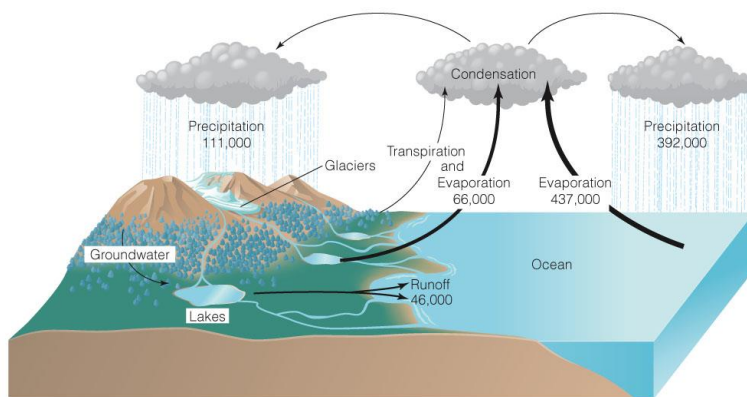


Ocean Chemistry part II

Review: Water Is a Powerful Solvent



A simplified hydrologic cycle. Water moves from _____ to _____, onto _____, to _____ and _____ and _____, back to the _____ and _____, in a continuous cycle (volumes: km³/yr).

Review salinity:

- A _____ is made of two components, with uniform molecular properties throughout:
 - The _____, which is usually a liquid, and is the _____ component.
 - The _____, often a solid or gas, is the _____ component.
- **Seawater:** _____, hydrogen, chloride, sodium, sulfate, magnesium...)

The Ocean Is in Chemical Equilibrium

- Is the ocean becoming progressively saltier with age?
- _____, the ocean is in **chemical** _____. The proportion and amounts of dissolved solids remain constant and is known as the “_____.”
- _____ are being added to and removed from the ocean at the same rate (remember subduction zones).

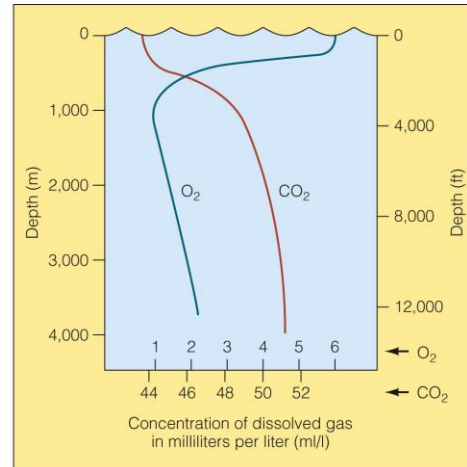
Gases (e.g., N₂, O₂, CO₂) dissolve in seawater: concentrations vary with depth

Oxygen is _____ near the surface because of the _____ activity of marine _____.

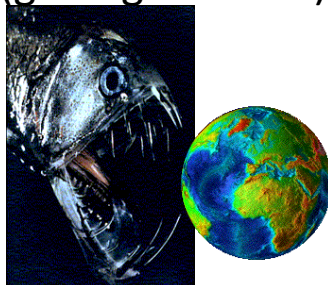
Oxygen _____ below the sunlit layer because of the _____ of marine _____ and _____.

In contrast, surface levels of CO₂ are _____ (photosynthesis).

CO₂ _____ with _____ due to less photosynthesis, and gas solubility increases as pressure increases and temperature decreases.

