Dynamic Planet

ScioVirtual Lesson 2, 10/24

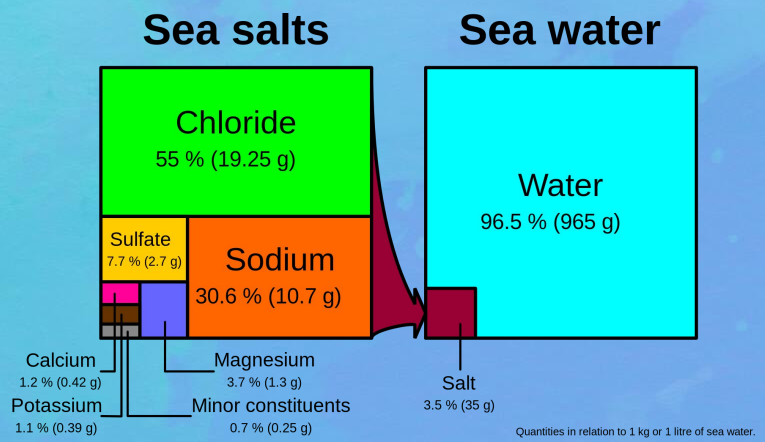


Google Classroom

A quick introduction to the Google Classroom (& other things covered in Thursday's email)!

Today's Lesson:
Properties & Composition of Seawater

What do you think
seawater is made up of?



Composition of seawater

Seawater is a complex mixture of 96.5% water and 3.5% salt (35 ppt or 35 psu).

The most abundant ions in seawater (make up 99% of all salts) are chloride, sodium, sulfate, magnesium, calcium, and potassium.

The other major dissolved substances in seawater are inorganic carbon, bromide, boron, strontium, and fluoride (make up 0.7% total).

Seawater also contains inorganic nitrogen and phosphorus, dissolved atmospheric gases (nitrogen, oxygen, argon, etc.), and some organic substance (carbohydrates and amino acids).

The major constituents of seawater almost always appear in the same proportions, regardless of salinity

THE PRINCIPLE OF CONSTANT PROPORTIONS (AKA MARCET'S OR FORCHHAMMER'S PRINCIPLE)

Where do these salts come from?

Most salts in the ocean originate from rocks on land. Sources of salts include:

- Chemical weathering: rain contains small amounts of carbon dioxide, which combined with water makes carbonic acid, making rainwater slightly acidic. While rain erodes rock, the acids break it down into ions that are carried out into the sea
- Outgassing due to volcanoes
- Wearing down of mountains/volcanoes
- Minerals washing into the sea due to rain or streams
- Leaving Earth's crust from underwater volcanic vents in solid/gaseous form
- Being dissolved from underwater rocks/sediments

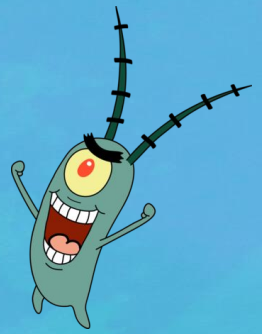


Seawater also contains nutrients!

The most important nutrients in the ocean are nitrogen and phosphorus. They play a key role in stimulating primary production (the conversion of energy to organic substances through photosynthesis) by plankton.

Larger organisms receive nutrients by eating the smaller organisms (like plankton).

Nutrients are cycled through the ocean by biological pumping: plankton extract nutrients out of surface waters and combine them into their organic matrix. When plankton die, the sink and decay. This allows the nutrients to be returned to their dissolved state deeper in the ocean.



More on nutrients and the marine food chain!



Other chemicals in seawater

Oxygen

Oxygen is continuously added to the surface ocean at the air-sea interface and by photosynthesis.

Oxygen from the surface ocean is brought to deeper depths through sinking/circulation of water masses.

