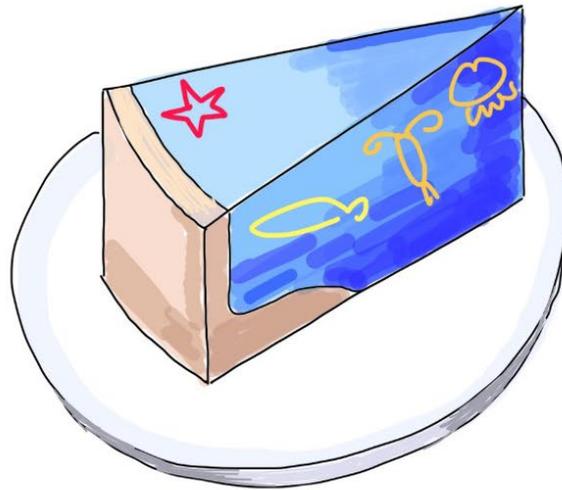


Learning seawater properties with an ice melt experiment

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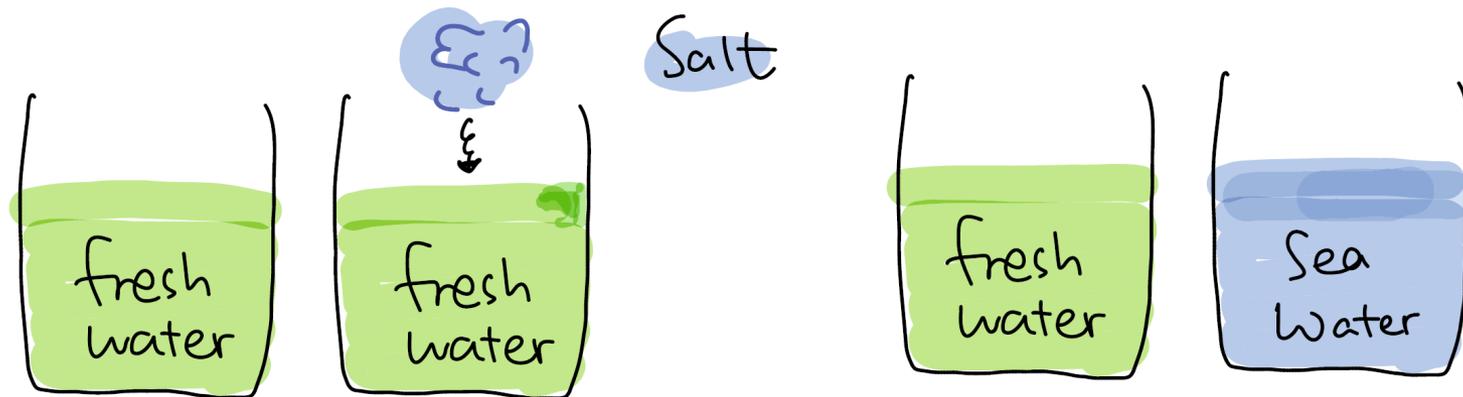


Outline

- A question with the ice melt experiment
- Seawater properties and fluid density
- Review of ice melt experiment with the T-S diagram and dye
- Conclusion

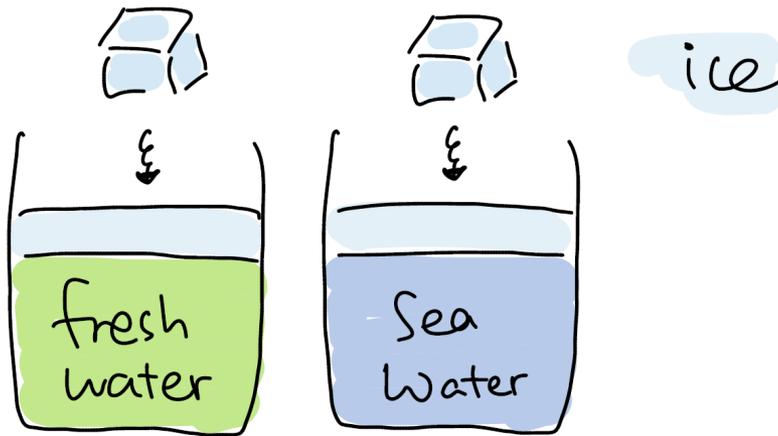
Ice melt experiment

- Making freshwater and seawater salt at room temperature by adding salt to freshwater
- Put (freshwater) ice on the top of both containers
- Which ice melts quicker?



