Acid-Base Equilibrium
BUFFERS

Dr. Ron Rusay

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BUFFERS

Weak Acid + Conj. Base ***or*** *Weak Base + Conj. Acid*

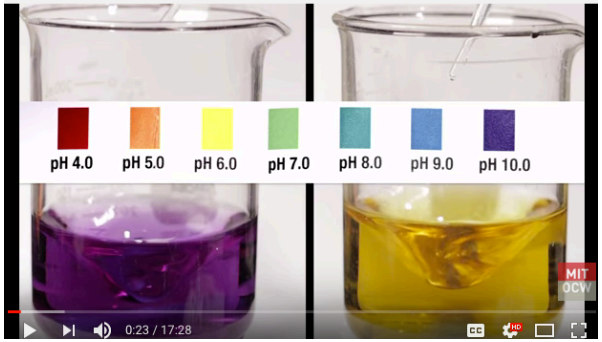
Example:

$H_2CO_3(aq)$ / $\mathbf{HCO_3^{-1}(aq)}$ / $CO_3^{-2}(aq)$

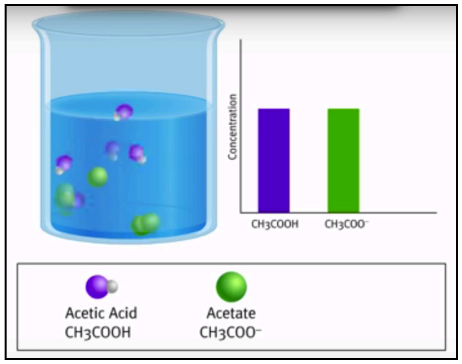
$H_2CO_3(aq) \leftrightarrows \mathbf{HCO_3^{-1}(aq)} + H^{+1}(aq) \leftrightarrows \mathbf{CO_3^{-2}(aq)} + 2H^{+1}(aq)$

$\downarrow\uparrow$

$\mathbf{CO_2(g) + H_2O\ (l)}$



https://www.youtube.com/watch?v=XR_0k8JlawY



https://www.youtube.com/watch?v=ZLKEjXbCU30

QUESTION

In the following equilibrium:

$HCO_3^-(aq) + OH^-(aq) \leftrightarrows CO_3^{-2}(aq) + H_2O(l)$

A) HCO_3^- is an acid and CO_3^{-2} is its conjugate base.
B) H_2O is an acid and OH^- is its conjugate base.
C) HCO_3^- is an acid and OH^- is its conjugate base.
D) H_2O is an acid and CO_3^{-2} is its conjugate base.
E) H_2O is an acid and HCO_3^- is its conjugate base.

$H_2CO_3(aq)$ / $HCO_3^{-1}(aq)$ / $CO_3^{-2}(aq)$

One of many VERY IMPORTANT Buffer Systems

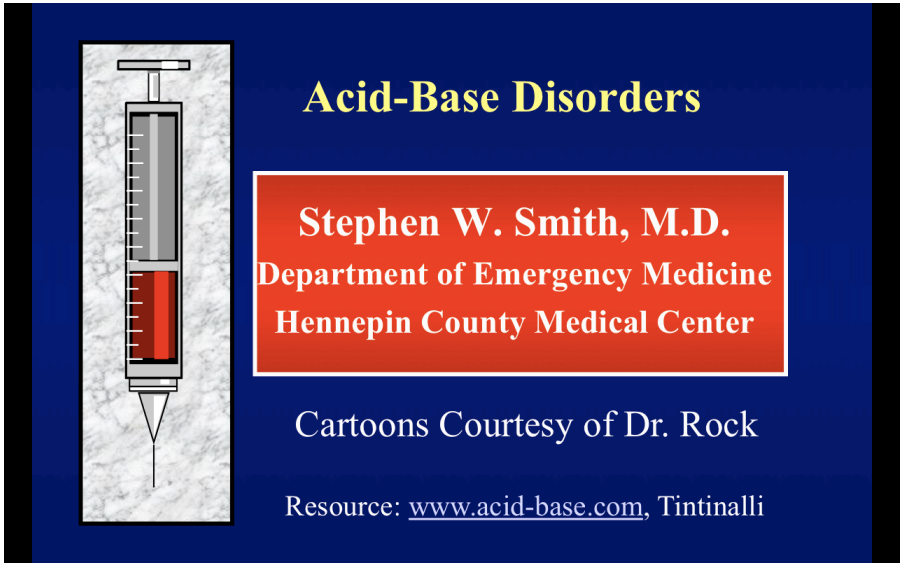
"Bicarbonate"

