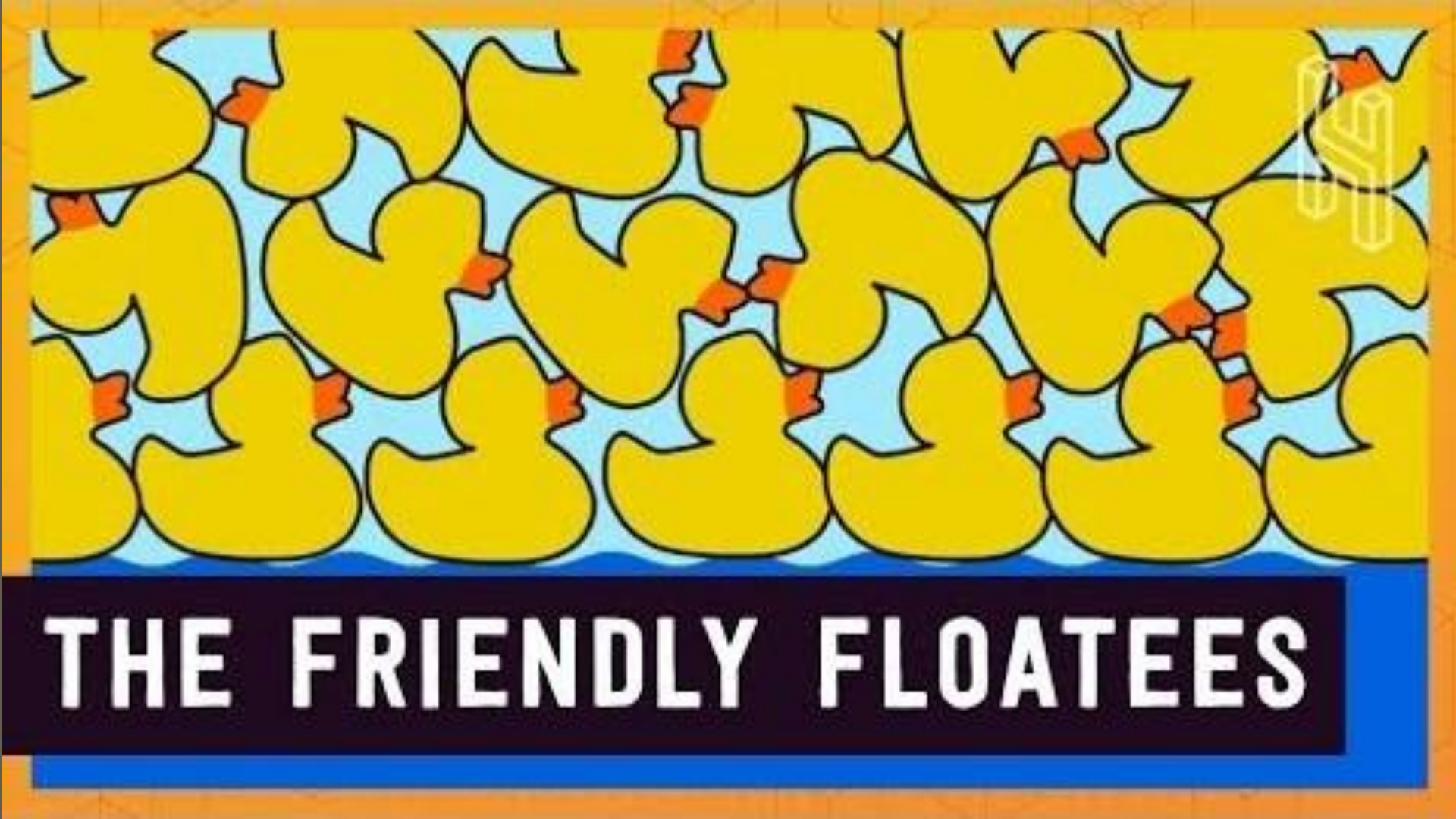
RUBBER DUCKS AROUND THE WORLD

How Ocean Currents Move

pp. 79-82

AS YOU WATCH THE VIDEO…

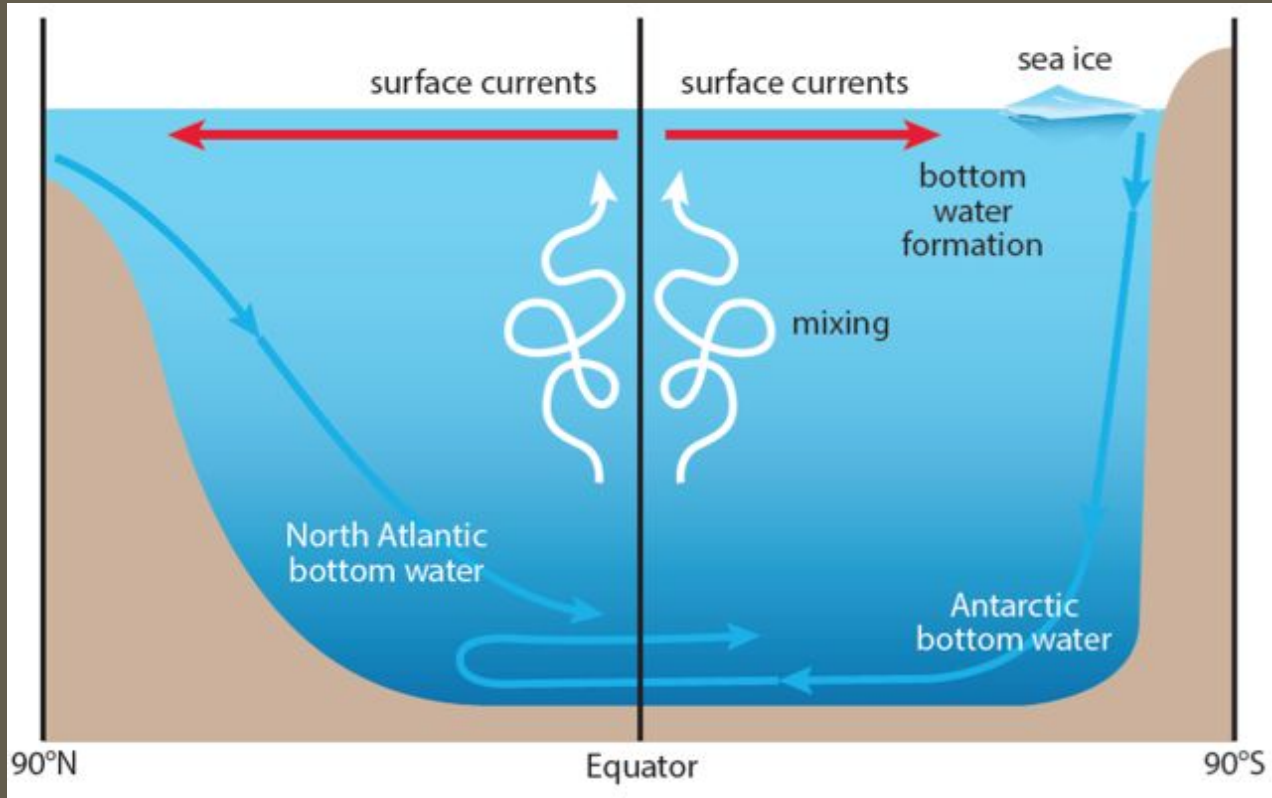
- Describe the pattern in which the rubber ducks moved around the world.
- What is causing the rubber ducks to move? (If you said oceans, what is causing the oceans to move?)


