

How my roots have shaped  
my life and paved the way for  
a career I believe in

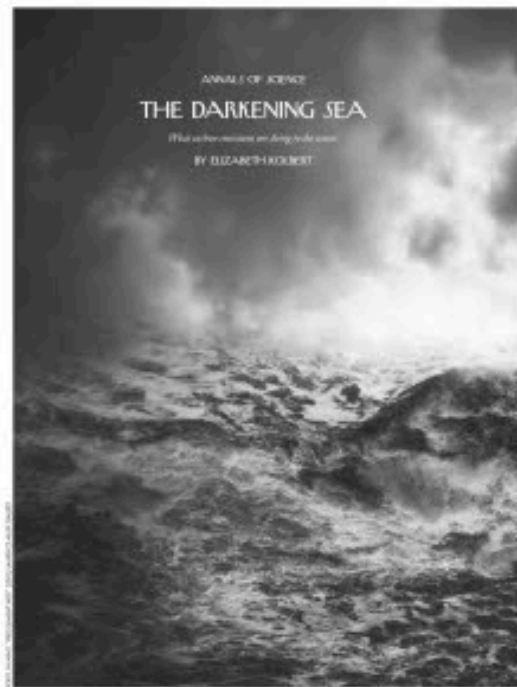
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Ocean Conservancy

# Let your roots shape you and your choices

- My roots are with the sea
- I've let these roots shape my life and my choices



# Your guiding principles can lead you to amazing opportunities



Pteropods are tiny ocean organisms that belong to the very hardiest class known to zoologists. In fact, usually, they swim by means of a pair of weighty, gummy flaps and feed by strapping over their mouths a series of little shells.

Victoria Foley, an oceanographer at California State University at San Marcos, is one of the world's leading experts on pteropods. She is slight and soft-spoken, with wavy black hair and blue-green eyes. Foley fell in love with the ocean at a teenage age, visiting the Outer Banks, off North Carolina, and took up pteropods when she was in high school, in the early 1980s. At that point, most biologists thought the animals had gone to be extinct, and, for her dissertation, Foley decided to study their shell growth. Her plan was to raise pteropods in tanks, but she ran into trouble immediately. When she added pteropods to her aquarium, the most common, and slowly died. Foley tried using Daphnia tanks for her pteropods, but the only solution, she realized, was to use the tanks "the quicker they died."

After awhile, she resigned herself to never actually observing any specimens. This, in turn, meant going out on just about any research ship that would have her. Foley developed a strategy. If David, the person that would be assigned to her, she would catch some pteropods, either by using a net or by using a diver, and place them in one of the tanks that would survive, so that she had a little small amount of evidence to return to.

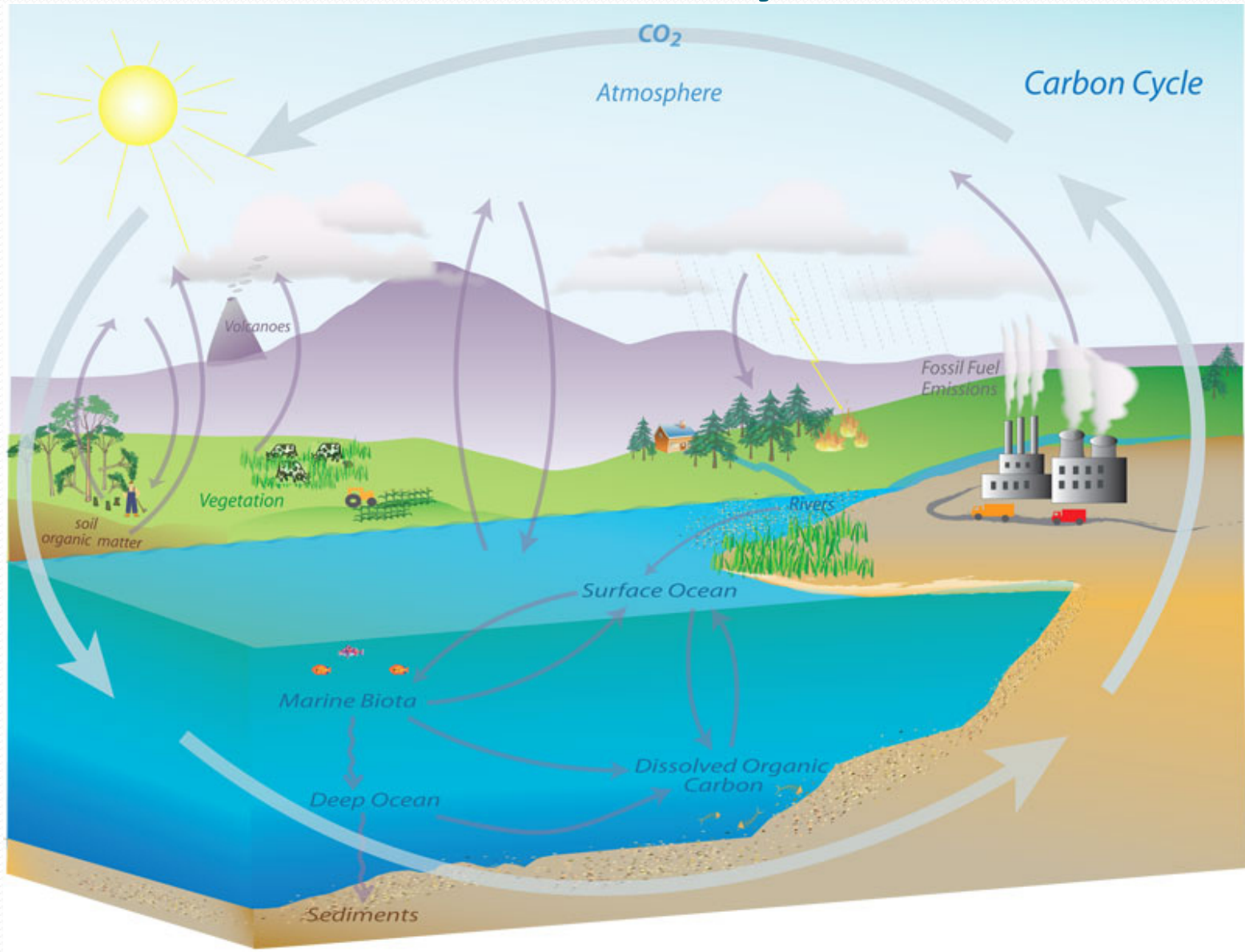
Forty-eight hours later, she would remove the pteropods from the tanks, check them to make sure they were still alive, and pull their bodies out with a pair of tweezers. Back to back, she would measure how much carbon 14 their shells had taken up during their two days of captivity.

