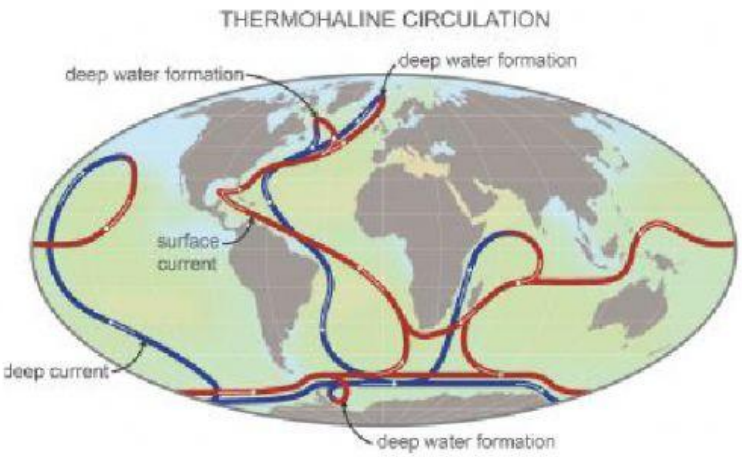
Feb 9 Ocean Conveyer Belt Reading

Direction: Read the text, then use it to answer the multiple-choice questions below.



1 Water in the ocean is always moving. Waves ripple the surface, and currents move in the shallows and in the depths. Currents near the surface are influenced by the forces of the winds and tides. Deep water currents run on a different engine.

2 The currents that run through all Earth's oceans are important for several reasons. The currents help regulate global temperatures. They transfer energy from one part of the ocean to the others. This helps others. This helps keep the poles from getting too cold and the equator and tropics from getting too hot. While deep water currents do play a part in energy transfer, this is primarily done by surface currents. These are currents in the top 100 meters of the ocean. Their primary driving force is from the wind. They flow quickly and form giant circles. For example, the Antarctic Circumpolar Current forms a giant ring around the continent of Antarctica.

3 Currents also cycle nutrients through the ocean. Water near the surface is rich in oxygen. Deep waters are rich in nutrients from the decaying marine creatures on the ocean bed. There must be a way to mix and exchange the two. In fact, there is—a slow, global, deep water current. Wallace Broecker, a noted oceanographer, called this the ocean conveyor belt.

4 Deep ocean currents are caused by thermohaline circulation. What does this mean? Thermo means "temperature," and haline means "salt." But how do temperature and salt cause currents? The linking factor is density.

5 Density is a physical property of all materials. It is the measure of how much mass the material has for a standard particular volume, generally 1 cm3 . Density is the property that determines if something sinks or floats on a liquid. The denser substance, either liquid or solid, will sink to the bottom. The less dense substance will be found at the top. Water is more dense as a liquid than as a solid. This is why ice floats. Liquid water can vary in density. As long as it remains a liquid, water becomes more dense as it gets colder. Also, as more salt is dissolved in a volume of water, the water gets more dense. Salinity is the measure of salt in a water sample.

6 There are three places on Earth where conditions are right to pump the oceanic conveyor belt. Two are in the North Atlantic Ocean, and the other is the Weddell Sea off the coast of Antarctica. All three locations lie near either the Arctic or Antarctic Circles. On the map at the top of this passage, these locations are labeled "deep water formation." Conditions are right in these places to make water so dense that it sinks to the bottom of the ocean. But how does this happen? We will focus on the Weddell

Sea for the answer, but remember that similar processes are also working in the North Atlantic to form deep water currents.

7 During the winter months, air temperatures are very cold in Antarctica. Depending on proximity to the South Pole, areas get little or no sunlight for much of the winter. At the Weddell Sea, local geography funnels winds from the interior of the Antarctic continent over the surface of the water. The Weddell Sea is fringed year-round by ice sheets, but in the winter, sheets of ice form rapidly and provide seasonal ice coverage. This rapid ice formation is one piece of the puzzle. The strong, icy winds are another.