THE FRIENDLY FLOATEES

DESCRIBE THE PATTERN IN OCEAN CURRENTS

2 TYPES OF OCEAN CURRENTS

- Surface
- Deep



DEEP OCEAN CURRENTS

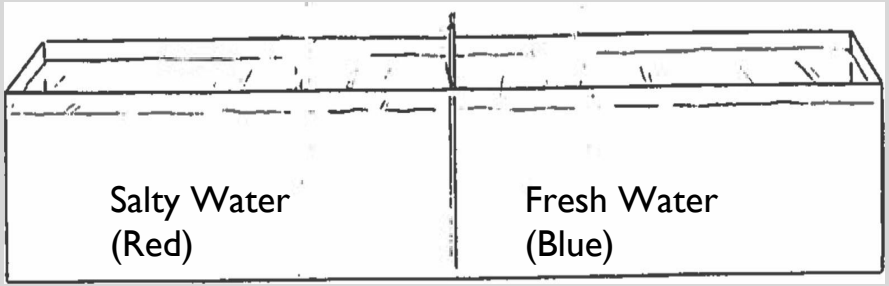
Currents Below 1300 feet

Let's see if the rubber ducks would move because of this current…

MODELING SALINITY AND DENSITY

HYPOTHESIS #1

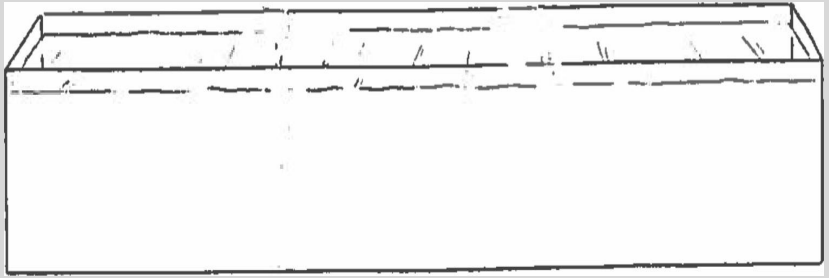
Predict what visible changes may be observed when the partition is removed between the fresh water and the salt water.



MODEL #1

Describe, explain, AND draw the visible changes you observed when the partition was removed.

Label the water types, densities, and halocline.

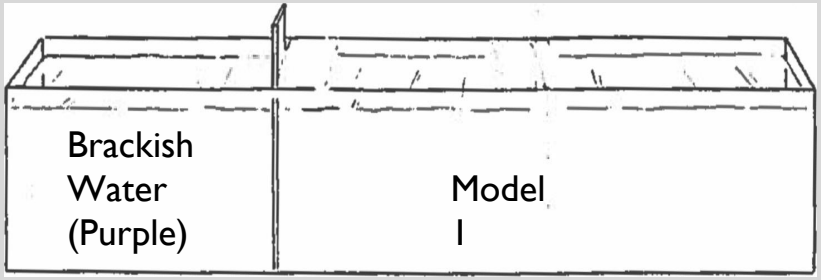


HALOCLINE: strong, vertical salinity gradient within a body of water.

HYPOTHESIS #2

I will mix the salty and fresh water to make brackish water.

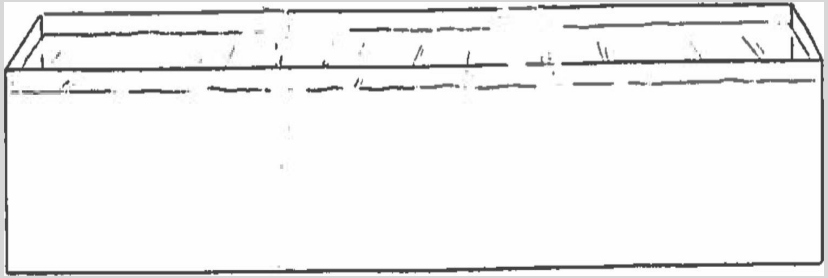
Predict what visible changes may be observed when the partition is removed.



MODEL #2

Describe, explain, and draw the visible changes you observed when the partition was removed.

Label the water types, densities, and halocline(s).



WHAT CAN YOU CONCLUDE ABOUT THE DENSITY OF SALT WATER IN COMPARISON TO BRACKISH OR FRESH?