In the summer of 1985, Foley got a berth on a research vessel sailing from Honolulu to Alaska Island. Late in the trip, near a spot in the Gulf of Alaska known as Sooty Spots, she came upon a

THE NEW YORKER, NOVEMBER 20, 2006 47

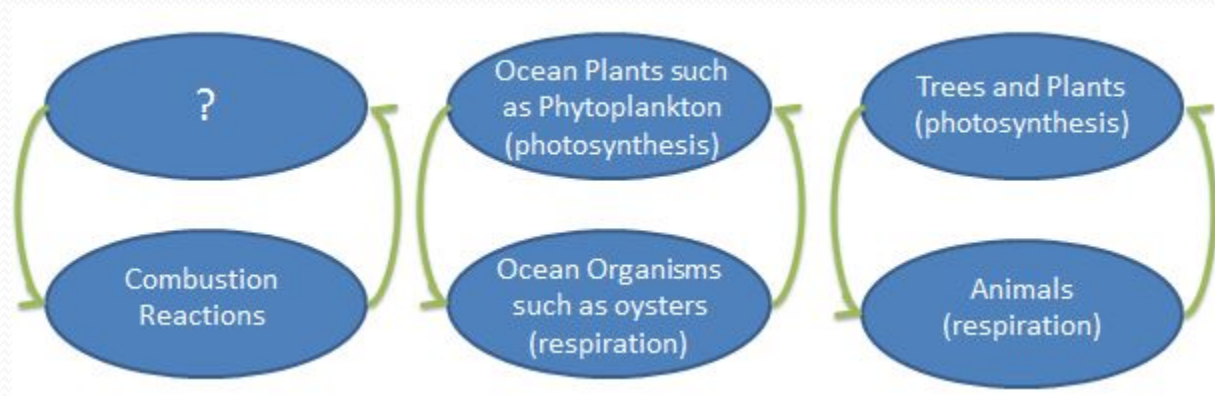
Elizabeth Kolbert, Annals of Science, "The Darkening Sea," *The New Yorker*, November 20, 2006, p.