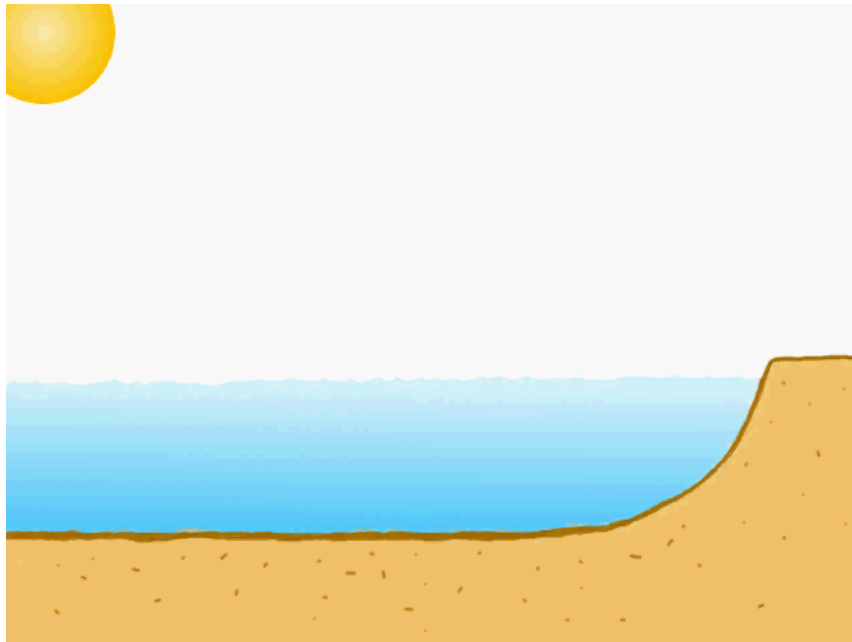
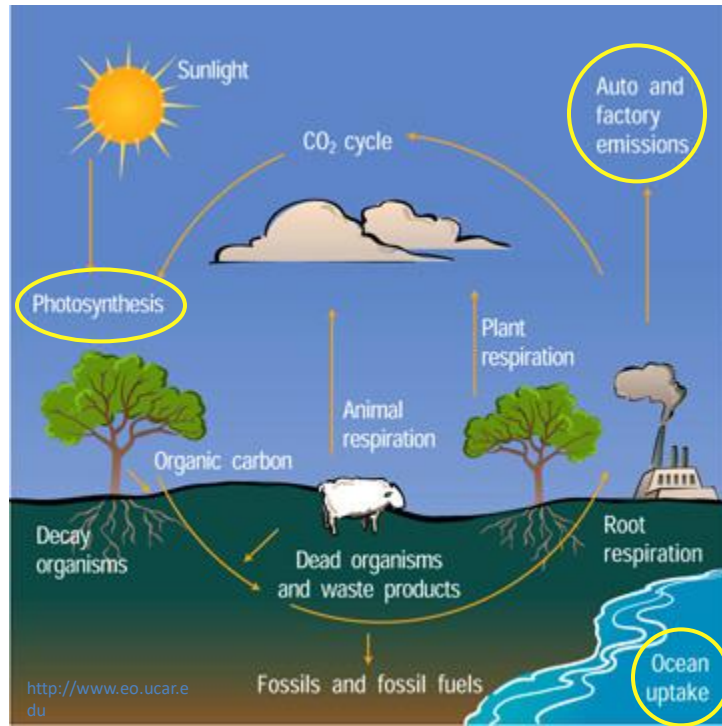


Biogeochemical cycle (Greek: bio = life; geo = earth) The continuous flow of _____ and _____ between _____ (biological form) and the _____ (geological form), e.g., carbon cycle.



The carbon cycle:

Carbon is the fundamental element to all life

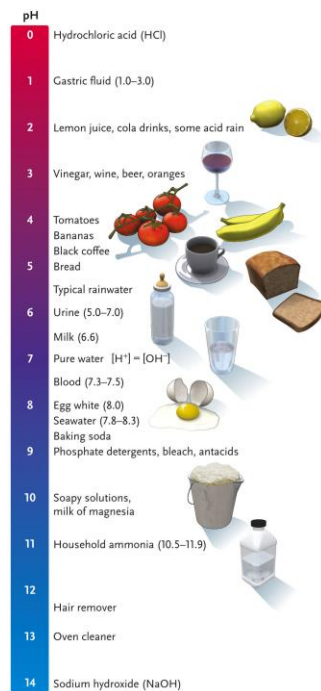


The Ocean's Acid-Base Balance Varies with Dissolved Components and Depth

- What are **acids** and **bases**?
- An _____ is a substance that _____ a _____ ion in solution.
- A _____ is a substance that _____ with a _____ ion in solution.
- A solution containing a base is called an _____ solution.
- Acidity or alkalinity is measured on the _____ scale.

The pH scale.

A solution at pH 7 is _____; _____ numbers represent _____, and _____ numbers represent _____.