Ice melt experiment

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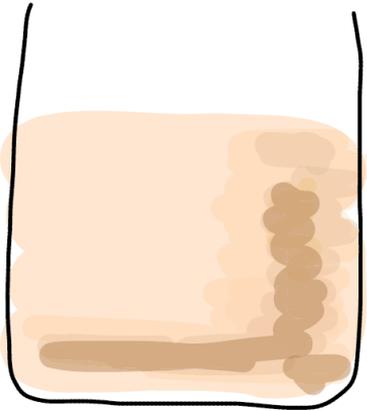
What are the properties of the sea water?

- Salty
- Cold/warm
- Lighter or heavier than freshwater?
- Dark or bright?

Table 6.1 Major Constituents of Sea Water

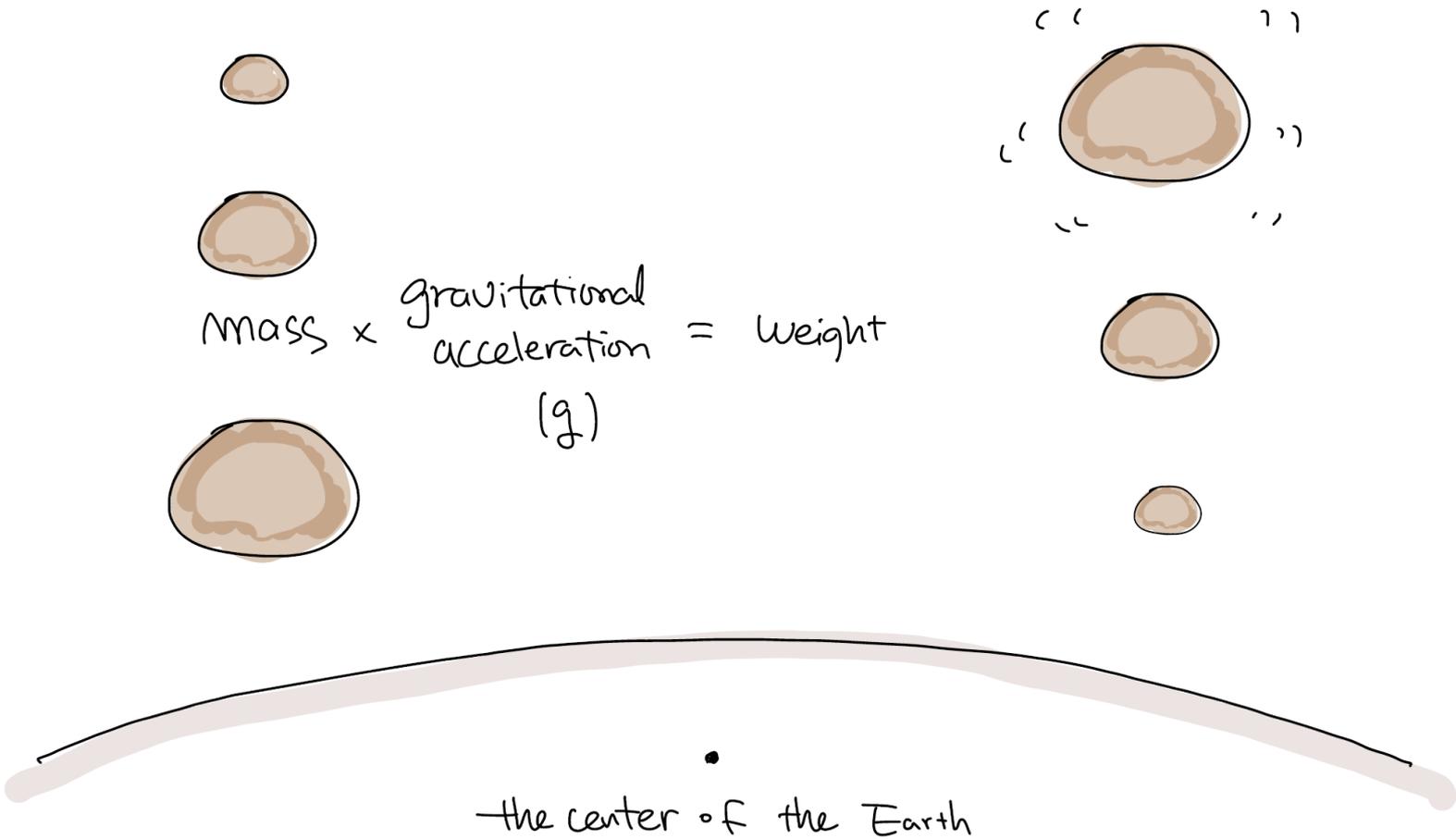
	Ion		Atoms
55.3%	Chlorine	55.3%	Chlorine
30.8%	Sodium	30.8%	Sodium
7.7%	Sulfate	3.7%	Magnesium
3.7%	Magnesium	2.6%	Sulfur
1.2%	Calcium	1.2%	Calcium
1.1%	Potassium	1.1%	Potassium

