Workshop on Ocean Acidification- High School Marine Science Symposium, March 9, 2016
C. Bastidas & J. Simpson, MIT Sea Grant

Description of Activities

I. Effects of ocean acidification on fish behavior

Most fish have an excellent sense of smell. Predatory fish can find their prey by smelling them, and small prey fish can avoid their predators by smelling them. Recent research has found that acidic water can interfere with prey detection and avoidance behaviors.

In one experiment, sharks were exposed to acidic, high CO_2 water for six hours. The sharks were then placed in tanks with the smell of squid (which they think is delicious) coming from one side, and no squid smell coming from the other side.

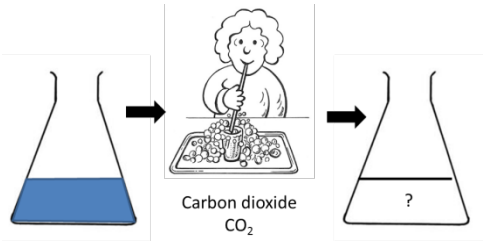
Normally when the researchers put sharks in this tank they swim towards the squid smell and start biting the walls of the tank. But the sharks that had been treated with acidic water ignored the smell and swam towards the other side of the tank.

The video shows a similar experiment with small prey fish being exposed to water that smells like their predators. One of the fish has been exposed to acidic, high CO_2 water and the other one has lived in normal water. Watch the video without sound; based on what you now know, which fish do you think had the acid treatment?

II. Breathing

Our breath contains CO_2 and the solution in the flask is a pH indicator.

a) Please blow into the flask. Observe and describe what happens to the solution.



b) Open the container and add 5 to 10 drops of the NaOH solution. Observe and describe what might be happening.

c) Based on this experience, please answer the following:

- Can a gas dissolve in a solution?
- Can a component of a gas mixture (oxygen, carbon dioxide, helium) dissolve in seawater?
- How does this experiment relate to ocean acidification?

III. WET Shells

Place 2 shells in each of the beakers containing water and vinegar (a weak acid).

a) What do you observe?

b) Knowing that the shells are made of calcium carbonate ($CaCO_3$), please speculate what compound might be in these bubbles?

c) If the vinegar reacts with the calcium carbonate, write a potential consequence of more acidic seawater might have for an organism that live inside a shell.

IV. DRY Shells

You have two groups of shells of three different species (mussels, quahogs and oysters). One of the groups was treated with a weak acid solution (vinegar) for 1 day. The other group is untreated. Please use the following table to describe the differences that you find between the two groups of shells.

a) Choose ONE characteristic and describe how these two groups of shells differ.
b) How the characteristic that you've chosen differs among species? If any
c) You can use more than one characteristic if you like

Characteristic	Acid treated shells	Control shells

d) Use one of the tools on the table (balance, flashlight, hammer, magnifying glass) to design a test for estimating differences between treated and untreated shells. Describe this test in sequential steps that anybody could follow to obtain the results of the test.

In case you find this useful, the shells have a number and in parenthesis are their weights (g) before acid treatment: 1 (4), 2(206), 3(213), 4(4.3), 5(5.2), 6(4.1), 7(5.6), 8(5.1), 9(5.1), 10(4.7), 11(3.7), 12(5.0), 13(4.9), 14(6.1), 15(4.8), 16(20.7), 17(17.5), 18(22.7), 19(16.9), 20(12.1), 21(18.2), 22(15.32)

Ocean acidification: how does it affect skeleton building?

March 2016
High School Marine Science Symposium
Northeastern University, Boston

Sea Grant
Massachusetts Institute of Technology

Carolina Bastidas
Juliet Simpson

Seaweed Might Have The Power To Make The Oceans Less Acidic

04/28/2015 07:33 am ET | Updated May 27, 2015

161

s
d Public Health Reporter, The Huffington Post

CLIMATE CENTRAL

Home | News | Research | Special Reports | Gallery

Ocean Acidification, Now Watchable in Real Time

Published: February 17th, 2015

Tweet | Share

By Brian Kahn

Follow @bkahn

Increased Ocean Acidity Puts Alaska Fisheries At Risk, Study Says

07/29/2014 09:01 am ET | Updated Sep 28, 2014

165

By BRIAN MASTROIANNI / CBS NEWS / *November 6, 2015, 5:15 PM*

Ocean acidification benefits invasive species

A jellyfish living in high CO2 waters near volcanic seeps in the Mediterranean. JASON HALL-SPENCER