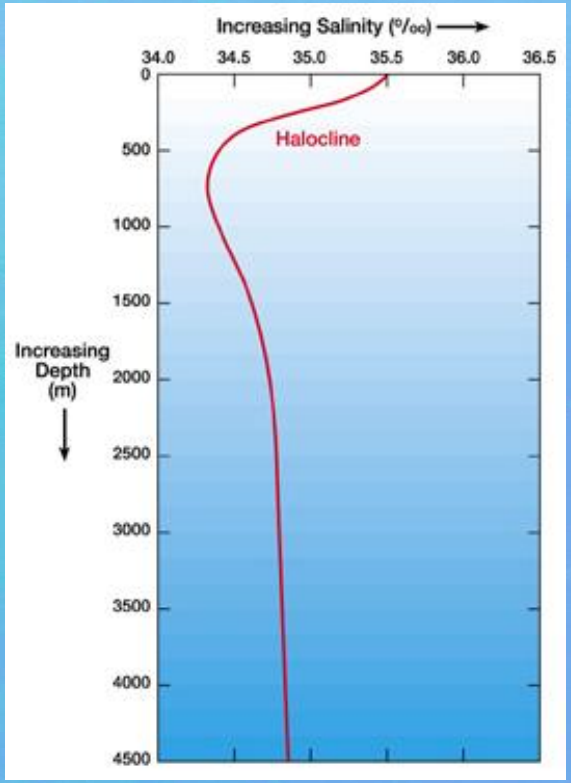
Oxygen is used up during respiration of marine organisms and during the decay/oxidation of organic materials.

Carbon Dioxide

Carbon dioxide is the opposite of oxygen when it comes to chemical and biological processes.

Increased levels of carbon dioxide decrease ocean pH (leads to ocean acidification). This is because carbon dioxide dissolves in water to form carbonic acid, which contributes hydrogen ions that decrease pH.

Properties of seawater



Salinity of seawater

In short, salinity is the amount of salt something (like seawater) contains.

Seawater has a salinity of 35 ppt/psu, but this can vary from 34-37 depending on where in the ocean. The region with a rapid change in salinity with depth is called the halocline.

Because of seawater's salt content, it has a higher viscosity, density, and boiling point, and a lower freezing point than freshwater.

Variations in salinity

With Depth

The large amounts of mixing that occur in the top layer of the ocean create fairly uniform salinity there.

The halocline is the region of the ocean with a rapid change in salinity with depth.

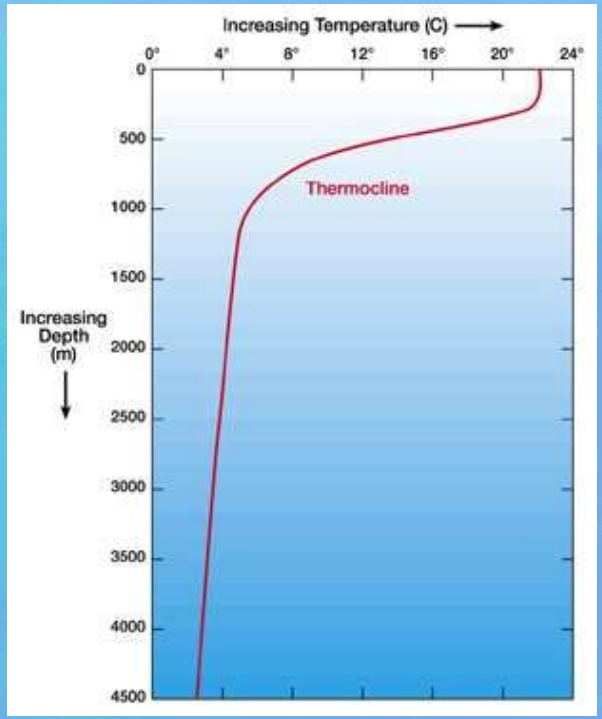
The deep ocean also shows little variation in salinity, because it is removed from the surface processes (evaporation, precipitation, runoff, etc.) that affect salinity.