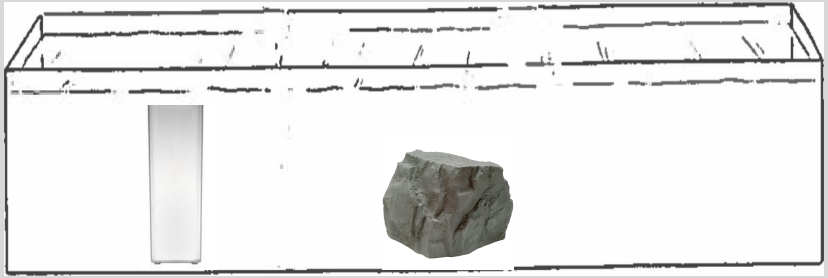
- The saltier the water, the denser the water

WHAT IS CAUSING THE DEEP OCEAN TO CIRCULATE WATER

- Make a hypothesis in your notebook and explain your idea.

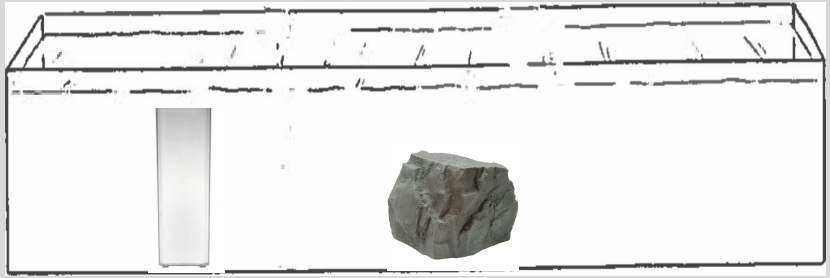
HYPOTHESIS #3

Predict what visible changes may be observed when the container of salty water is added.



MODEL #3

Draw and describe what you observed.

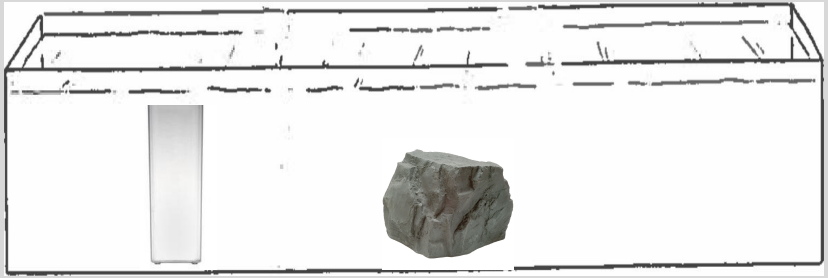


Answer the following questions/complete the following activities:

1. Label the respective densities of the ocean current, container of water (initially), and surrounding water
2. Use arrows to show the motion of the fluids.
3. What happened when the current encountered the rock? What would this be like in the real world?
4. Describe the direction in which the fluid is moving with respect to density.

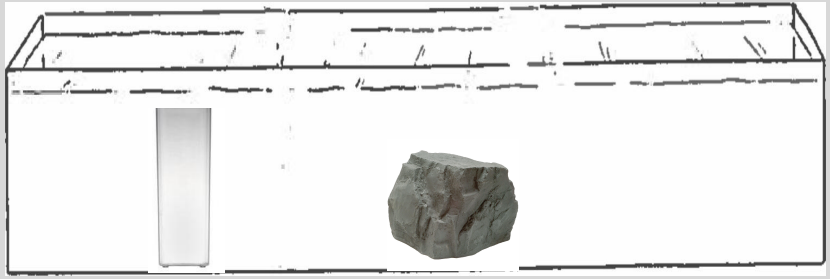
HYPOTHESIS #4

Predict what visible changes may be observed when the container of fresh water is added.



MODEL #4

Draw and describe what you observed.



Answer the following questions/complete the following activities:

1. Label the respective densities of the ocean current, container of water (initially), and surrounding water
2. Use arrows to show the motion of the fluids.
3. What happened when the current encountered the rock? What would this be like in the real world?
4. Describe the direction in which the fluid is moving with respect to density.

REFLECTION

- Think about what you know about wind movement and density. Explain how fluids move.
- Predict how salinity might affect the movement of water in the oceans.

KEY IDEAS ABOUT SALINITY

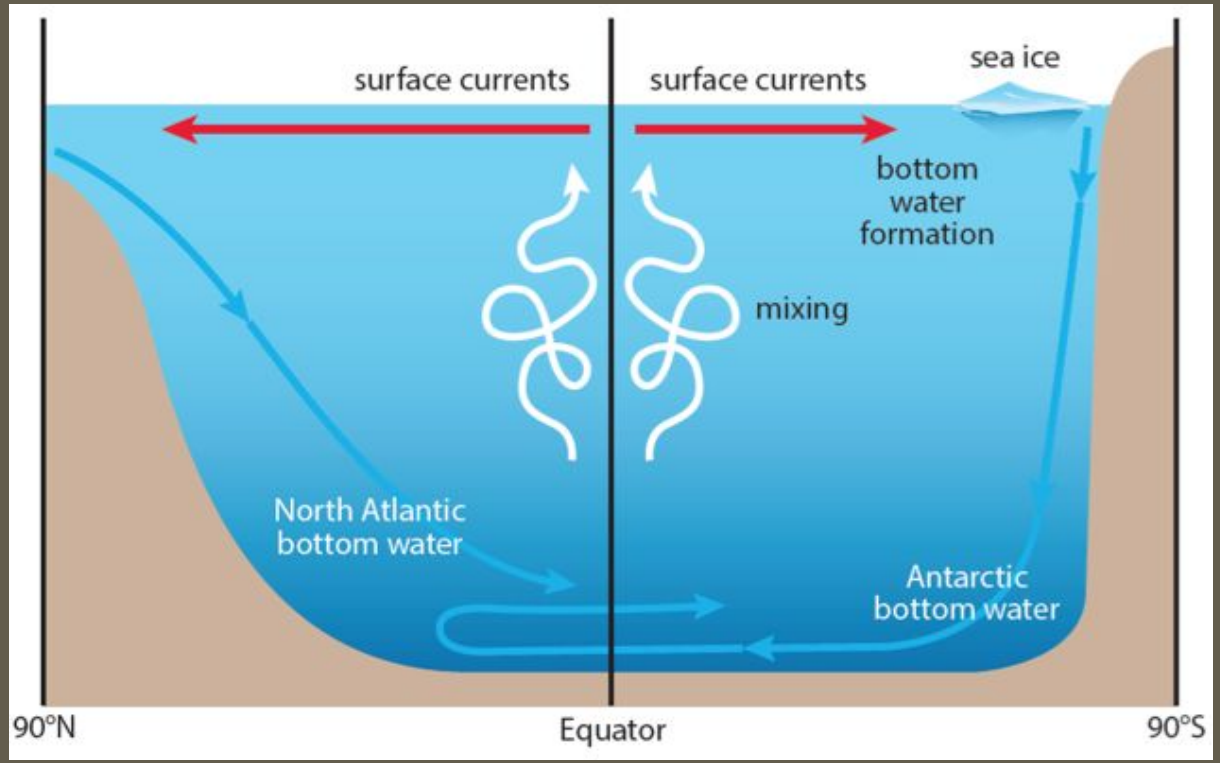
Deep ocean circulation is primarily driven by changes in seawater density, which is determined by salinity and temperature.