$\boldsymbol{HCO_3^{-1}(aq) / CO_3^{-2}(aq)}$

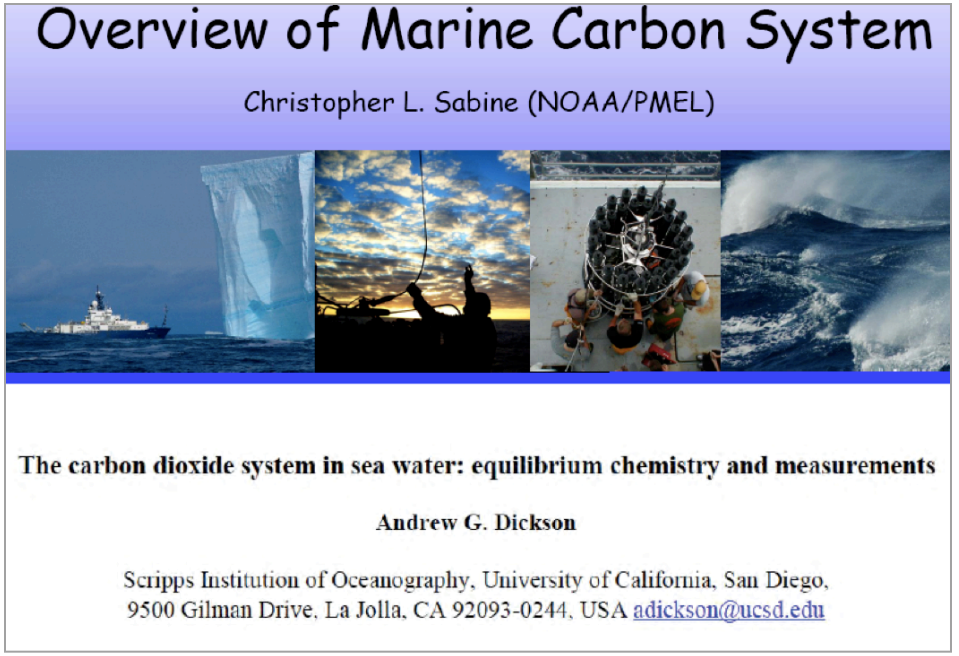
$$CO_2(g) + H_2O\,(l) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq) \leftrightarrows CO_3^{-2}(aq) + 2H^{+1}(aq)$$

1. ***Blood:*** *a human's blood serum volume is relatively small, 4-6 Liters with a narrow pH range, pH = 7.35 – 7.45; pH is maintained through buffering (homeostasis)*
   Have you ever had respiratory alkalosis during an exam?
2. ***Oceans:*** *an extraordinarily large volume of a "salt water" solution with a pH ~ 8.1; maintained through buffering*

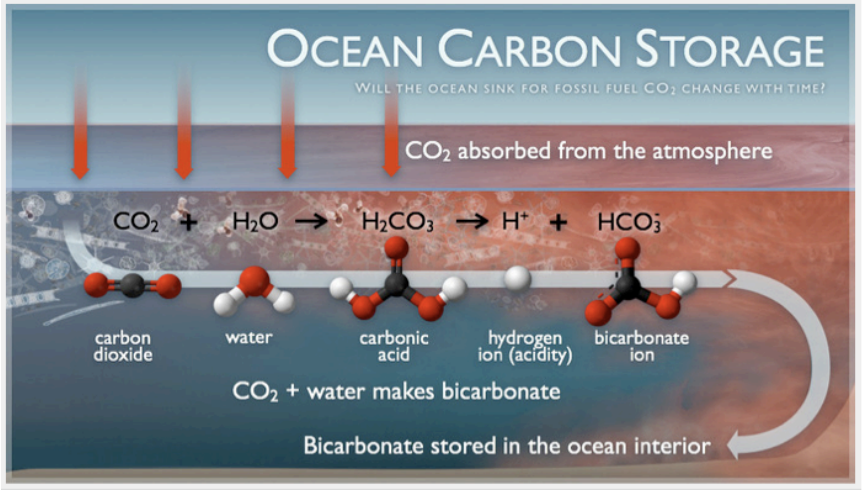
Human & Oceanic Bicarbonate Buffer Systems