0 Comments | Share | Tweet | Stumble | Email

AP | BECKY BOHRER

ASSOCIATED PRESS

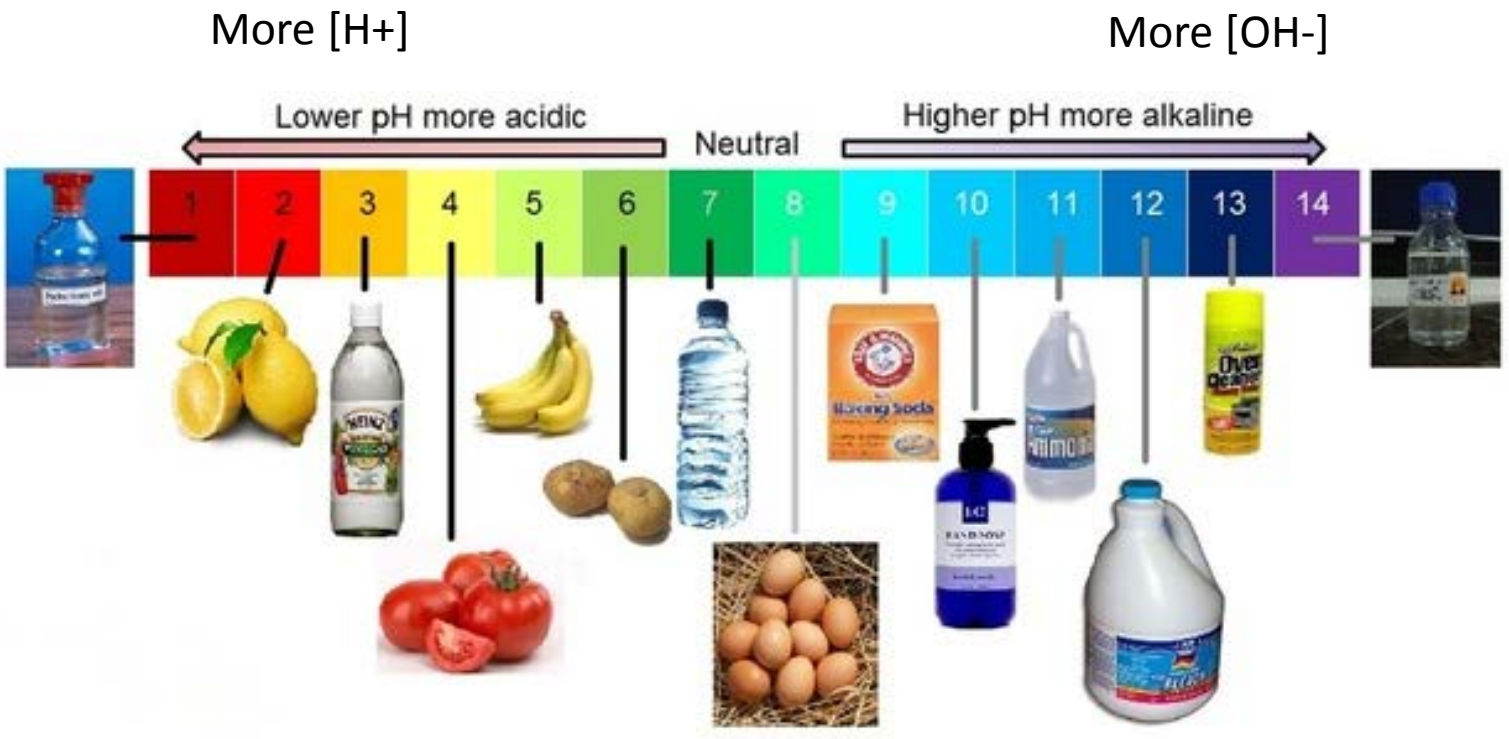
Sea Grant
Massachusetts Institute of Technology