8 When ice forms from salt water, an interesting thing happens. The ice that forms is pure water, and the salt is left behind. (This works as long as some of the water remains liquid.) In the Weddell Sea, rapid formation of lots of pack ice leads to the formation of water with very high salinity. Another interesting property of water is that as the salinity of a water sample goes up, its freezing point goes down. This means that very salty water will remain liquid below the freezing point of fresh water. The icy winds that blow across the water cool it, often to -1°C (30°F). The winds turn this high-salinity water into the coldest, densest water in Earth's oceans. It sinks and becomes known as Antarctic Bottom Water. The other two locations form slightly less dense North Atlantic Deep Water.

9 The sinking of the newly formed deep water pushes the water from previous years, driving the slowly moving ocean conveyor belt. The North Atlantic Deep Water slowly creeps south to join the Antarctic Bottom Water, which has formed a current that travels around the continent of Antarctica. Portions of the giant current break off to travel along the bottom of the Indian and the Pacific Oceans. The deep currents are shown in blue in the image above. Finally, the deep water returns to the surface in upwellings that bring nutrients up to replenish surface water. Scientists think that it may take between 600 and 1,000 years after sinking for the deep water to return to the surface.

1. What is the driving force of the deep water ocean conveyor belt?

A Winds push the deep water into the Pacific and Indian Oceans.

B Gravity from the Moon pulls the deep water toward the equator.

C The spinning of the Earth makes the deep water current run in circular paths.

D Very cold temperatures create very dense water that pushes the deep current along.

2. What is the meaning of the word ***circumpolar*** in paragraph 2?

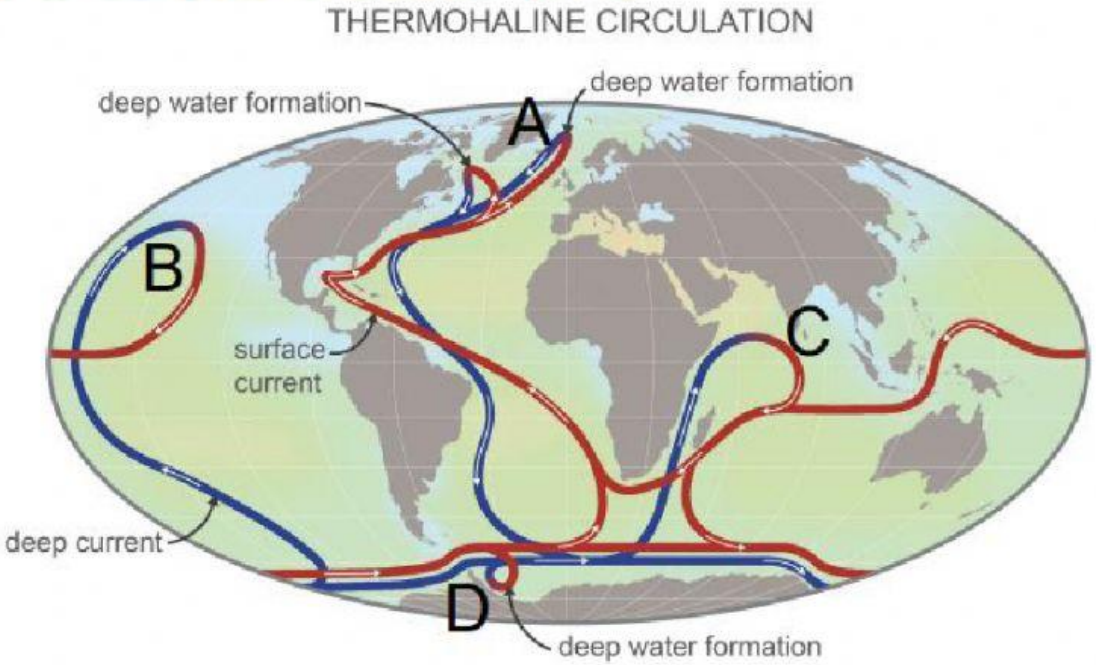
A "Circular path around the pole"

B "Wind-blown current"

C "Cold and salty"

D "Sinking"

Examine the map below. Use it to answer questions 3 and 4.



3. Based on the information in the passage, which location on the map marks the Weddell Sea?

A A

B B

C C

D D

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4. Which location on the map above is a source of North Atlantic Deep Water?

A A

B B

C C

D D

5. Which of these characteristics will produce the densest water?

A High salinity, high temperature

B High salinity, low temperature

C Low salinity, high temperature

D Low salinity, low temperature