Salty water is denser, so it sinks.

Water (like all fluids) from high density to an area of lower density

Warm, surface currents move in to replace the sinking salty, cold water

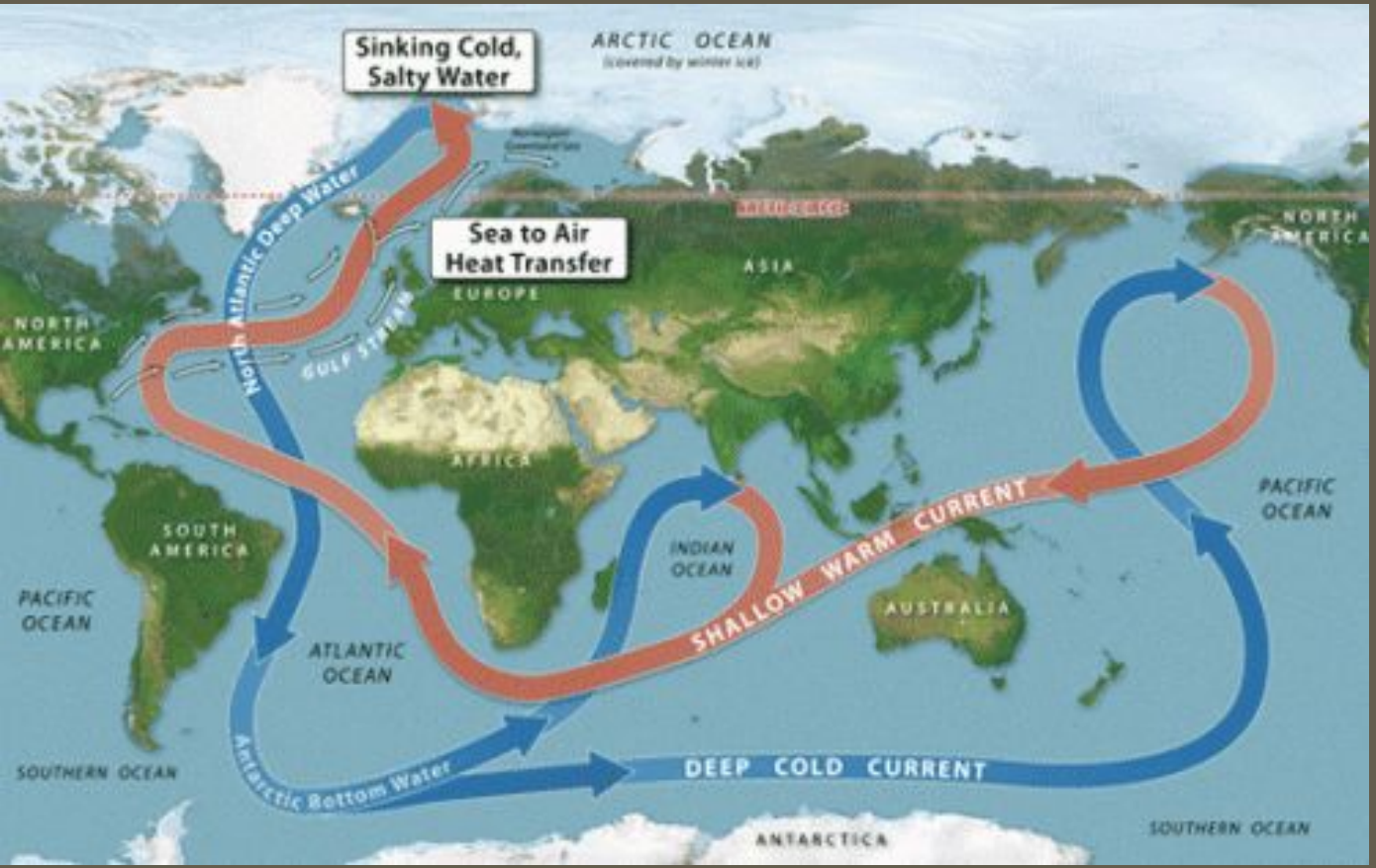
Mixing occurs when some water is sinking and other is rising.