# Carbon cycle



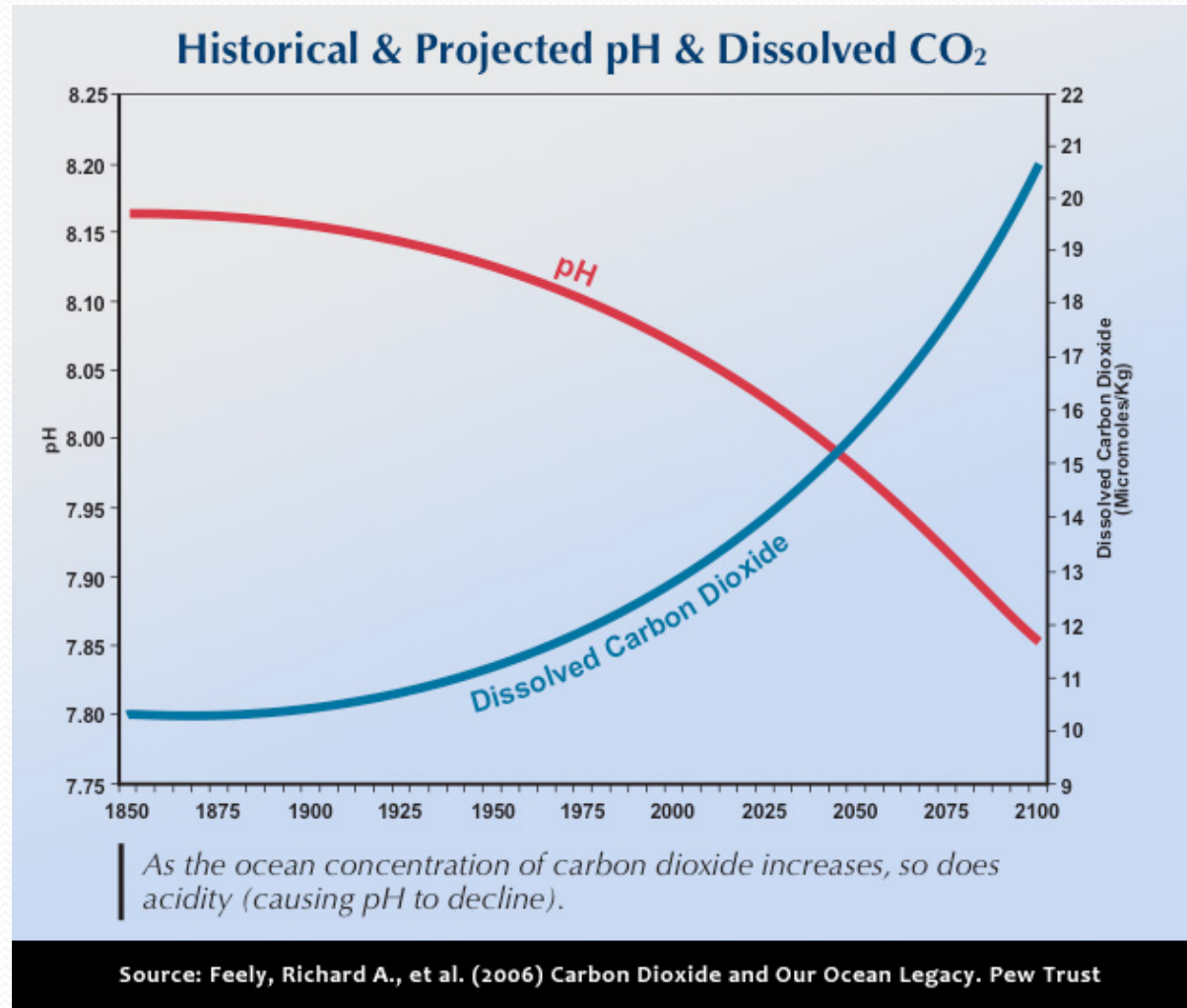


# Is our carbon cycle out of balance?



# What happens when CO<sub>2</sub> goes into the ocean?

- ~30% of the CO<sub>2</sub> emitted into the atmosphere dissolves into the ocean
- When CO<sub>2</sub> dissolves into water, it forms an acid
- The pH of the ocean has dropped 30% since the industrial revolution



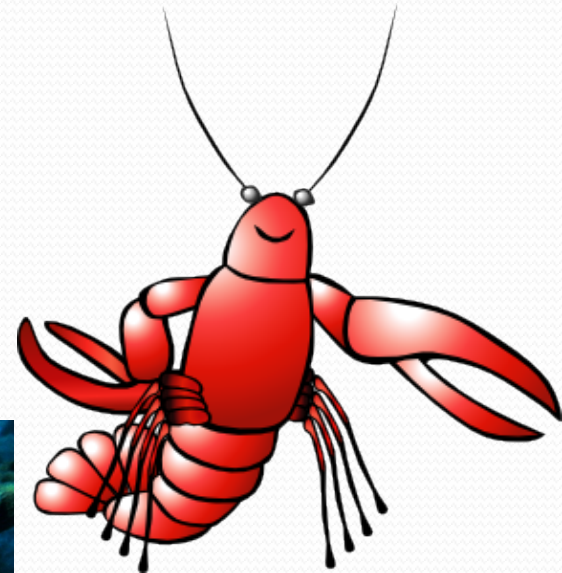
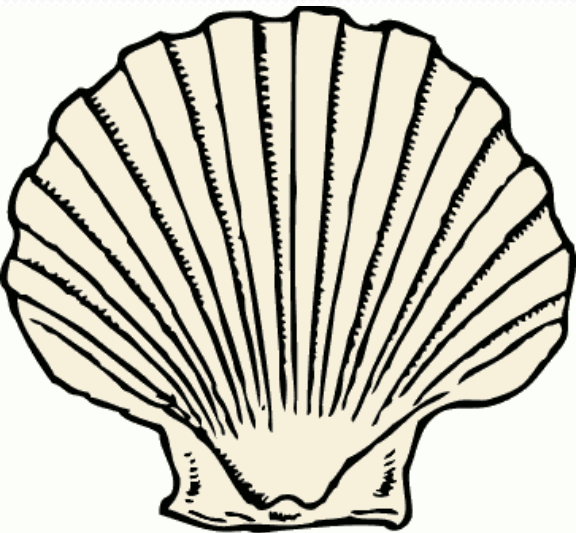
# Oceanic pH affects chemical and biological processes