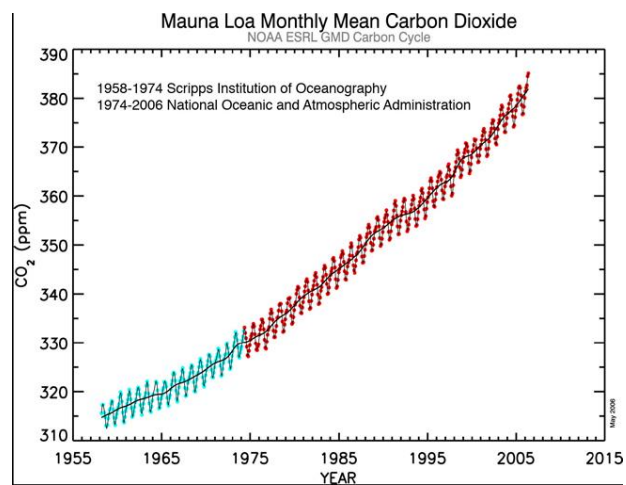


Universal indicator scale



From: http://celebrating200years.noaa.gov/datasets/mauna/image3_650.jpg

Increasing Carbon

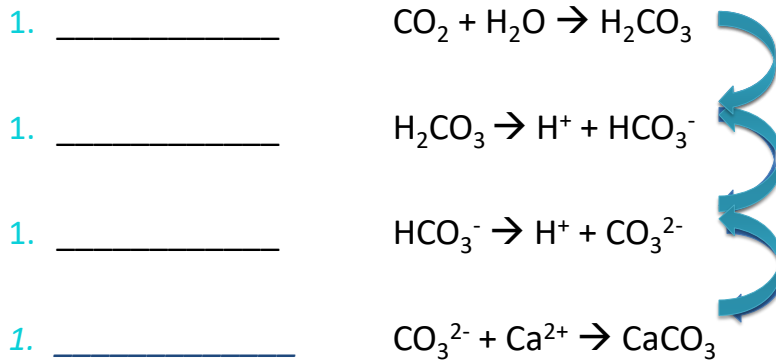


- Global climate change
- Ocean acidification?

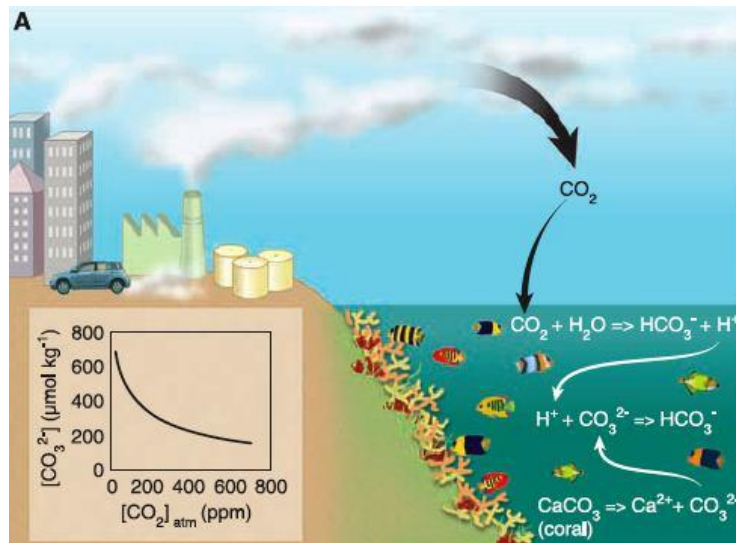
How does Ocean Acidification Happen?

Four Major Reactions....

Increased CO₂ Conditions



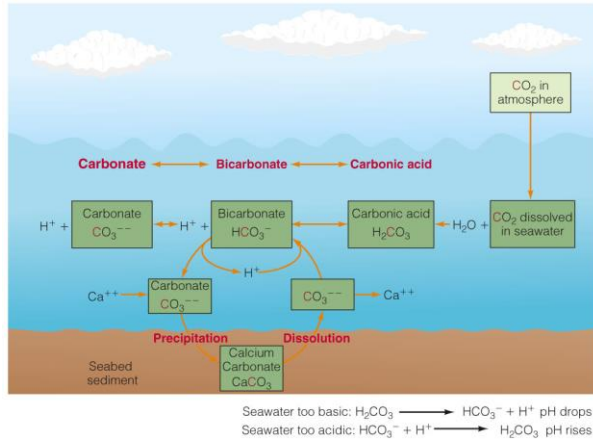
**Important for calcifiers (e.g. coral, coccolithophores)



(CO₂) combines readily with seawater (H₂O) to form

(H₂CO₃).

Carbonic acid can lose a H⁺ ion to become a bicarbonate ion (HCO₃⁻), or two H⁺ ions to become a carbonate ion (CO₃²⁻).

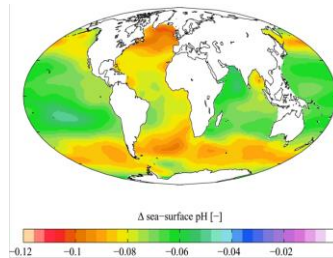


Some bicarbonate ions dissociate to form carbonate ions, which combine with calcium ions in seawater to form calcium carbonate (CaCO₃), used by some organisms to form hard shells and skeletons (e.g., clams and corals).

Big Picture

pH _____ from 8.179 to 8.104

- Between 1700 and 1990s
- 25% increase in pH



Affects the _____

– Can no longer use _____ for growth and metabolism

- Primary producers – _____
- Primary consumers – _____
- _____

Affect _____

- 70% _____ fish from reef communities
- _____

From: http://en.wikipedia.org/wiki/File:WAOa5_GLODAP_del_pH_AYool.png

Ocean Acidification – Hermie the hermit crab