http://chemconnections.org/general/chem121/Buffers/Buffers-Med-Pres.htm

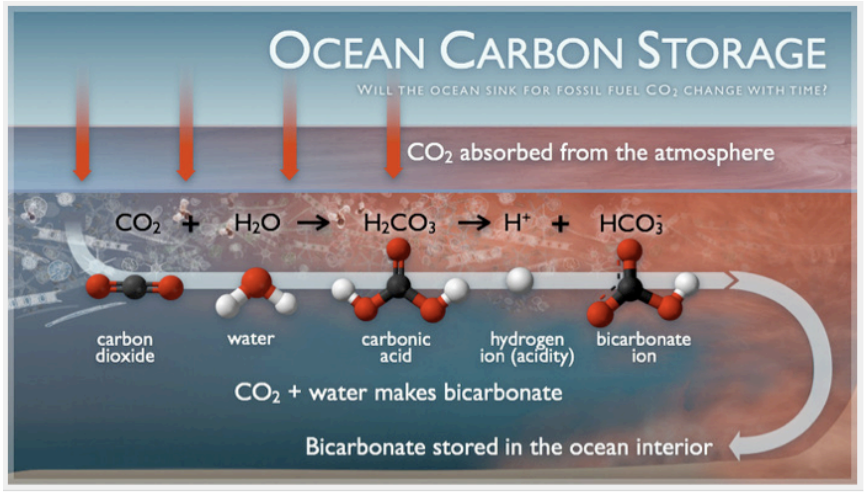


http://chemconnections.org/general/chem121/Buffers/Buffers-CO2-Oceans-2011.htm

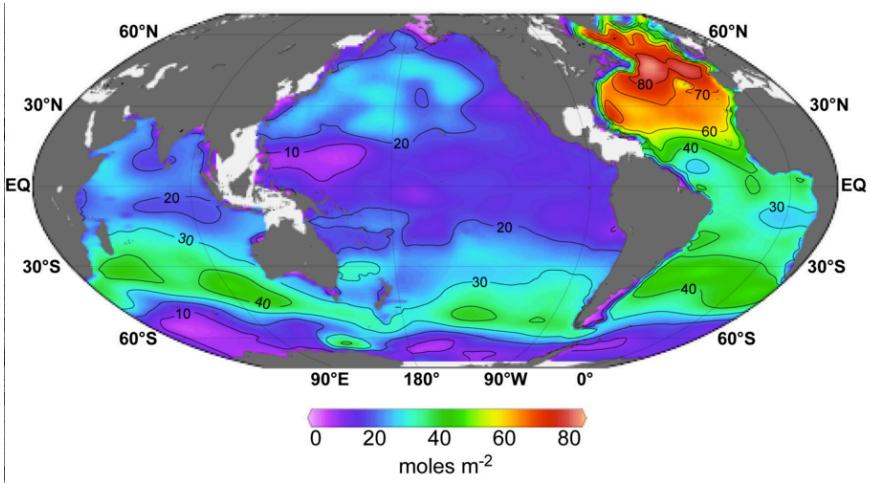


EQUILIBRIUM

CO_2 Chemistry & Oceanic Storage



TOTAL = 39 PtC (petatons) of carbon = 10^{12}



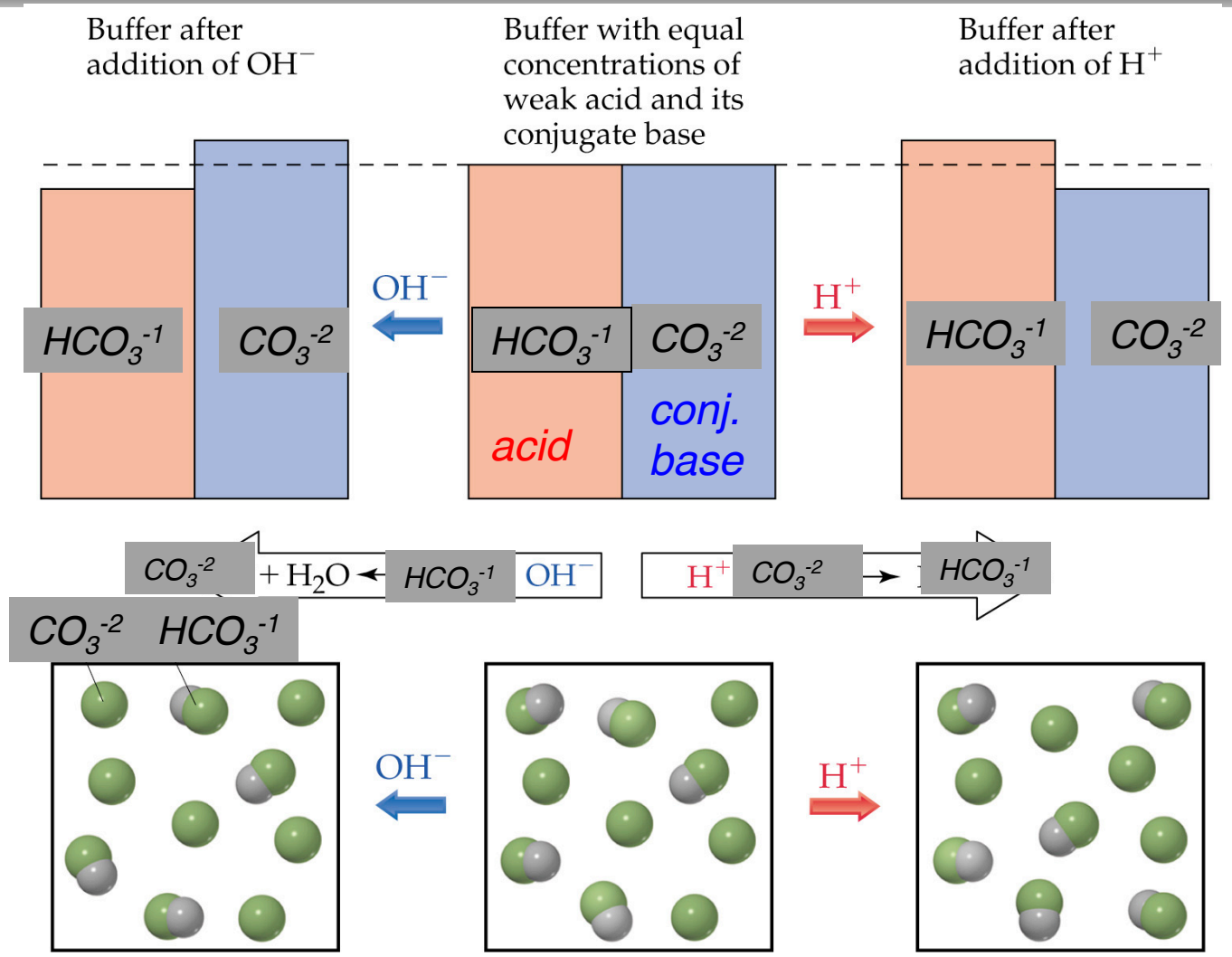
Oceans adding ~2.4 Gt CO_2/yr
TOTAL atmospheric added ~ 10 GtC/yr
G = giga = 10^9

$$CO_2(g) + H_2O\ (l) \leftrightarrows H_2CO_3(aq) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq)$$