By Latitude

Mid-latitudes (subtropical regions) have the highest salinity due to high amounts of evaporation and low amounts of precipitation.

The Equator (tropical regions) has moderate salinity; evaporation is highest here, but large amounts of rain make surface water fresher.

High latitudes (polar regions) have the lowest salinity because evaporation is low and melting snow/ice contribute freshwater.



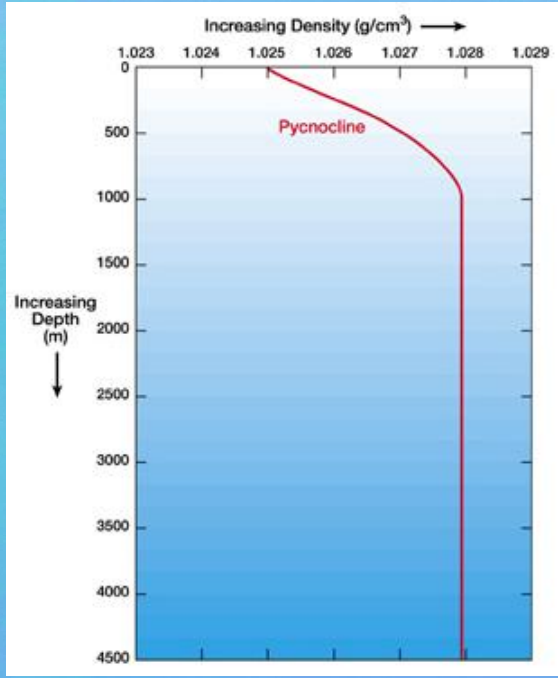
Temperature of seawater

Temperature decreases with depth in the ocean. The average temperature of ocean surface water is about 17° C, while most water in the deep ocean is close to 0° C.

The region with a rapid decrease in temperature with depth is the thermocline. About 90% of total ocean volume is located below the thermocline.

The thermocline can vary by latitude. In tropical regions, it is more stable. In subtropical regions, it is most pronounced in the summer. And in polar regions, the thermocline is weak/nonexistent.

Colder water typically holds more dissolved gases.



Density of Seawater

Density: the degree of compactness of a substance.

Density is a function of salinity and temperature, but temperature has a greater effect than salinity. As salinity increases, density increases. As temperature increases, density decreases.

The density of seawater at the ocean's surface is about 1.027 g/cm^3, and density increases with depth in the ocean. The region of the ocean with a rapid increase in density with depth is called the pycnocline.

The maximum density of seawater occurs at its freezing point (-2° C).



Kahoot!

If time permits! No memes in this one, sorry :(
https://mail.google.com/mail/u/0/#inbox/FMfcgxwKjBMdKbmqXfnWPfncDJQXtwQd

For Next Week

Some things to do before next class:

- Once again, I'll be emailing all of you and your parents with course updates this week, so be on the lookout for that! I'll also be posting all of this week's material to the Google Classroom (so try to join that ASAP)!
- The material we covered this week can be pretty difficult, so I'll try to release a review worksheet for it in the upcoming days. This is totally optional, but it'll be really helpful for you to retain information! I'll put this in the Classroom, as well as email the link to you once it's complete. Just contact me if you'd like me to check it!
- We will be doing a hands-on lab next week (yay density columns)! I'll give more details about that in the email, but you'll most likely need some sort of clear container, food coloring, and various household liquids (vegetable oil, water, dish soap, milk, etc.)
- As always, please don't hesitate to reach out and let me know if you have questions! A reminder that my email is great.michelle.li@gmail.com



Let’s chat

If we have extra time...let’s chat! Do you guys like this lecture format? How was the difficulty of the material? Anything goes!

Any questions?

I'll be emailing everyone soon!
Always feel free to contact me at
great.michelle.li@gmail.com :)

Thanks!



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