- Some molecules will only form in ocean water when the pH is above a certain level
- Calcium carbonate is one of these molecules
  - When the pH gets too low, calcium carbonate does not form very easily in ocean water

$\text{CO}_2 + \text{seawater} = \text{carbonic acid}$   More carbonic acid =  pH

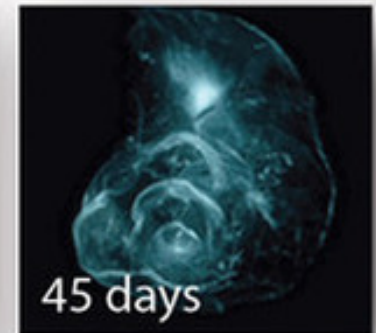
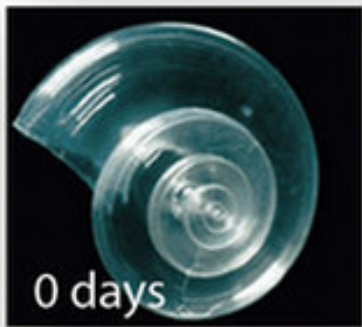
 pH = less calcium carbonate

Calcium carbonate is the building block of shells and skeletons

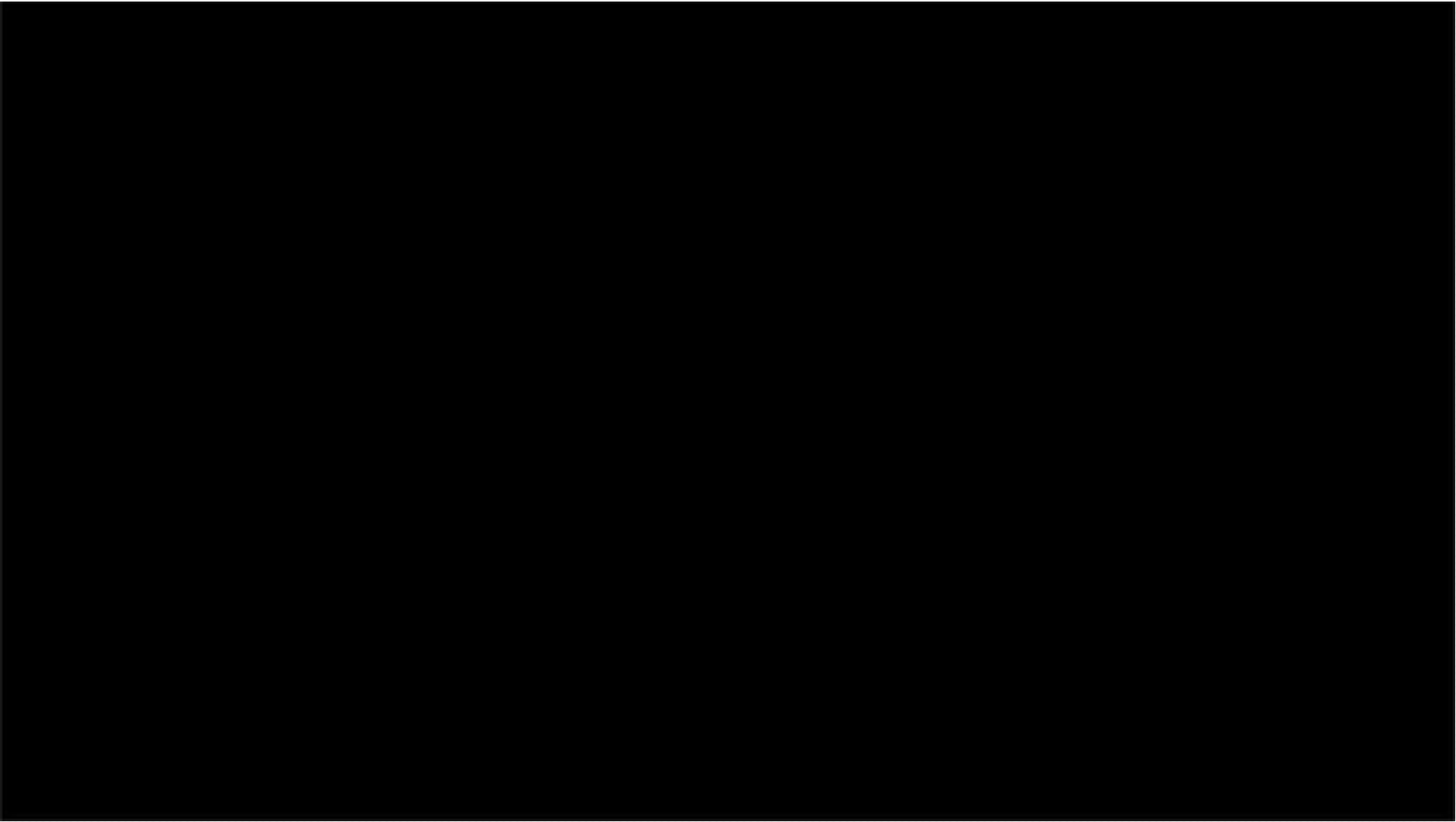




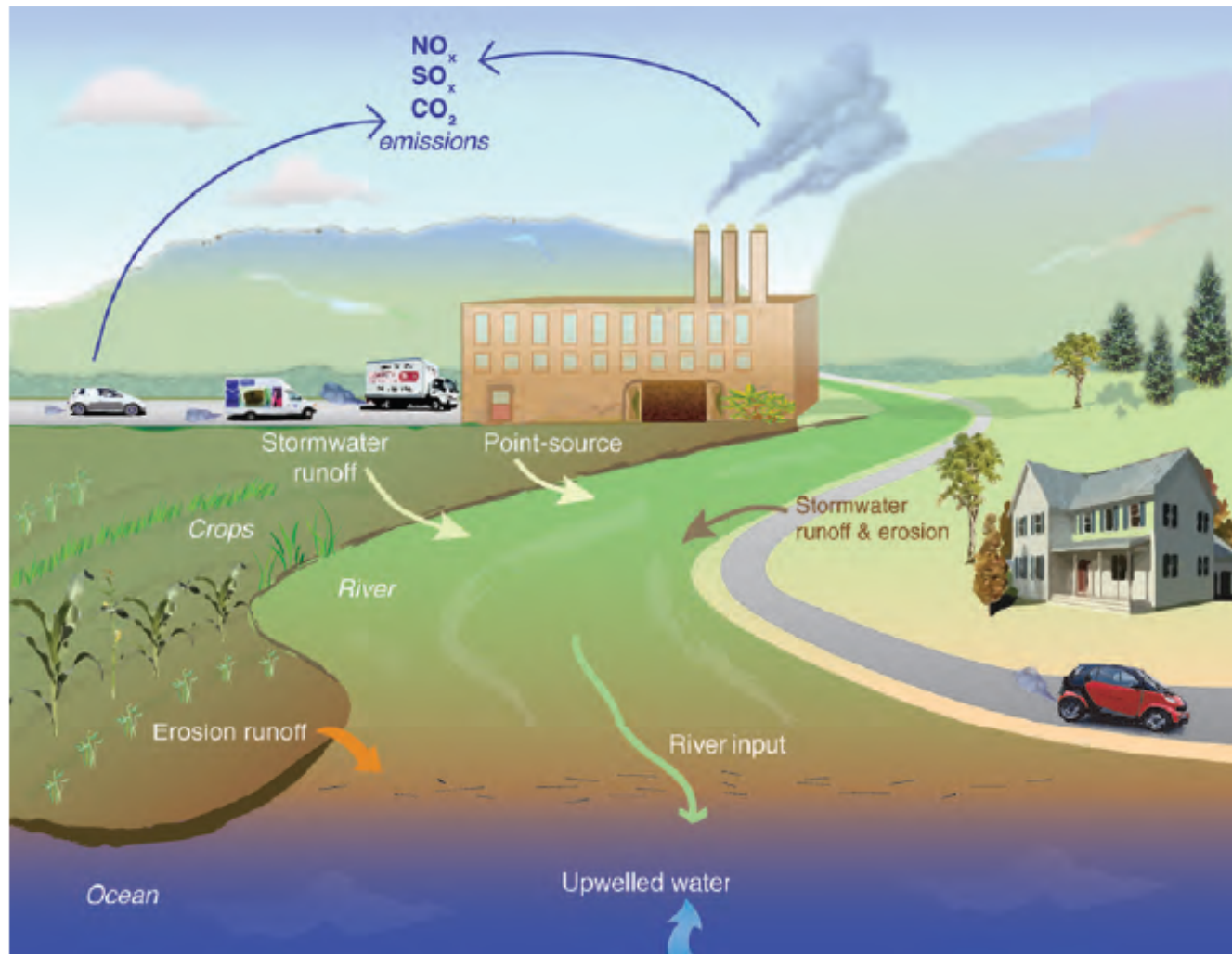
# What happens to shells when the pH gets too low?