https://www.youtube.com/watch?v=ugCjVK0dCSE

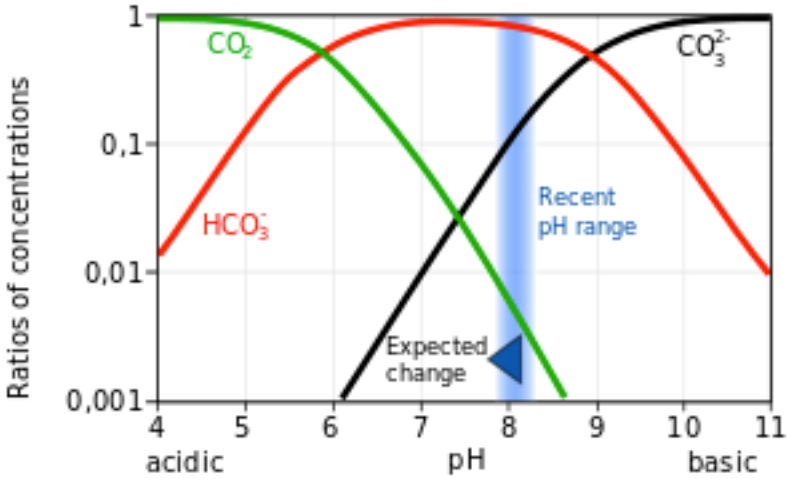
Bicarbonate Buffer Systems

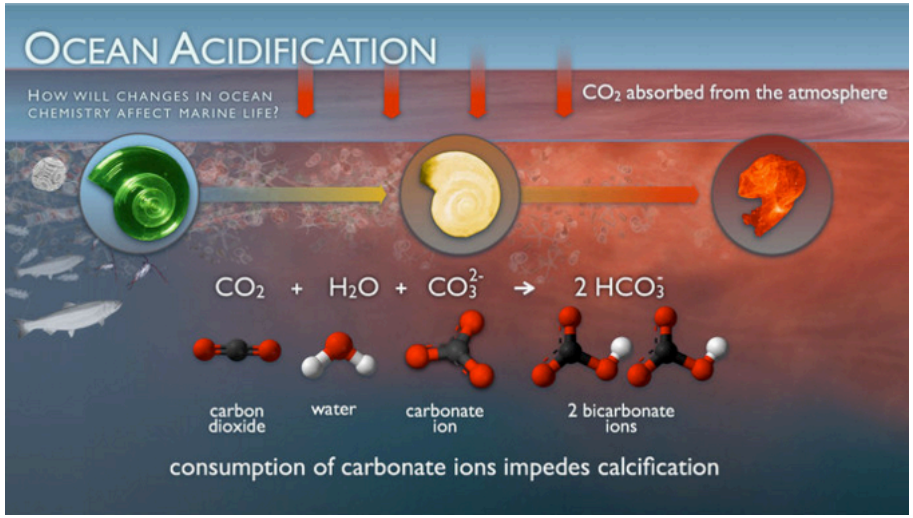
https://www.youtube.com/watch?v=xuttOKcTPQs



EQUILIBRIUM

CO_2 : Buffering & Affects on Carbonate





$$CO_2(g) + H_2O\ (l) \leftrightarrows HCO_3^{-1}(aq) + H^{+1}(aq) \leftrightarrows CO_3^{-2}(aq) + 2H^{+1}(aq)$$

Ocean acidification: *pH ~ 8.1 and falling*

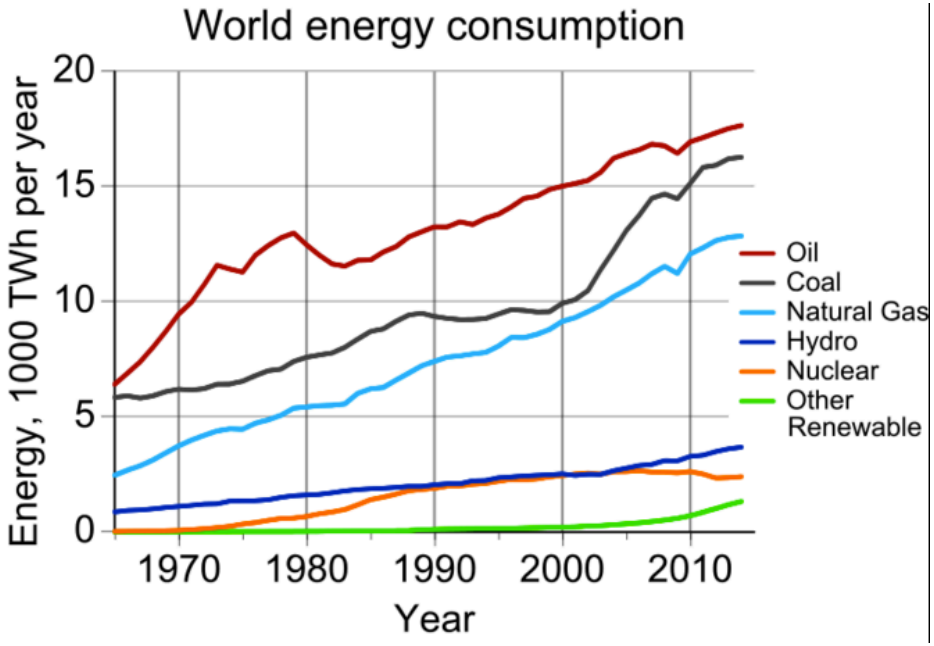
Increasing CO_2 is decreasing ocean pH with long term effects.