Density of fluid

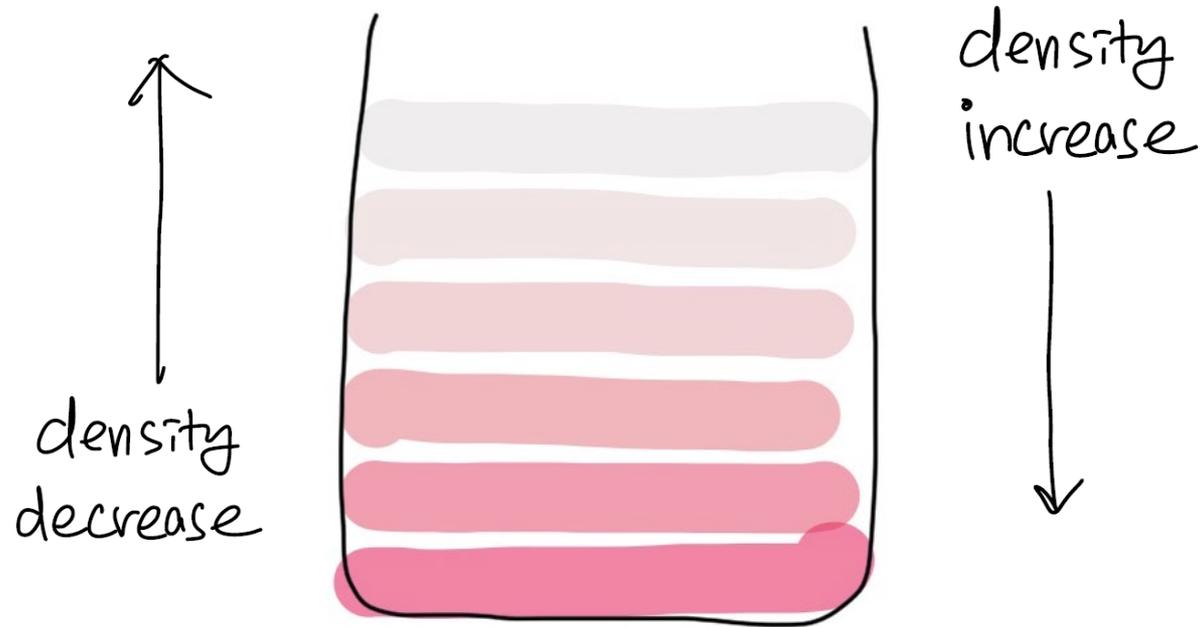


$$\text{density} = \frac{\text{mass}}{\text{Volume}}$$

Which one is stable and unstable?