Ocean acidification- Workshop

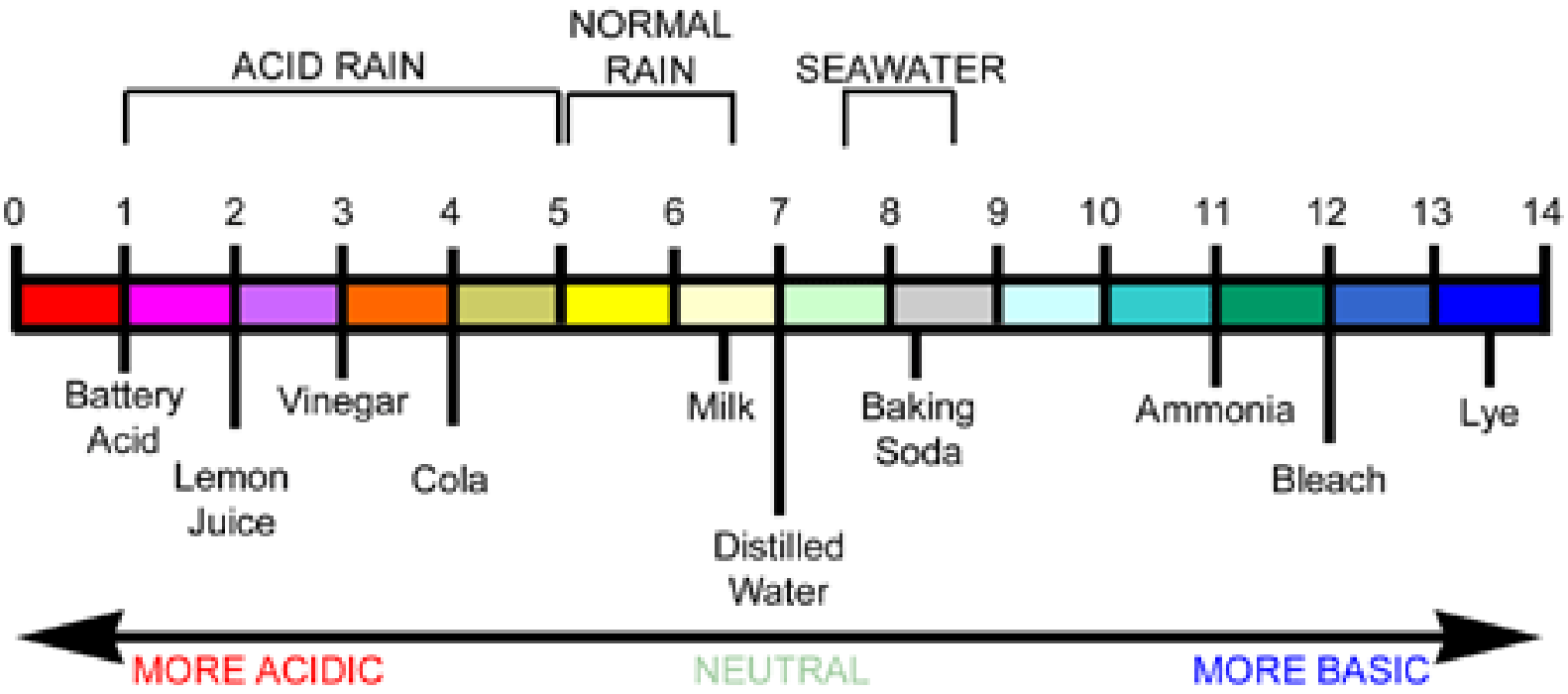
By the end of this session you will be able to:

define what OA is and recognize two impacts for marine life

What is acidity?



What is acidity?