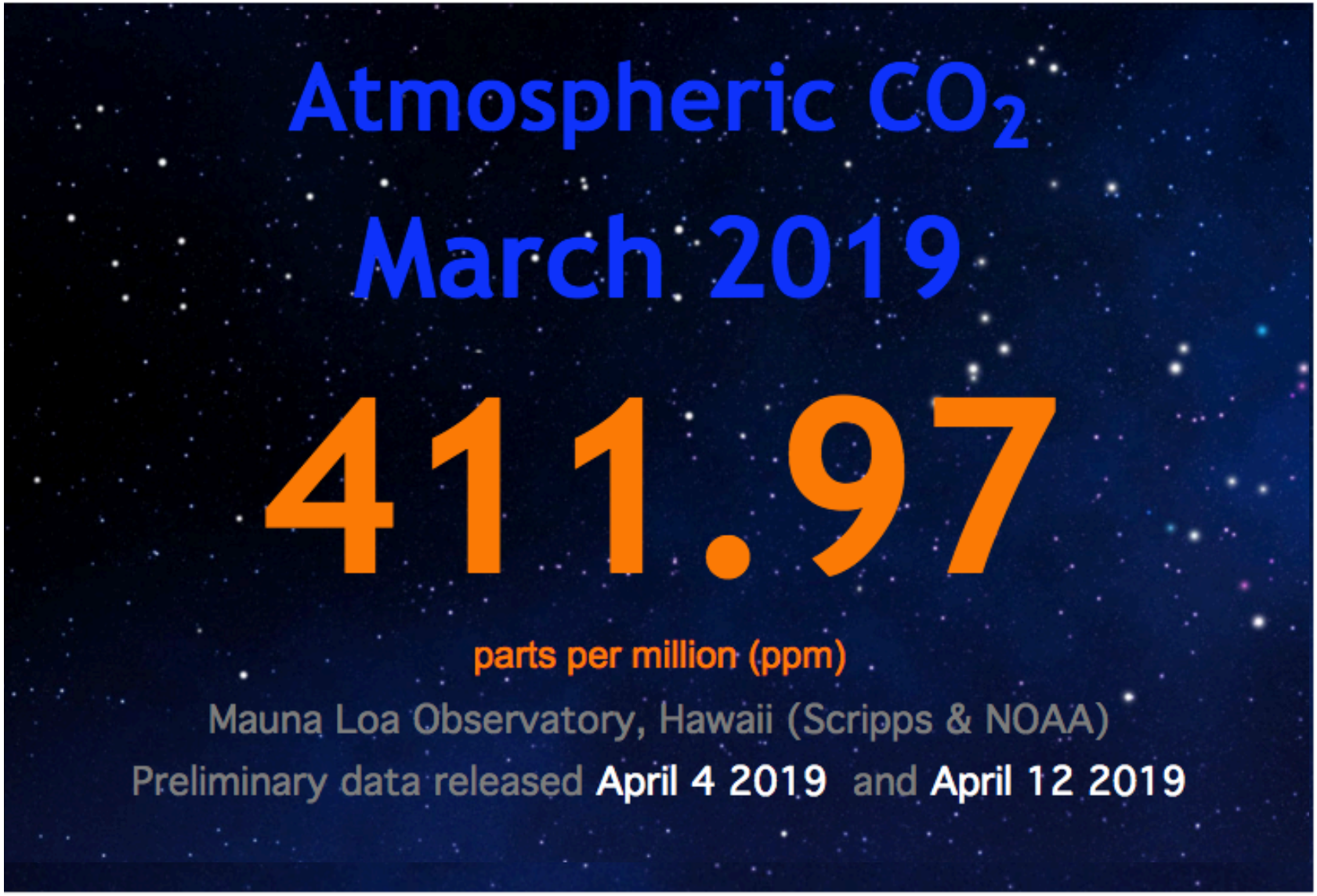
https://www.youtube.com/watch?v=ogZkV-Yj7Hc

Energy —*(Carbon)* (CO_2)→ *Global Warming*

(Carbon) (CO_2)