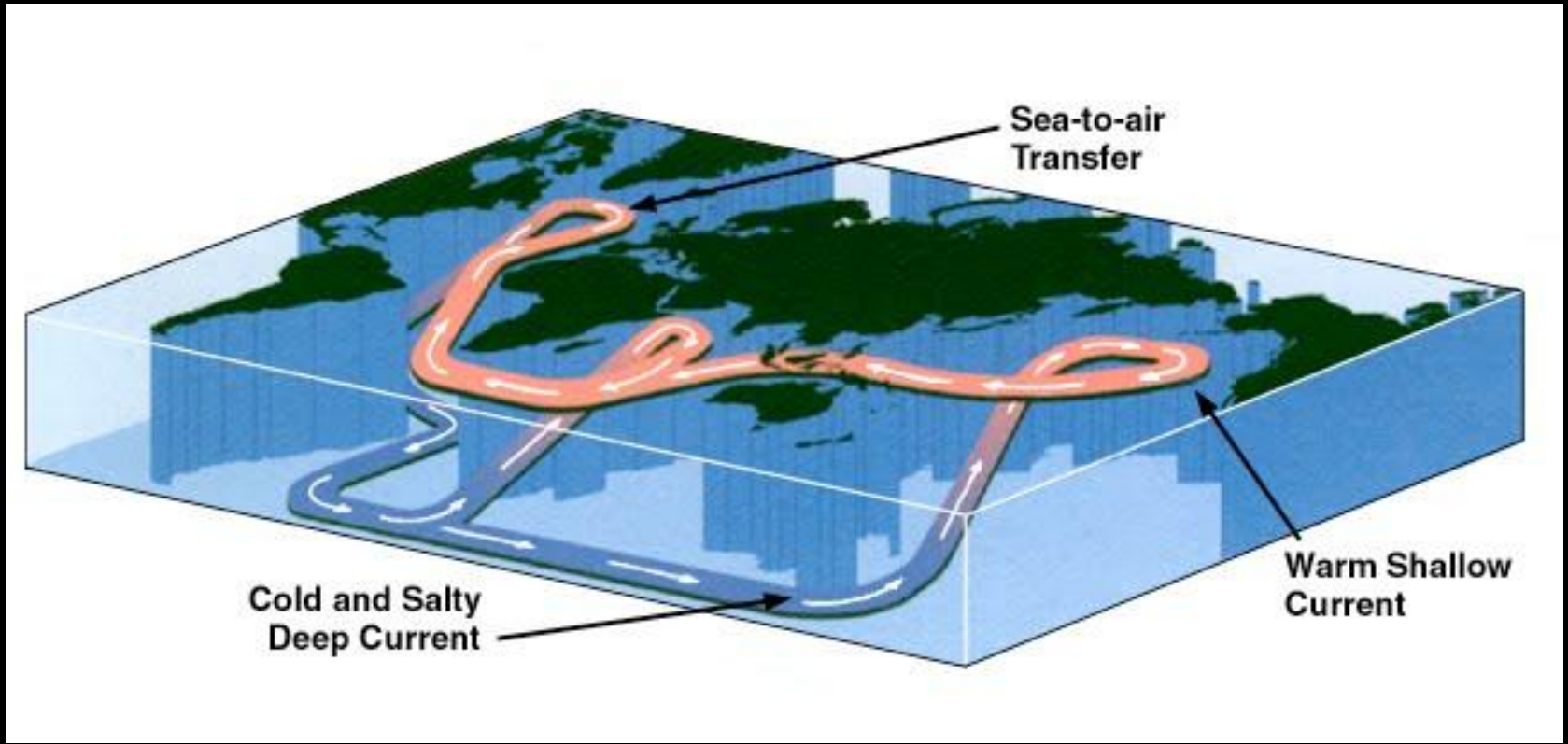
Water gets very cold, forming sea ice. The seawater gets saltier, and it sinks

The cold water moves along the ocean bottom toward the equator.

It warms and begins to rise, turning to a surface current.

