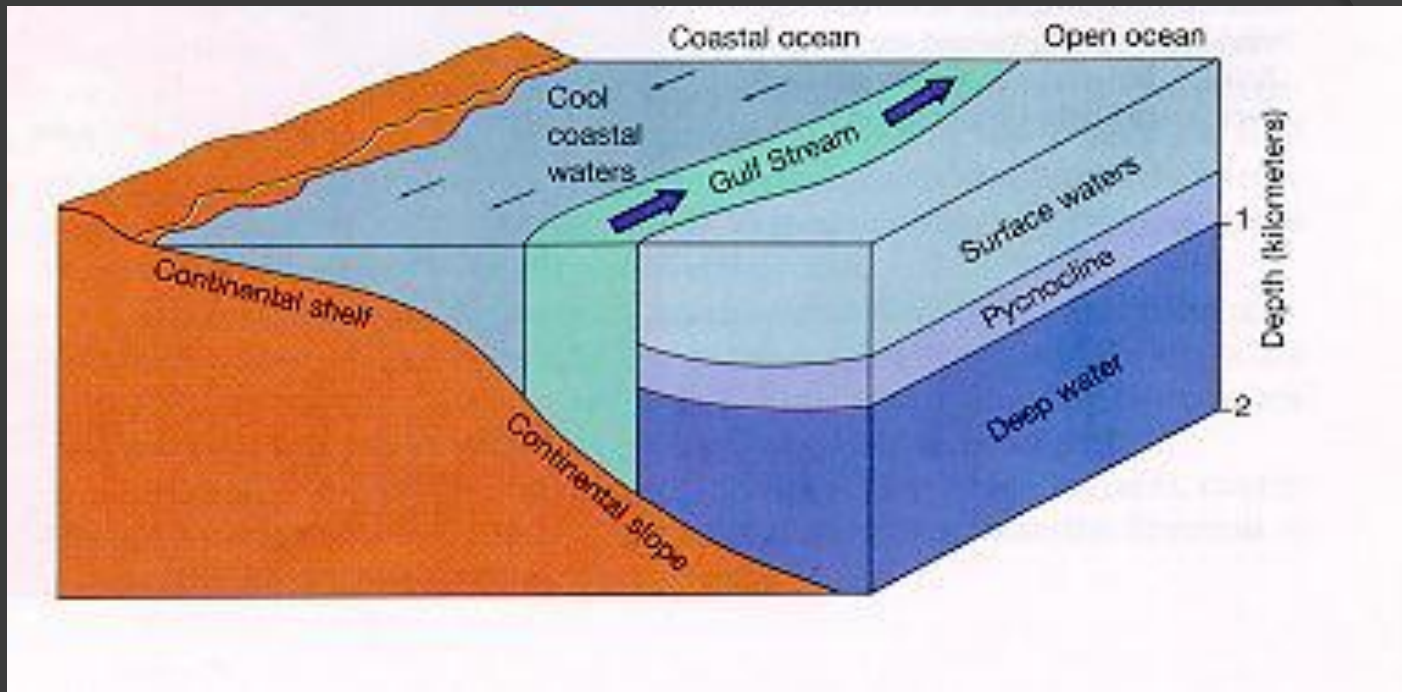
Density currents can result from increased salinity of ocean water due to freezing freshwater.



Deep water forms when sea water entering polar regions cools or freezes, becoming saltier and denser. Colder or saltier water tends to sink

Currents flow in complex patterns affected by wind, the water's salinity and heat content, bottom topography, and the earth's rotation.