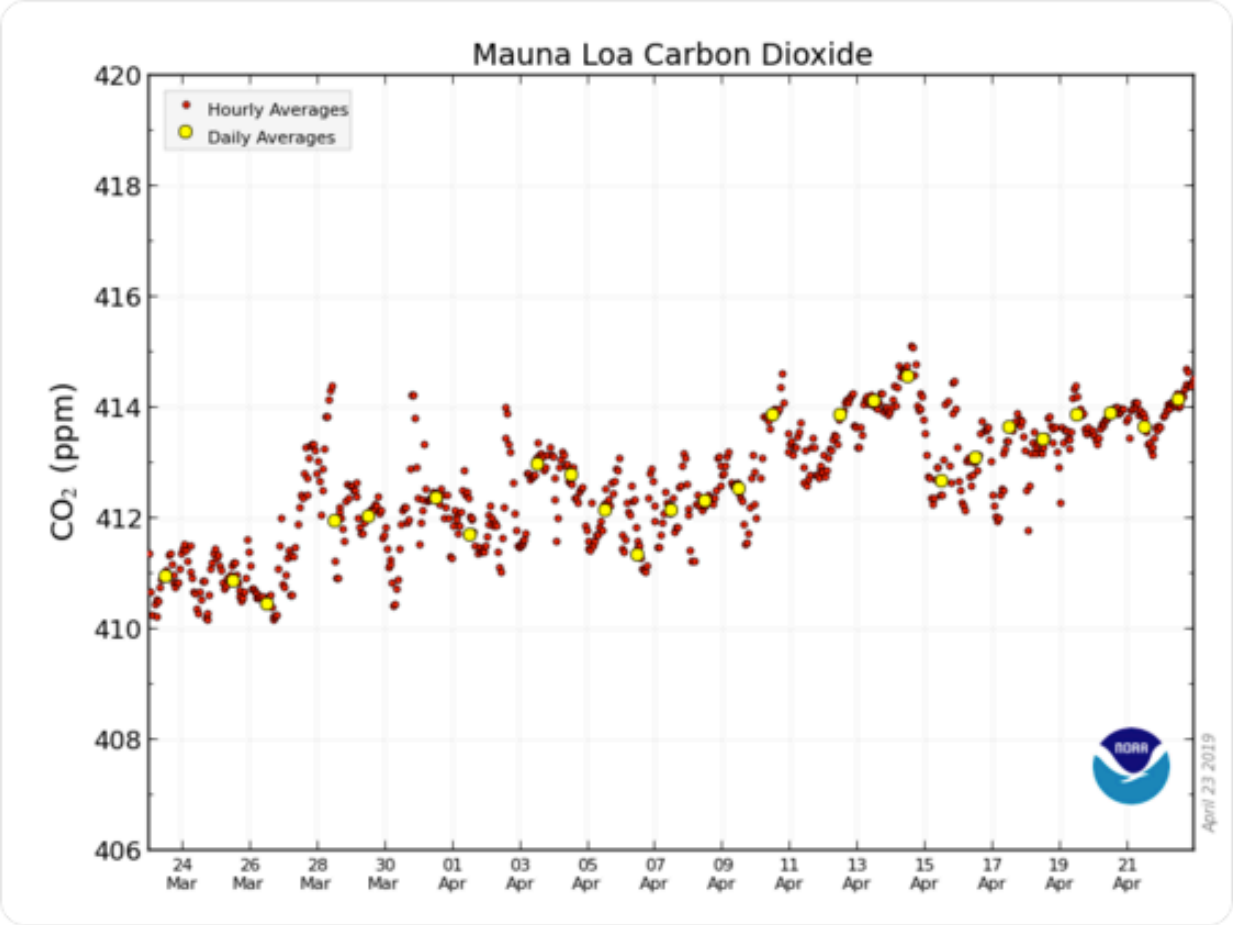
Economy (Jobs)





https://www.co2.earth/

CO_2 Variation