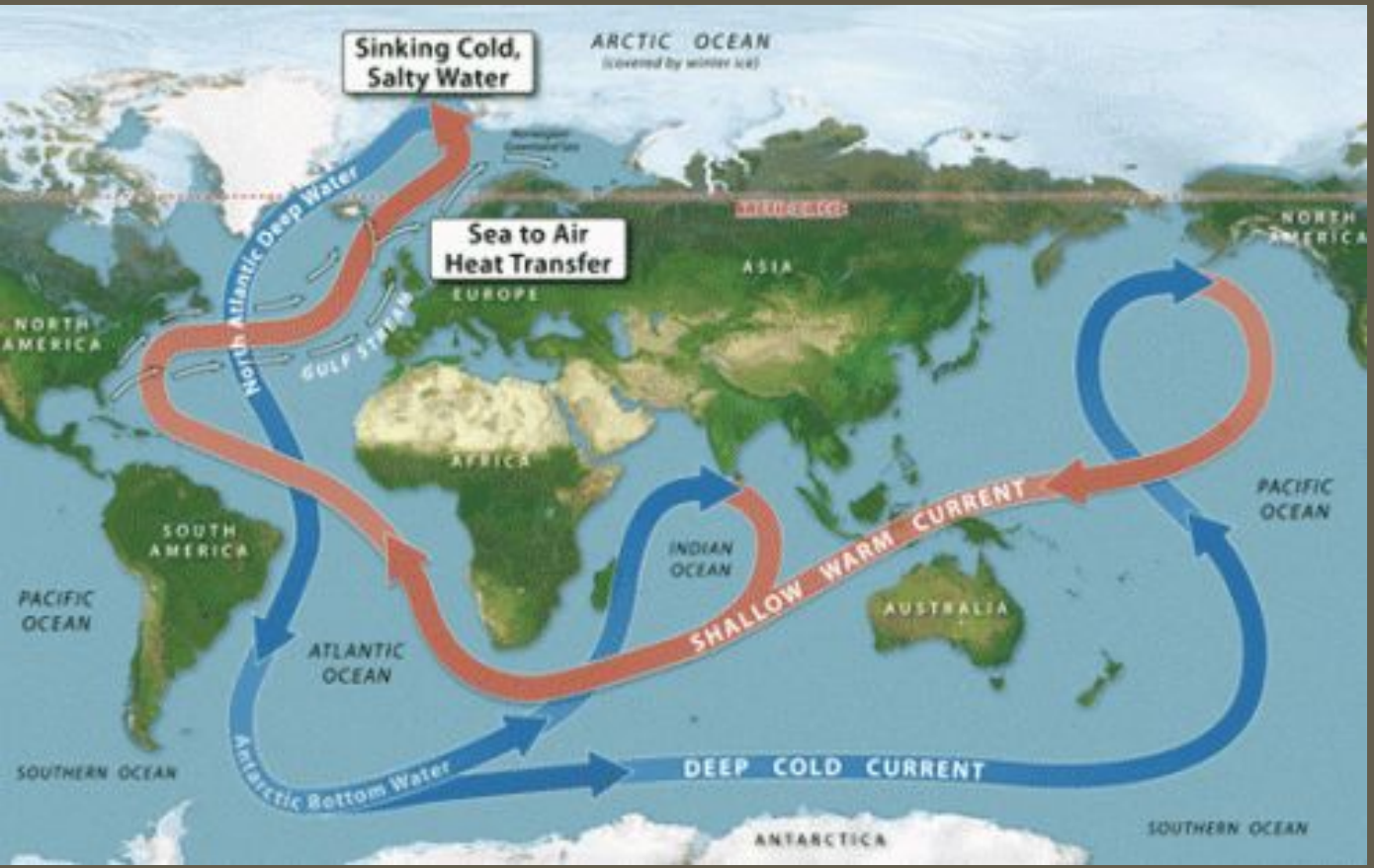


In the Earth's polar regions ocean water gets very cold, forming sea ice. As a consequence the surrounding seawater gets saltier, because when sea ice forms, the salt is left behind. As the seawater gets saltier, its density increases, and it starts to sink. Surface water is pulled in to replace the sinking water, which in turn eventually becomes cold and salty enough to sink. This initiates the deep-ocean currents driving the global conveyer belt.


Sea-to-air
Transfer
Warm Shallow
Current
Cold and Salty
Deep Current

HOW DOES CONVECTION RESULT IN DEEP OCEAN CURRENTS?

- Ocean currents are convection currents and are caused by **differences in water density as a result of temperature/salinity in differences**.
- Convection occurs because the oceanic waters heat up becoming less dense. This water moves above the cooler water. As it cools and becomes saltier, it begins to sink, and the process begins again. Convection results in the continual circulation of ocean water on a global scale.



How does the Coriolis Effect affect deep ocean currents?

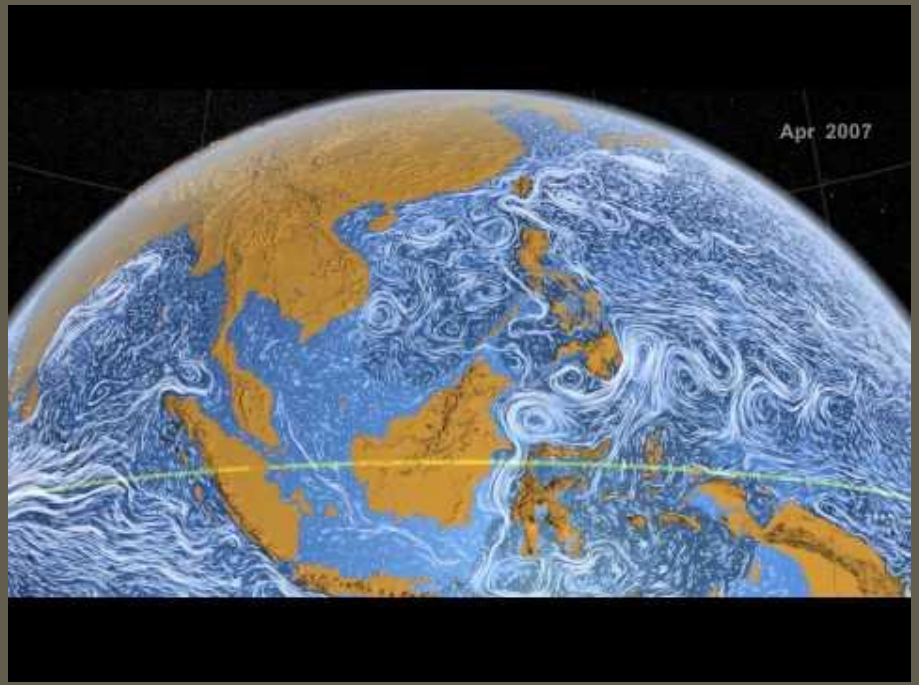
In the Northern Hemisphere, the current curves to the right.

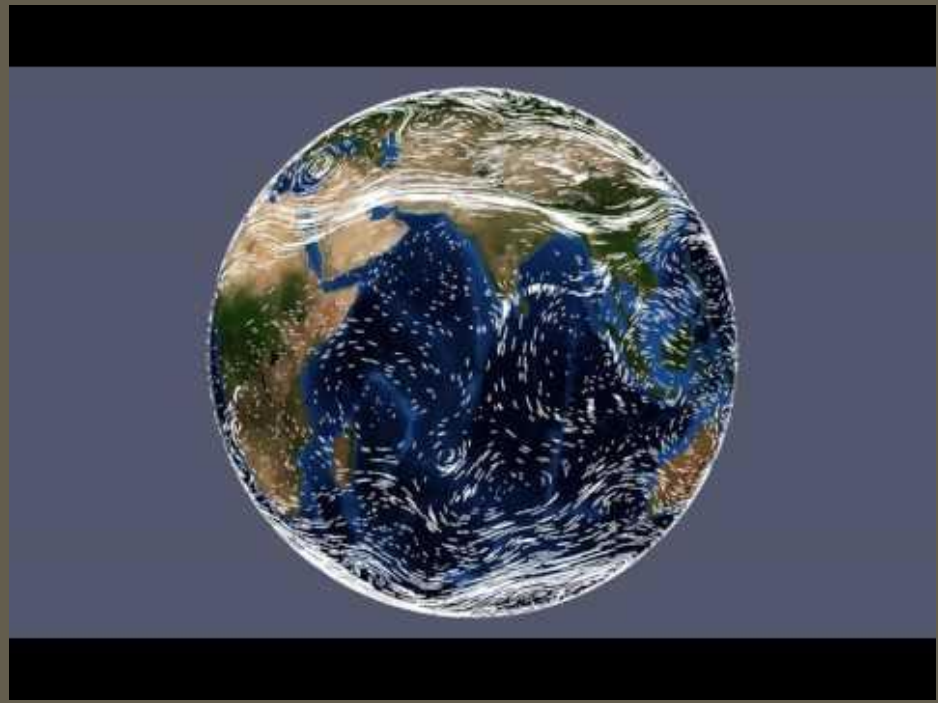
In the Southern Hemisphere, the current curves to the left.