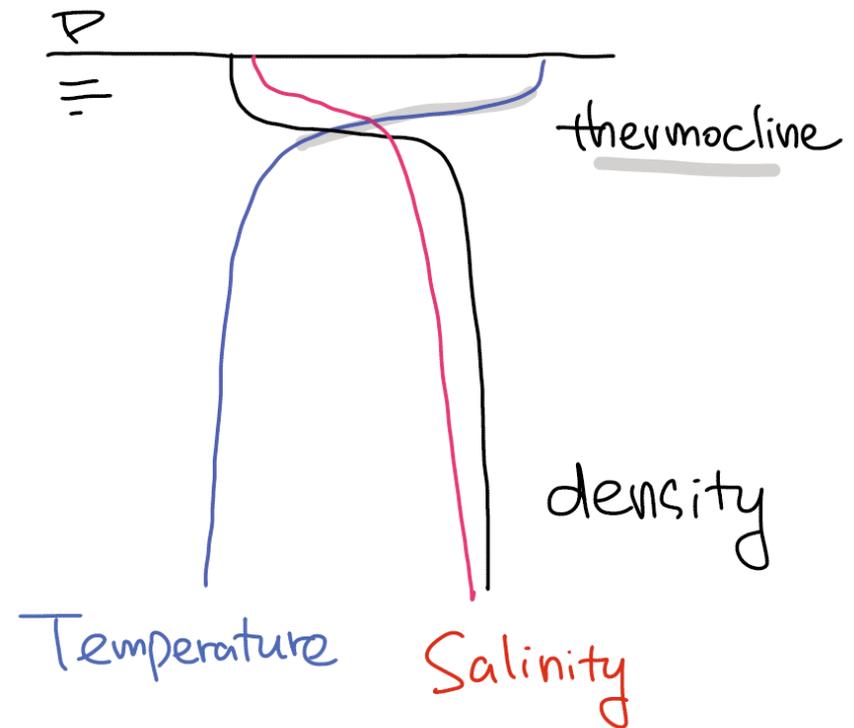


Stable water column with density



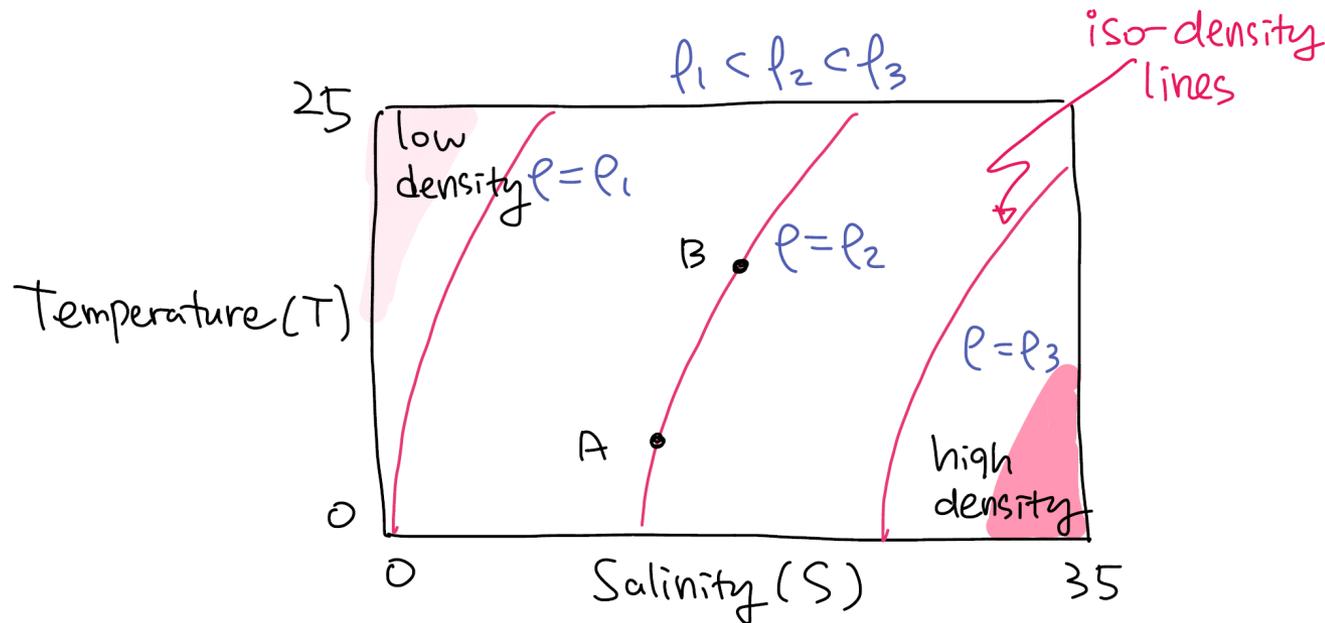
Density distribution in the ocean

- Temperature decreases and salinity increases with depth in the ocean
- Density increases with depth as density is determined by temperature and salinity