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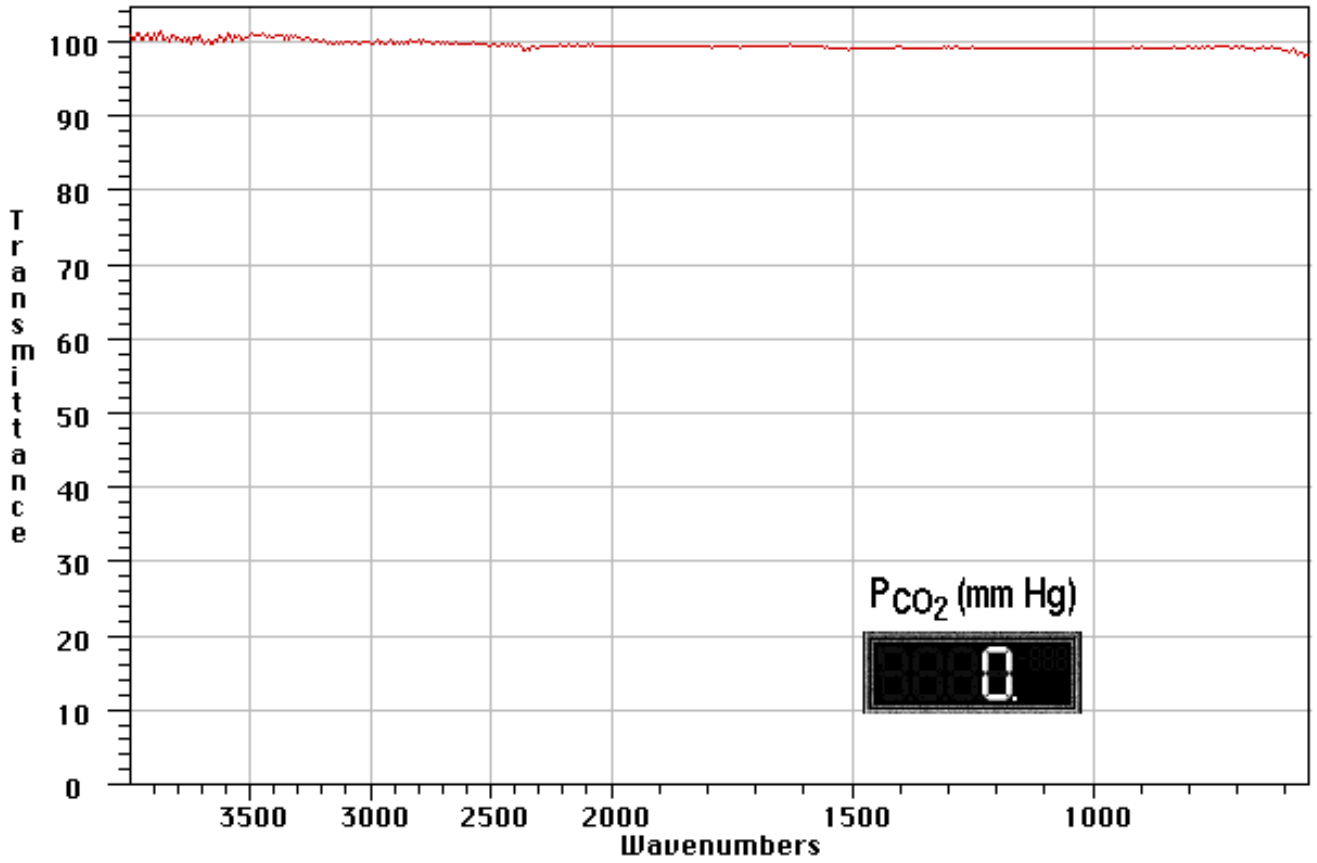
https://www.co2.earth/daily-co2