Shell dissolution after exposure to pH expected by 2100



# Other sources of acidification



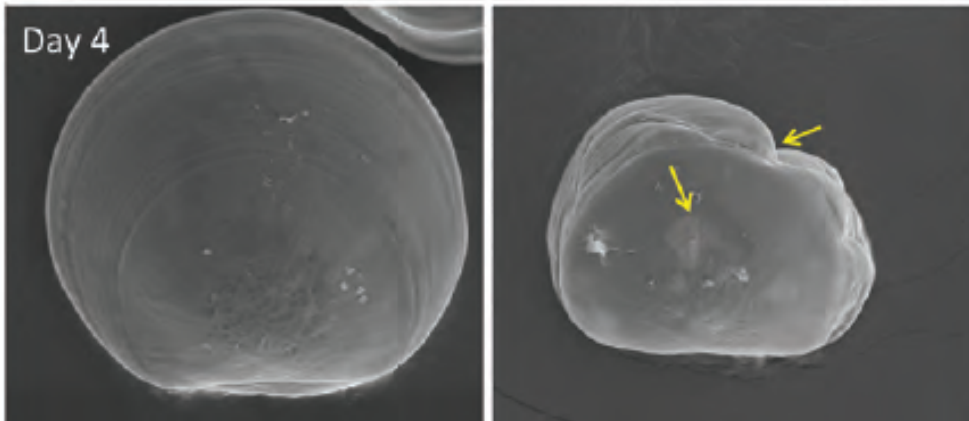
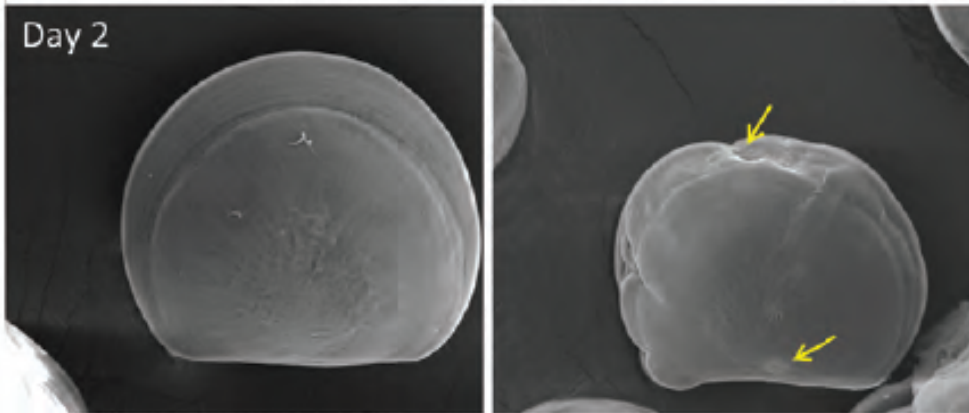
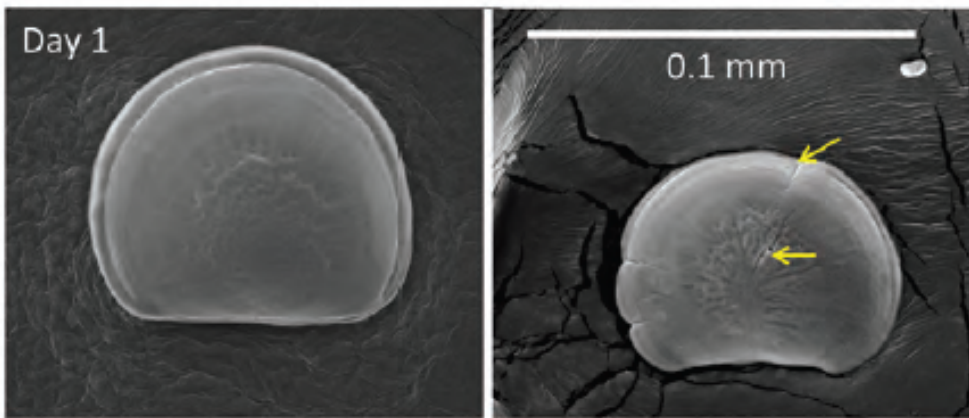
**Figure 2.** A range of sources, including upwelled seawater rich in carbon dioxide ( $\text{CO}_2$ ) and excess nutrients and organic carbon from point and nonpoint sources, can contribute to acidification of marine waters. Absorption of carbon dioxide, nitrogen oxides ( $\text{NO}_x$ ), and sulfur oxides ( $\text{SO}_x$ ) from the atmosphere into marine waters may also be important in some local areas (adapted from Kelly et al., 2011).<sup>29</sup>

# Oyster industries struggle to survive

- Hatcheries in the PNW experienced massive larval die offs
- \$270 million/yr industry in the state in dire straits!
- Low pH -> limited  $\text{CaCO}_3$  -> dissolving shells?