[Conceptual Image Lab Animation 20029 - Ocean Circulation Conveyor Belt Helps Balance Climate](#)

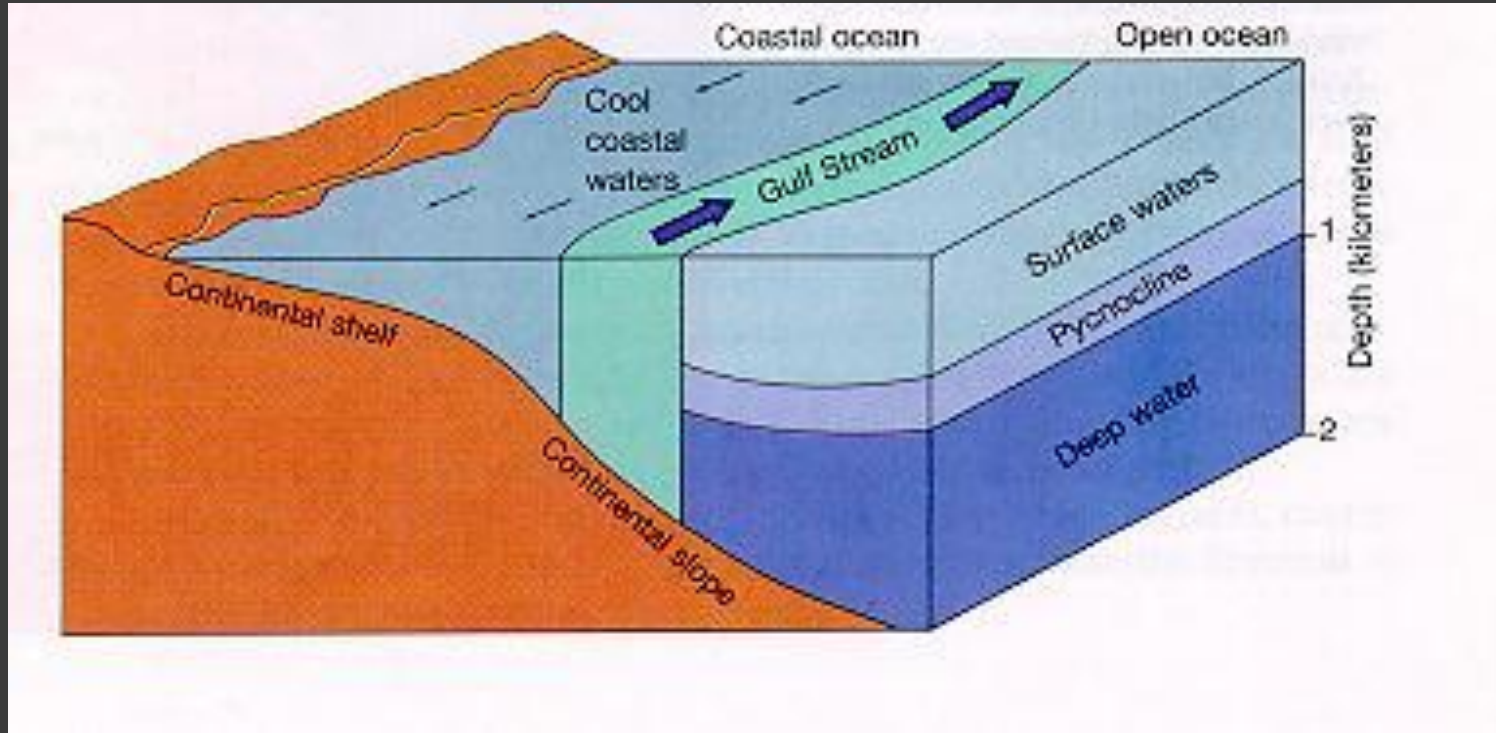


Deep waters are "formed" where the air temperatures are cold and where the salinity of the surface waters are relatively high.

The combinations of salinity and cold temperatures make the water denser and cause it to sink to the bottom.



