

### At the beginning of the class period

1. Pass out cups of water with Phenol Red and straws.
2. DO NOT DRINK! Gently blow bubbles into the liquid.
3. Question map:
  - o Describe what happened.
  - o How long did it take to happen?
  - o DO NOT ask about interpretation (e.g. anything about pH or what was added to the water)
4. Every couple of minutes, everyone with birthday Jan-Jun blows more bubbles, and those with birthdays Jul-Dec just stir the liquid around.

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### Lecture

1. Recall what happened when you blew bubbles in the red liquid
  - a. Bubble blowers, what does your liquid look like?
  - b. Non-bubblers, what does your liquid look like?
  - c. What did you add to the liquid by blowing bubbles?
  - d. The red liquid is Phenol Red, and is a pH indicator
2.  $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+ \rightarrow \text{CO}_3^{2-} + 2\text{H}^+$

### Demo

3. Glass of vinegar
4. Drop a piece of chalk or an antacid in
5. Question map:
  - a. Describe what happened
  - b. What is chalk made of?
    - i. Ppt of chalk and antacids
  - c. What is it about vinegar that makes the chalk fizz?

### Lecture

6. How does pH affect marine organisms?
  - a. What organisms will be affected by low pH?
7. Where does the CO<sub>2</sub> come from?
  - a. Show ppts on CO<sub>2</sub> from Mauna Loa, carbon sinks and pH forecasts
  - b. Ppt on corrosive upwelling water
8. Visible physical impacts on larvae

**9. Is high CO2 bad for all marine organisms?**

- a. Seagrasses seem to do really well with elevated CO2
  - i. Video of CO2 vents near Italy
- b. Kelp seem to have lowered growth rates

**Wrap-up**

- 1. Who loses in an acidified world?
- 2. Who wins?
- 3. The main point is that we expect a CHANGE in community members, not the extinction of all marine life

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- 4. Nothing is as clean as this story. If you feed organisms enough they seem able to compensate for negative impacts from acidification.
  - a. Gives them energy to pump ions to make a more favorable chemical environment