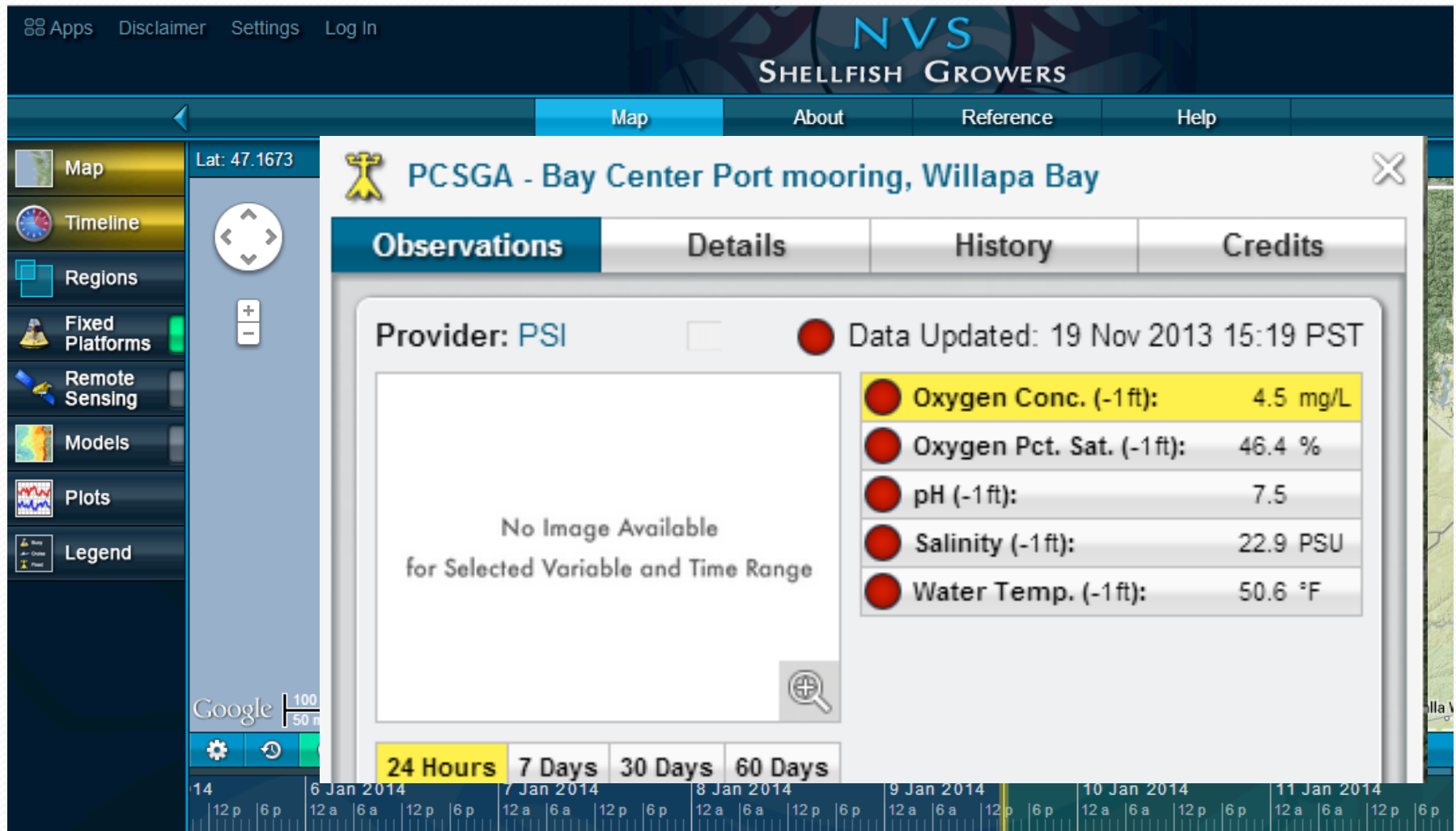


$\Omega$ Aragonite = 1.64  
pCO<sub>2</sub> = 403 ppm  
pH (total) = 8.00

$\Omega$ Aragonite = 0.47  
pCO<sub>2</sub> = 1418 ppm  
pH (total) = 7.49

Pacific oyster larvae from the same spawn, raised by the Taylors Shellfish Hatchery in natural waters of Dabob Bay, Washington under favorable (left column, pH (total) = 8.00) and unfavorable (right column, pH (total) = 7.49) carbonate chemistry.