Increase in atmospheric CO2

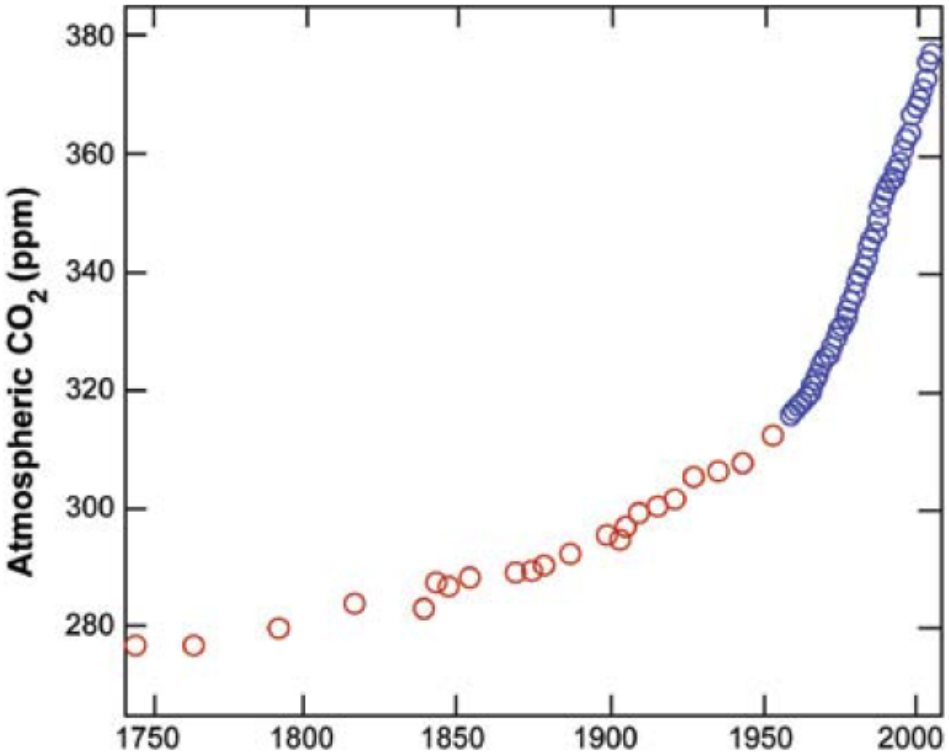
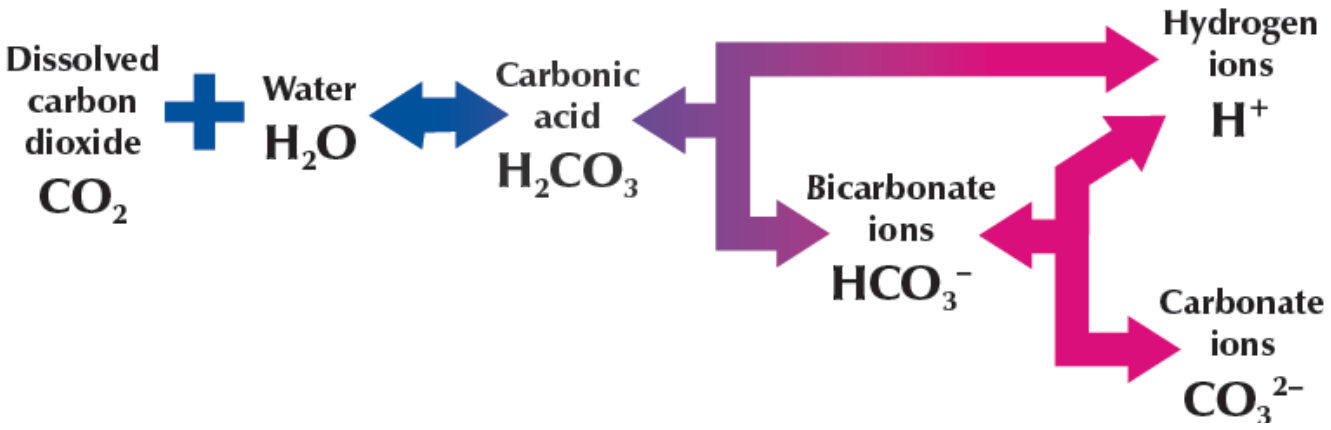


Figure 2.2 Atmospheric CO_2 concentration from 1750 to 2005. The data prior to 1957 (red circles) are from the Siple ice core (Friedli et al., 1986). The data since 1957 (blue circles) are from continuous atmospheric sampling at the Mauna Loa Observatory (Hawaii) (Keeling *et al.*, 1976; Thoning *et al.*, 1989) (with updates available at http://cdiac.ornl.gov/trends/co2/sio-mlo.htm).