# Gulf Stream



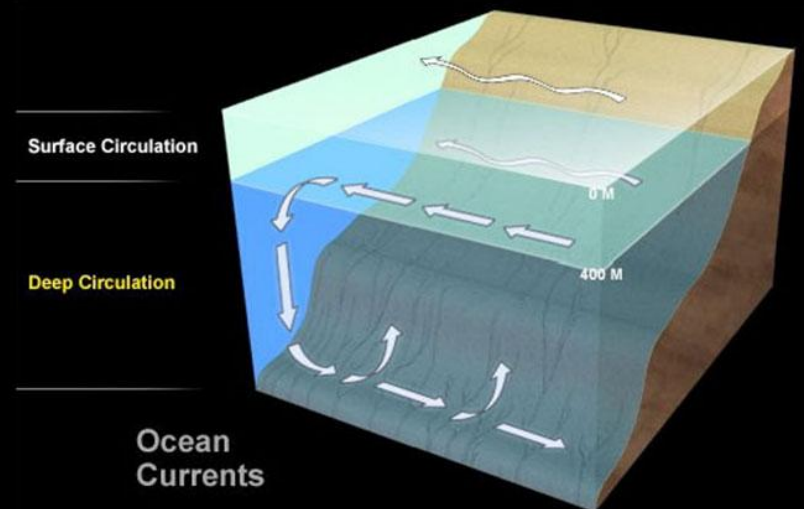
The Gulf Stream carries salt into the high latitude North Atlantic where the water cools. The cooling and the added salt cause the waters to sink in the Norwegian Sea. This is the formation of Atlantic Deep Water

# Deep-Ocean Circulation

What is the global ocean conveyor belt?

The global ocean conveyor belt is a **constantly moving system** of deep-ocean circulation driven by temperature and salinity.

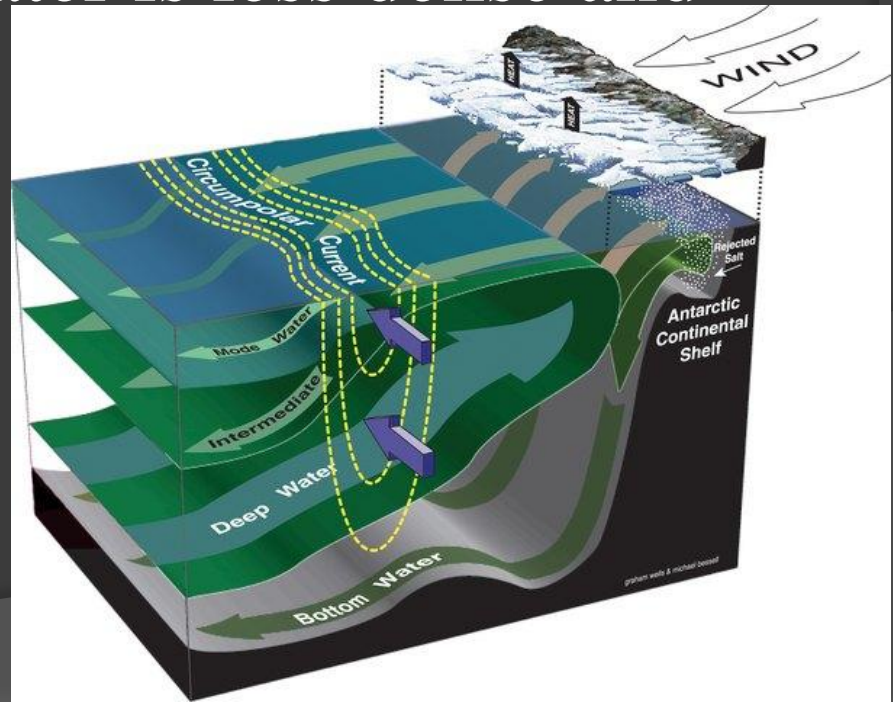
Ocean circulation travels from the Atlantic Ocean, through the Indian and Pacific Oceans, and back again.



“This motion is caused by a combination of thermohaline currents (thermo = temperature; haline = salinity) in the deep ocean and wind-driven currents on the surface.

Cold, salty water is dense and sinks to the bottom of the ocean while warm water is less dense and remains on the surface”

Where is another place on earth where this motion occurs?  
They are very similar...