Infrared Spectra: CO_2 Concentration Effects

Nitrogen & Oxygen produce flat lines: 100% Transmission, 0 Absorbance



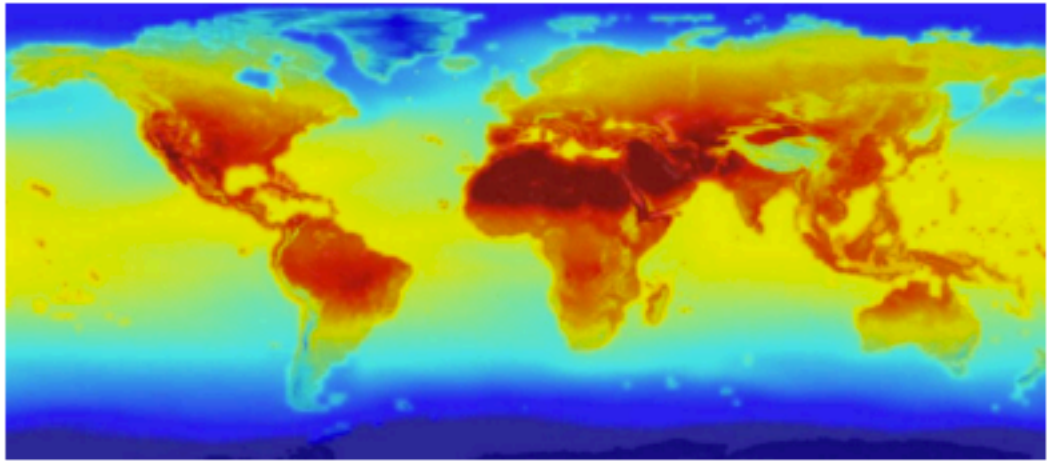
http://chemconnections.org/general/chem108/Global%20warming%20%26%20Carbon%20Footprint.2017.pdf

Bonus

Due May 22nd

Global Warming & Your Carbon Footprint

http://chemconnections.org/general/chem108/Global%20Warming%20Bonus.html



The United Nations' Nobel Prize winning International Panel on Climate Change (IPCC: http://www.ipcc.ch/) of more than 1,000 scientists have concluded that "Human influence on the climate system is clear, and recent anthropogenic (man made) emissions of greenhouse gases are the highest in history, The atmospheric concentration of key greenhouse gases — carbon dioxide, methane, and nitrous oxide — is unprecedented in at least the last 800,000 years, and our fossil-fuel driven economies and (mankind's) ever-increasing population are to blame."

http://chemconnections.org/general/chem108/Global%20Warming%20Bonus.html