Dissolved CO_2



Working stations ~ 5 min each

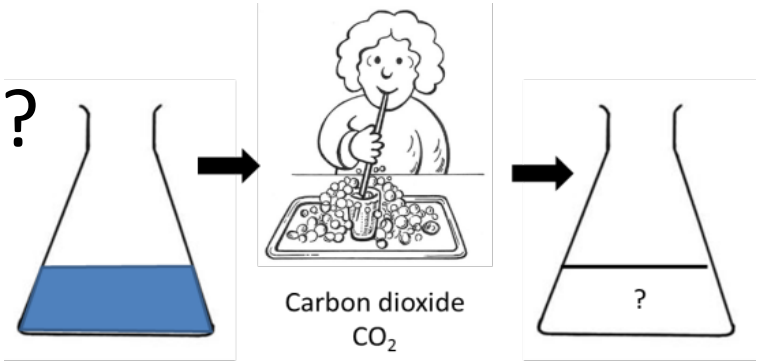
1. Video
2. Wet shell experiment
3. Dry shell experiment
4. Breathing

Working stations - RESULTS

1. Breathing
2. Wet shell experiment
3. Dry shell experiment
4. Video

1. Breathing- RESULTS

- What happened to sol?

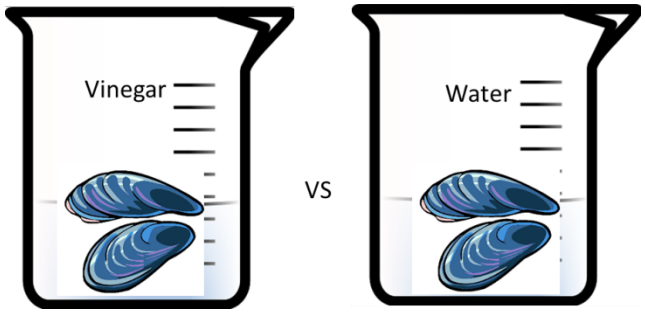


- Add NaOH

- A gas can dissolve in a solution
- CO_2 dissolves in sol
- Atmospheric CO_2 can dissolve in seawater which becomes more acidic

2. Wet shells- RESULTS

- What happened to liquids?

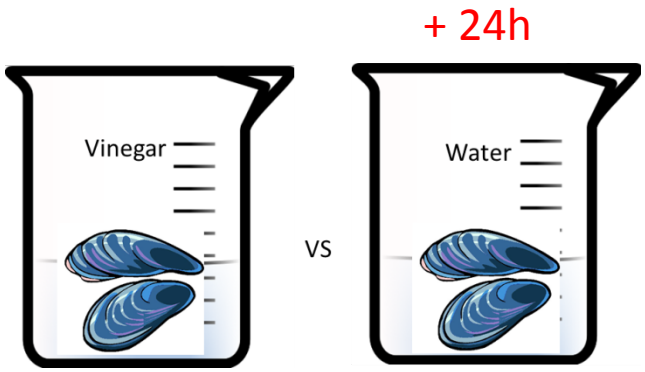


$CaCO_3(s) + 2\ CH_3COOH(aq) \rightleftharpoons Ca(CH_3COO)_2(aq) + H_20(l) + CO_2(g)$

- If CaCO3 reacts with vinegar, what might happen to shell?

3. DRY shells- RESULTS

- Differences among shells?



