

The Day After Tomorrow: Whaaaaat? How does that work?

Part 1 – Understanding the Deep Ocean Current

1. **What is thermohaline circulation?** In your own words, explain what the term *thermohaline* means and what causes deep ocean water to move.
2. Deep ocean currents are strongly affected by two properties of seawater. Identify them and explain how each affects the **density** of seawater.
3. Near Greenland and the North Atlantic, surface water becomes cold and salty enough to sink. **Why does cold, salty water sink while warmer, less salty water tends to remain near the surface?**

Part 2 – Draw the Current

5. **Draw a simplified diagram of normal Atlantic Ocean circulation.** Your diagram should include:
 - Equator
 - North Atlantic/Greenland
 - Warm surface water moving north
 - Cooling of the surface water
 - Cold, dense water sinking
 - Deep water moving south
 - Arrows showing the direction of water movement

Below your drawing: Explain what causes the water to sink in the North Atlantic.

6. **Now draw what happens to this circulation in *The Day After Tomorrow*.** Your diagram should show:
 - Melting ice
 - Freshwater entering the ocean
 - A change in salinity
 - A change in water density
 - What happens to sinking water
 - How the deep ocean circulation is affected

Below your drawing: Explain why/how adding freshwater could weaken deep-water formation.

More melting ice → _____ **salinity** → _____ **water density** → _____ **sinking** → _____ **ocean circulation.** What type of feedback loop is this?

7. If the circulation weakened, would that mean that **all ocean currents would stop**? Explain why or why not.

Part 3 – Movie vs. Reality

8. **What part of the movie's basic scientific idea is realistic?** Explain how climate change and melting ice could potentially affect North Atlantic ocean circulation.
9. **What part of the movie seems most scientifically unrealistic?** Support your answer using what you know about oceans, weather, climate, or energy.

Part 4 – Put the Science Together

10. **Cause-and-Effect Challenge:** Complete the following diagram based on the scientific idea behind the movie:

Global warming

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Increased melting of ice

↓

More _____ enters the North Atlantic

↓

Ocean salinity _____

↓

Surface water becomes _____ dense

↓

Less water _____

↓

Deep ocean circulation _____

11. If the current stopped like in the movie how might that impact the global air circulation. (include a picture in your explanation). Include a comparison of latitude of Europe and the US, and why Europe is so warm comparatively.
12. What would happen to Europe's climate if the wind pattern changed, specifically explain how the gulf stream forms, moves, and how it impacts the climate in Europe.
13. The researchers in Scotland were drinking their scotch and one said he would like to have seen his son grow up and the other said at least he will. His family was in Spain. Using what you now know about thermohaline circulation and ocean currents how would you evaluate this statement? Explain.