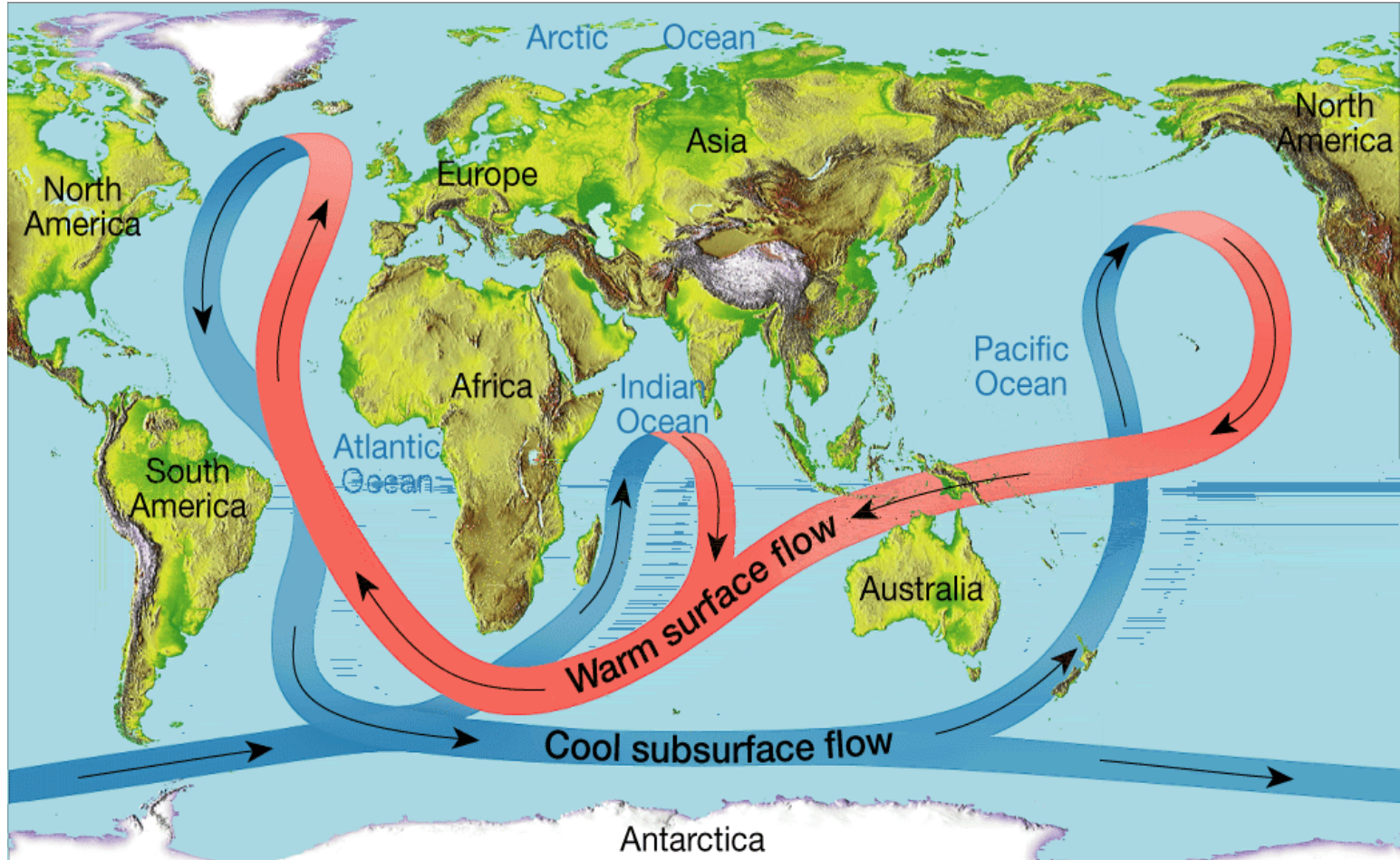


# Conveyor Belt

- Water Movement in the deep ocean is similar to Convection Currents in the Mantle.
- Warm water in ocean's upper layers move toward the poles
- Warm water's temperature drops and salinity increases, making more dense.
- The dense cold water sinks and move toward the equator.
- Deep water eventually up-wells to complete the circuit.

<http://oceanmotion.org/html/impact/conveyor.htm>

# Conveyor Belt Model



# What Should I Learn?

1. Name three physical properties that describe ocean water.
2. Ocean water is composed of pure water and\_\_\_\_\_.
3. What three dissolved gases are found in both the atmosphere and ocean?
4. Define salinity.
5. How does an increase of temperature affect the volume and density of ocean water?
6. What factors affect the path of ocean currents?
7. How does the ocean conveyor belt influence global climate?