SURFACE CURRENTS

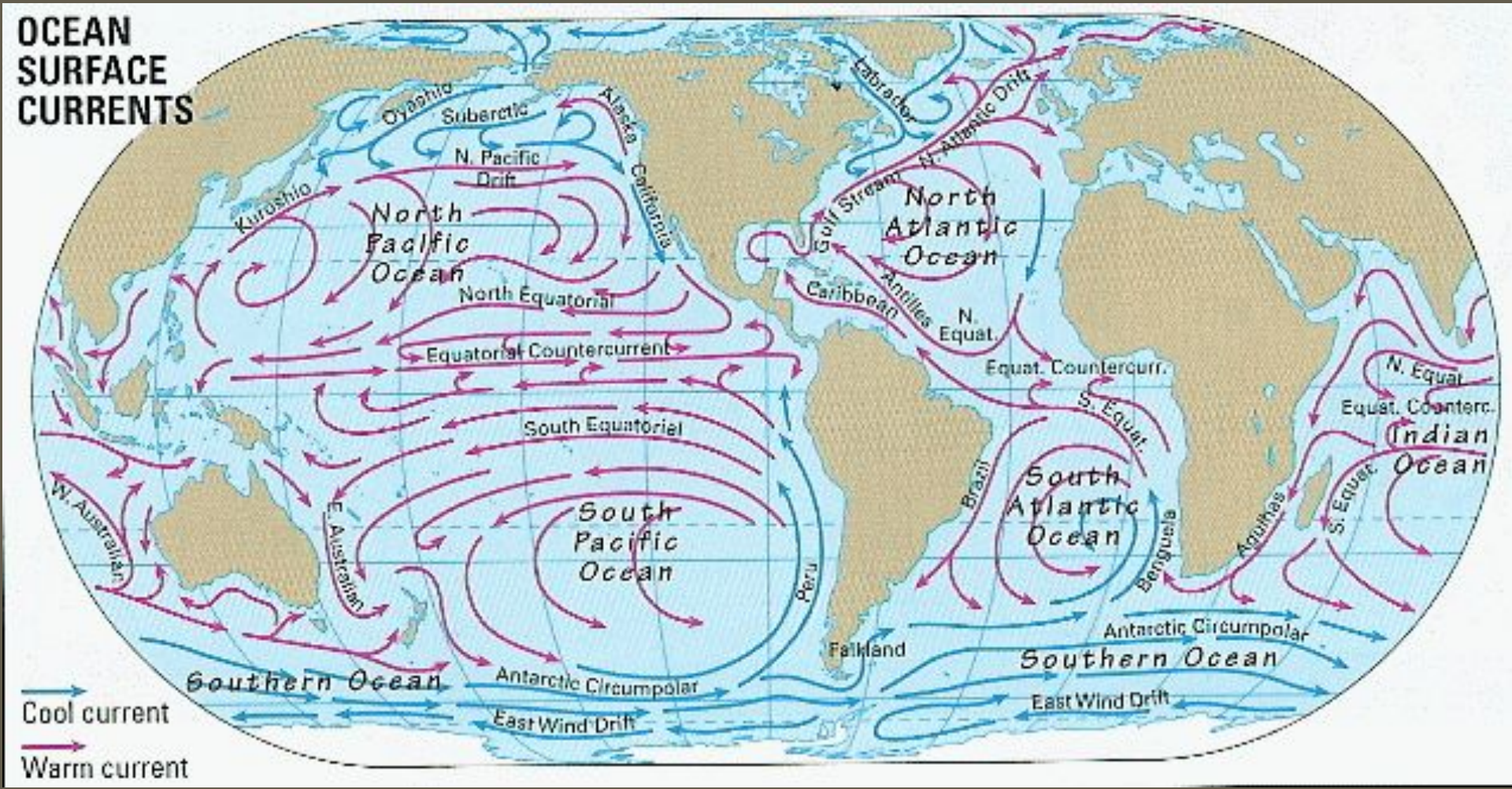
Upper 10% of the ocean's waters (1300 feet and up)

COMPARE SURFACE CURRENTS TO WINDS





WHAT DO YOU THINK DRIVES THE SURFACE OCEAN CURRENTS?


OCEAN SURFACE CURRENTS
Oyashio
Subarctic
Alaska
California
N. Pacific Drift
Kuroshio
North Pacific Ocean
North Equatorial
Equatorial Countercurrent
South Equatorial
South Pacific Ocean
W. Australian
E. Australian
Peru
Southern Ocean
Antarctic Circumpolar
East Wind Drift
Labrador
N. Atlantic Drift
Gulf Stream
North Atlantic Ocean
Caribbean
Antilles
N. Equat.
Equat. Countercurr.
S. Equat.
Brazil
South Atlantic Ocean
Benguela
Falkland
Antarctic Circumpolar
Southern Ocean
East Wind Drift
Aguihas
S. Equat.
N. Equat.
Equat. Counterc.
Indian Ocean
Cool current
Warm current

LET'S TEST IF WINDS CAN CREATE OCEAN CURRENTS

- **Directions**: Use a straw to blow a wind current onto the surface of water. Answer the questions that follow.
- **Questions**:
  - What did you observe happening on the surface of the water?
  - What did you observe happening in the deep ocean?
  - What happened when the water current encountered the edge of the container? What might this be similar to in the real world?
  - What can you conclude about winds and surface ocean currents?