T-S diagram

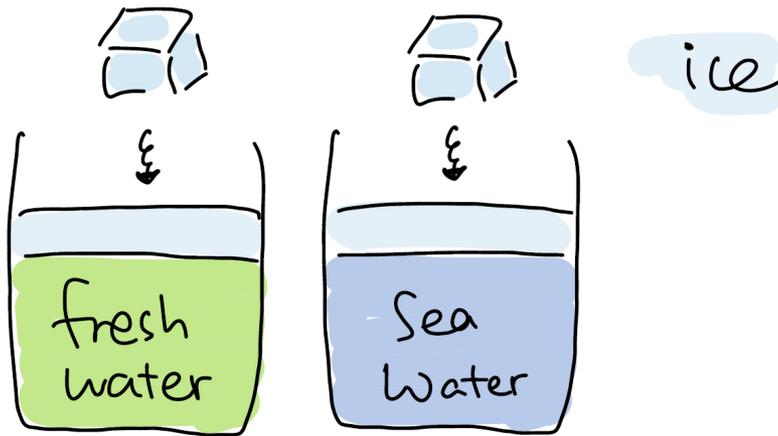
- A unique combination of temperature and salinity for density
- Density increases from upper-left to lower-right with iso-density lines



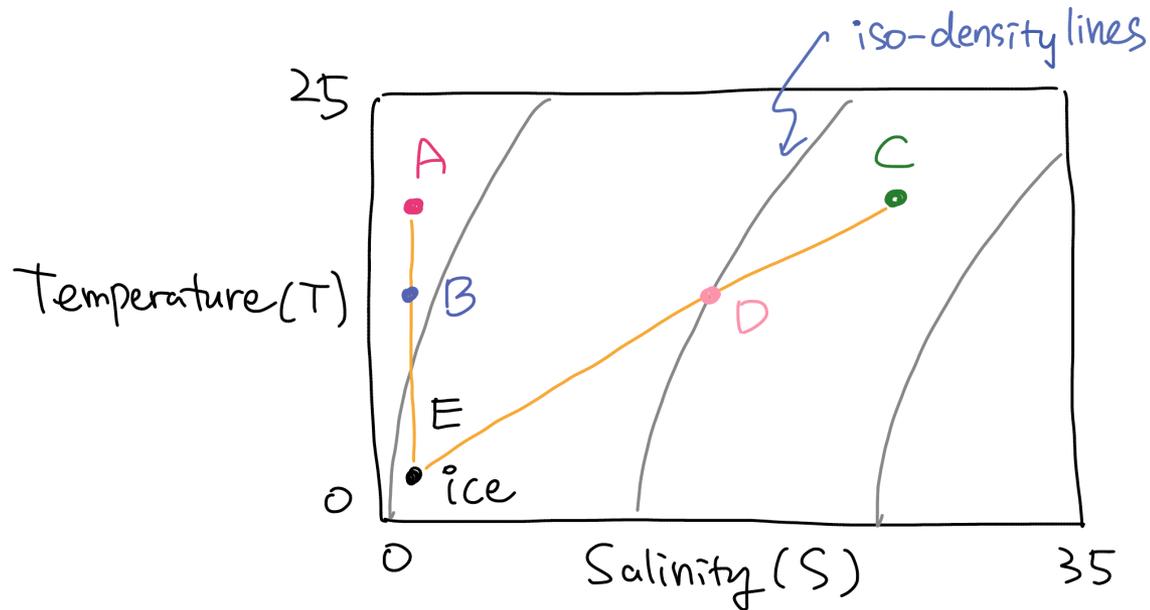
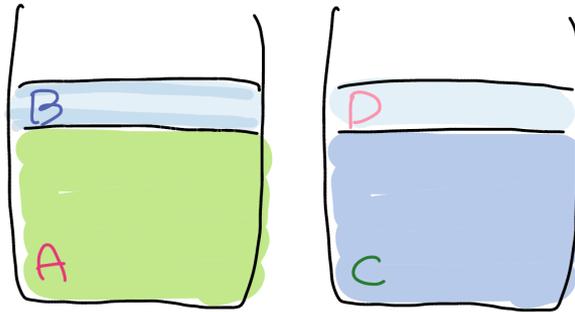
$$\rho_2 = \rho_A(T_A, S_A) = \rho_B(T_B, S_B)$$