- Design your experiment to test differences among treated and control shells

4. Video- RESULTS

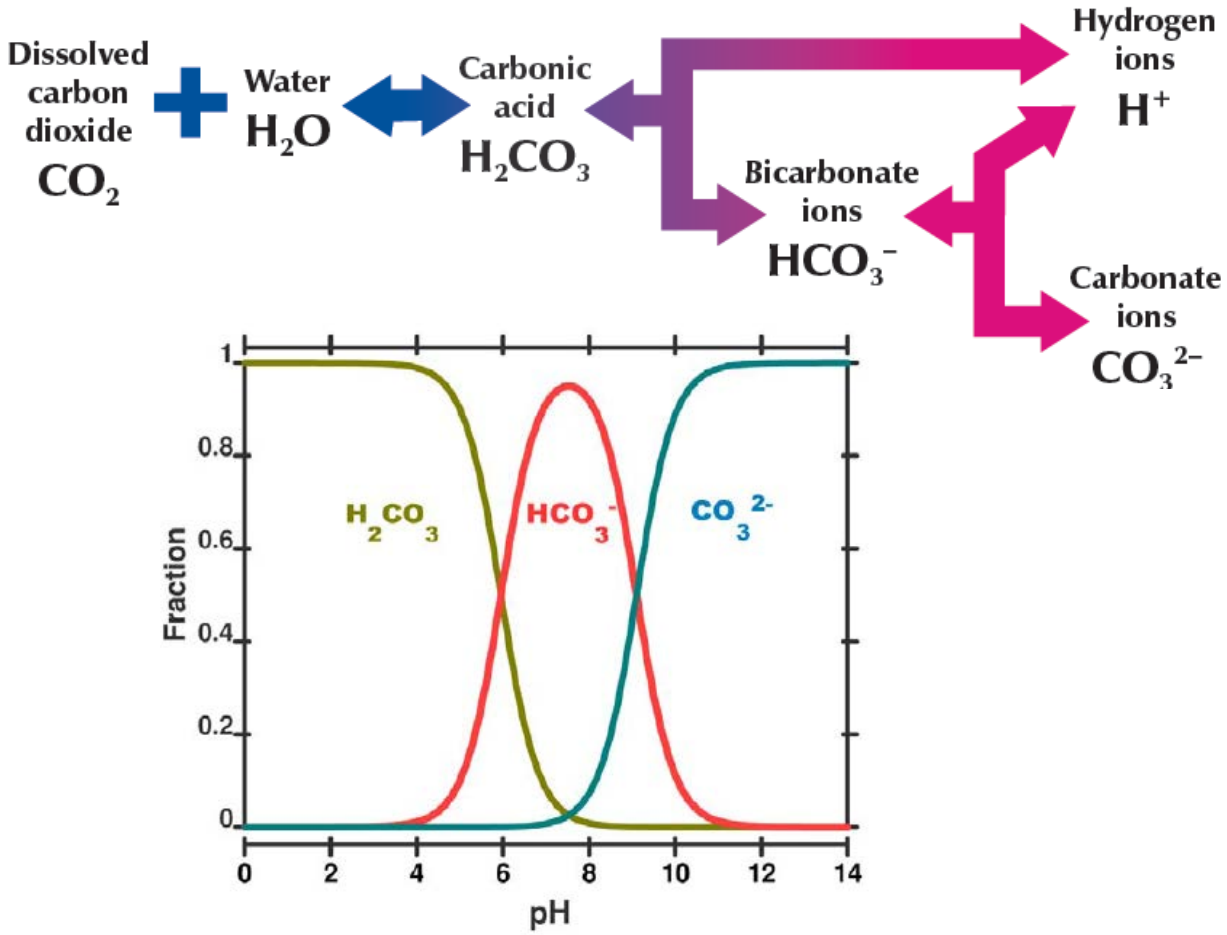
- Is predator fish behavior changed by acidic waters?

- Is prey fish behavior changed by acidic waters?

4. Video- RESULTS

- Is predator fish behavior changed by acidic waters?
  - *YES* – sharks either cannot smell prey or don't understand that the smell means something good to eat
- Is prey fish behavior changed by acidic waters?
  - *YES* – small fish either can't smell predators or don't understand that they're dangerous

More CO_2 in seawater--> increased acidity



Summary of Activities

1. Increasing pCO_2 increases **carbonic acid** $CO_{2(g)} \rightarrow CO_{2(aq)} + H_2O \rightarrow H_2CO_3$

2. Increasing **carbonic acid** results in titration of **carbonate ions** $H_2CO_3 + CO_3^{2-} \rightarrow 2HCO_3^-$

3. pH is driven largely by the ratio of **carbonic acid** to **carbonate ions** ($pH = -\log[H^+]$) $[H^+] = \sqrt{[K_1 \bullet K_2] \bullet \left[\frac{H_2CO_3}{CO_3^-}\right]}$

What is Ocean Acidification?

Increase in seawater acidity due to increased atmospheric CO_2

How does OA affect skeleton building?

Dissolved CO2 also reduces carbonate ions, a building block for calcifying organisms

Does increased [H+] affects other vital functions?

Yes, for example olfactory sense