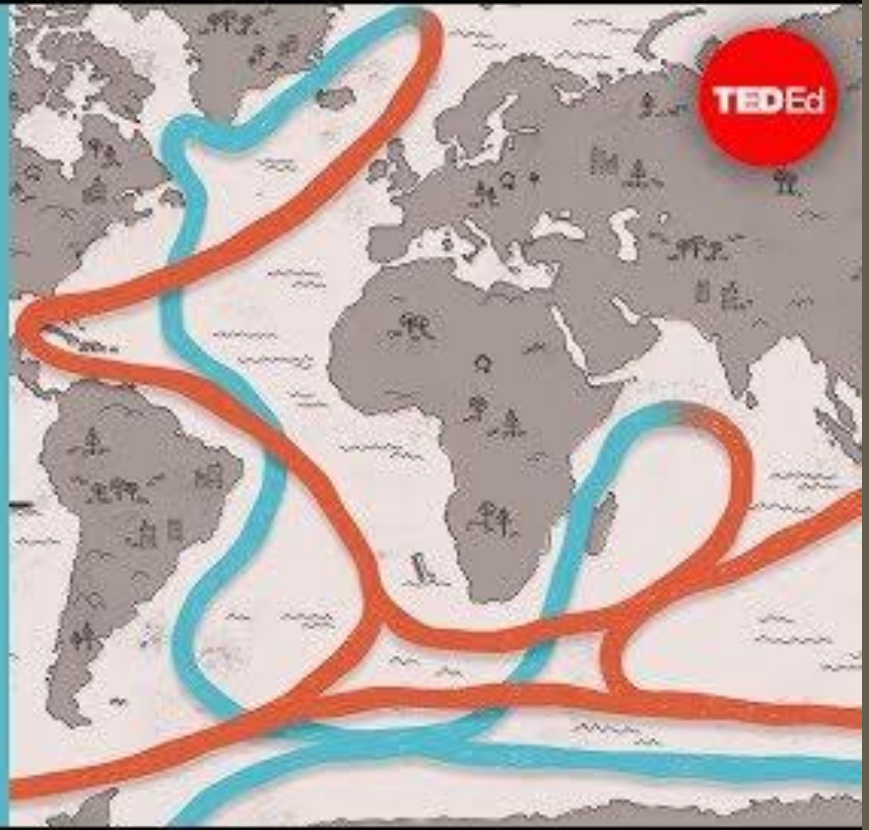
SURFACE OCEAN CURRENTS

- How do winds help create surface ocean currents?
- How does the Coriolis Effect impact the motion of the surface ocean currents?
- How do landforms impact surface ocean currents?

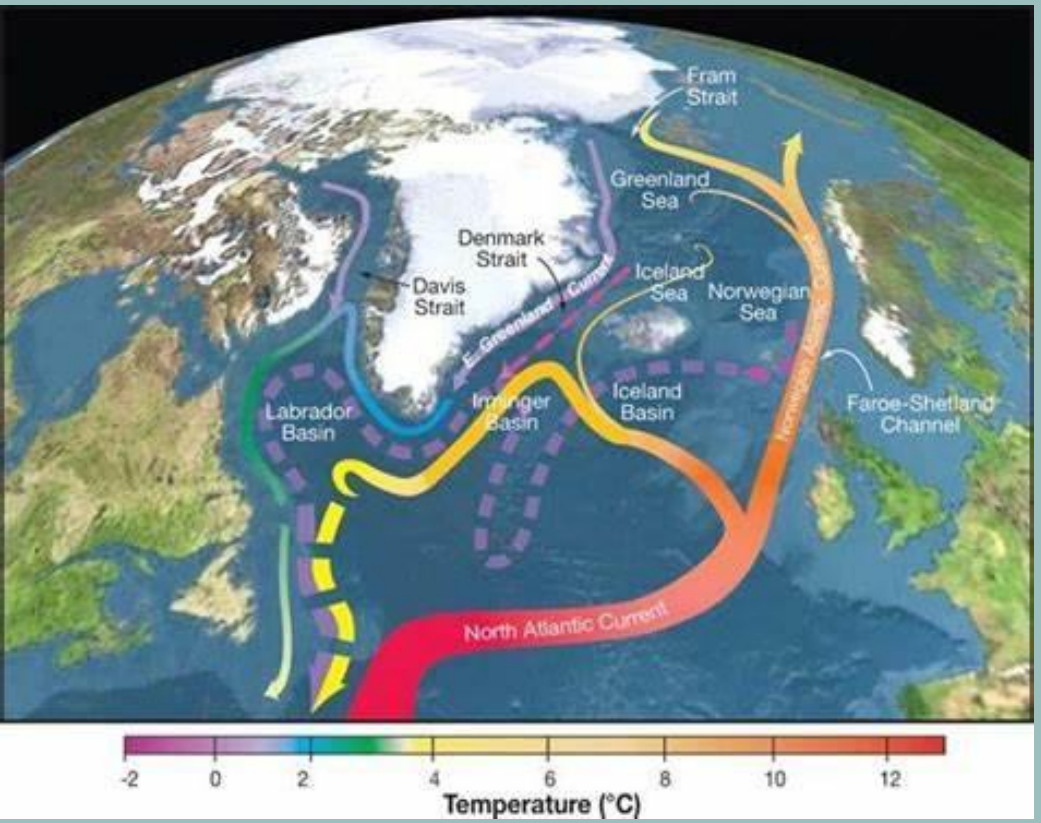
KEY IDEAS

- Ocean surface currents are produced by global winds, the Coriolis effect, and the shape of each ocean basin.
  - The global winds drag the water, creating a current.
  - Coriolis: In the Northern Hemisphere, the current curves to the right. In the Southern Hemisphere, the current curves to the left.
  - The currents deflect when they encounter a landform
- Surface ocean circulation brings warm equatorial waters towards the poles and cooler polar water towards the equator.

HOW DO OCEAN CURRENTS WORK?



WHAT KIND OF CURRENTS MOVED THE DUCKS? EXPLAIN.



GREENLAND

- How is Greenland affected by ocean currents – surface and deep?

Why does Greenland have a temperature inversion?

Greenland Temperature Inversion

Draw the visible changes you observed when the partition is removed between the fresh water and the salt water.

Describe why this happened.