Ice melt experiment (reminder)

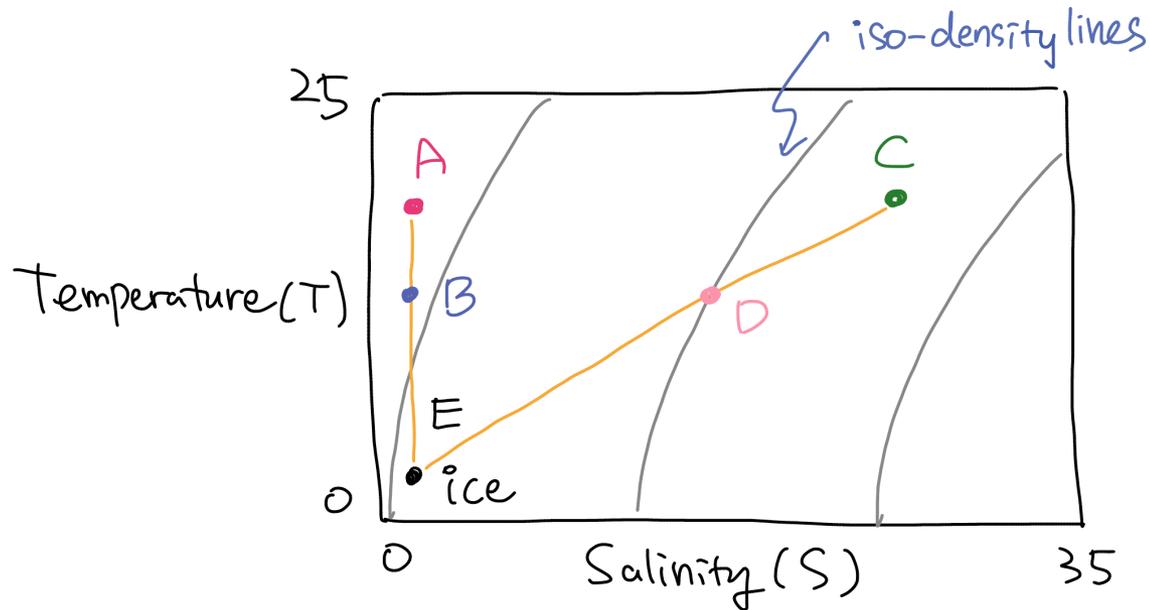
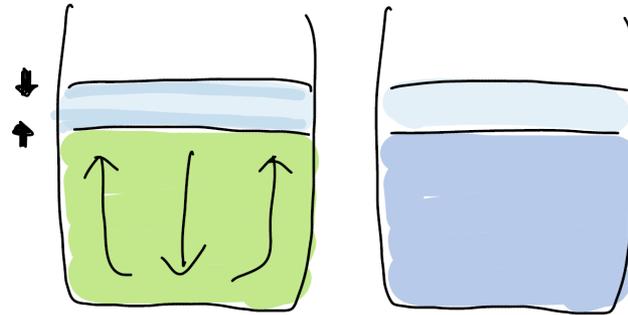
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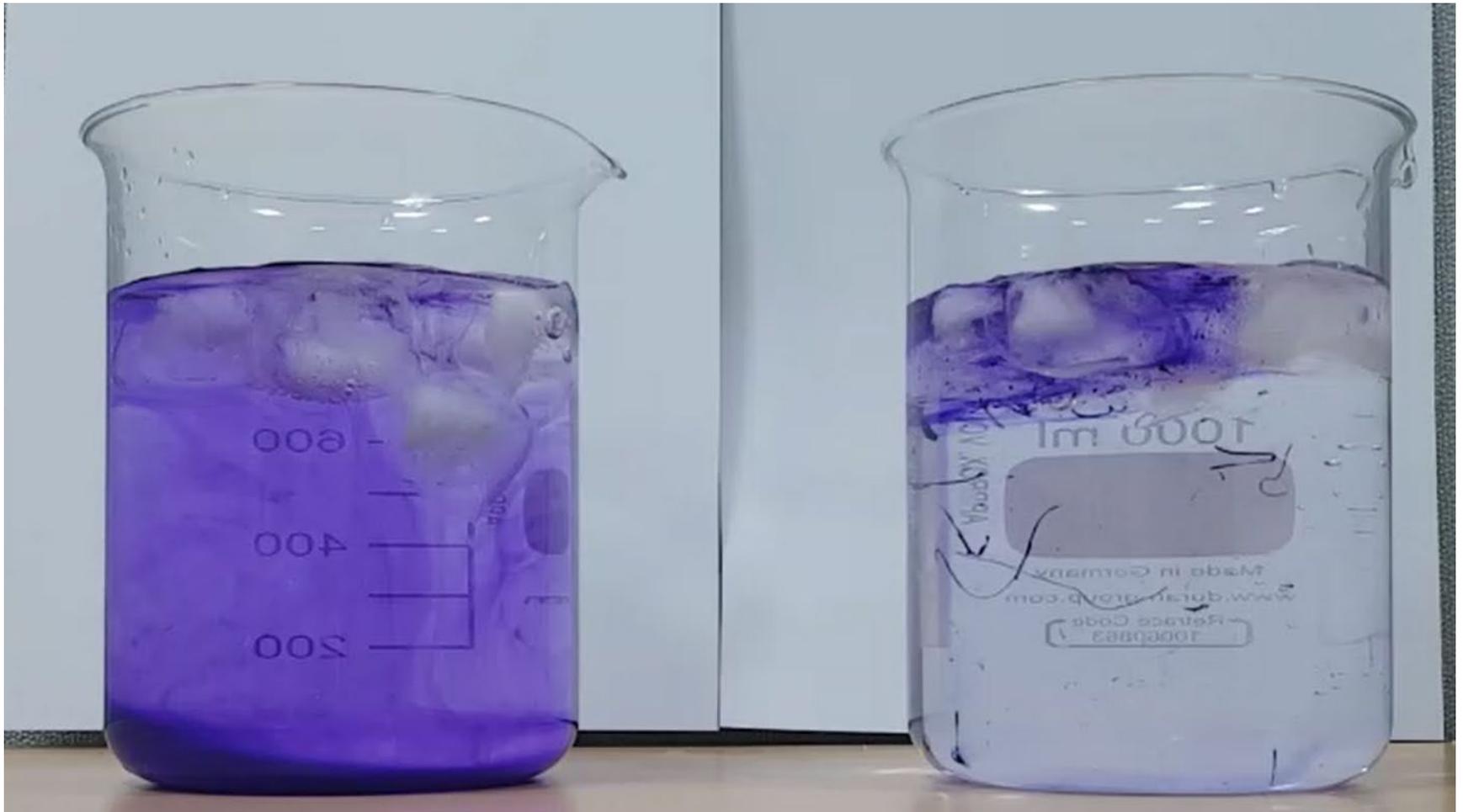
Ice melt experiment with T-S diagram



Ice melt experiment with T-S diagram



Ice melt experiment with dye



Conclusion

- Seawater is characterized by salinity and temperature, of which a unique combination provides the density of seawater.
- When we place ice cubes on the top of freshwater and seawater, the ice melts quickly in the freshwater container.
- Because the melted water in the freshwater is heavier and sinks, and it generates vertical circulation and leads to active heat exchange in the container.
- On the other hand, the melted water in the seawater is lighter and stays, which maintains a stable density structure vertically.