# pH monitoring at hatcheries



# What are other effects of OA?





# Natural CO<sub>2</sub> vents give us a view of the future



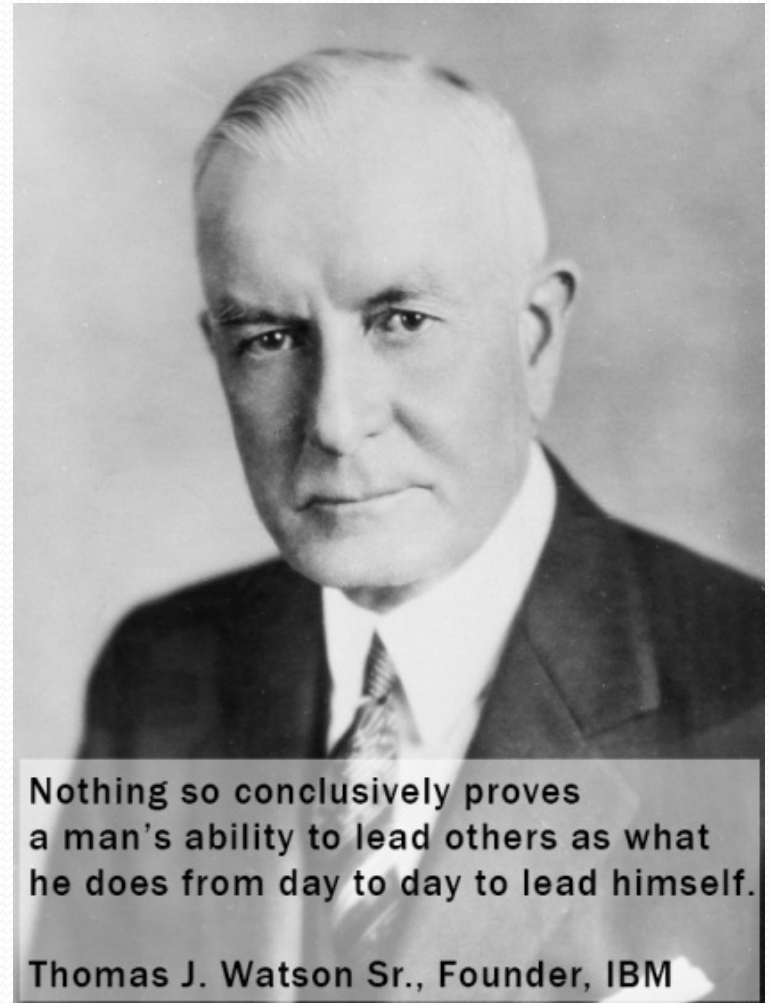


# Holding on to my roots, despite lack of options

- Finding a way to incorporate my beliefs and interests into my academic projects
  - Ex: OA as a topic in classes
  - Creating a new kind of honors thesis in the biology department
  - Finally, applying for a Watson!

# Thomas J. Watson Fellowship

- 1 year
- Solo research/travel
- Exploring your passion way outside of your comfort zone
- My journey?
- Thinking Outside the Lab:  
Discovering the Human Toll of Ocean Acidification
- Norway, Hong Kong, Thailand, New Zealand, the Cook Islands, Peru













# Sechura Bay, Peru

- Booming scallop industry is backbone of entire region's economy





# The industry affects many lives













# Aitutaki, the Cook Islands



<http://thevakacruise.com/wp-content/gallery/aitutaki/aitutaki-newaerial.jpg>





# What did I learn?

- Goal: to understand how OA might affect human communities around the world
- Reality: it allowed me to deepen my understanding of how communities interact with and depend on their environments, how those interactions can be healthy or unhealthy, and how we can strengthen and repair unhealthy relationships with the environment



# Since returning home...





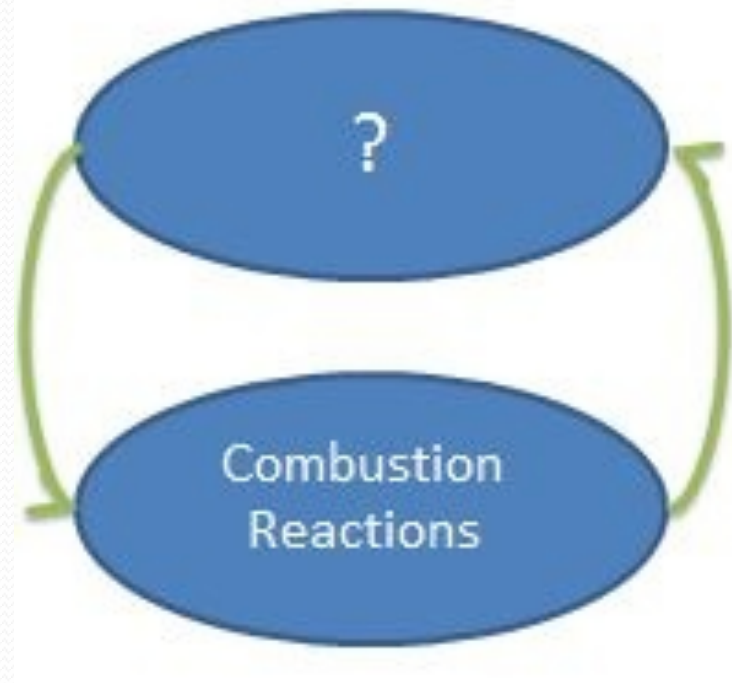
# What makes islands special places?

- Most parts of the world, the environment is out of sight and out of mind
- Not on islands!
- Islands are highly dependent on their environment
  - Dominant industries:
    - Tourism
    - Primary production (i.e. fishing, farming)
- Inhabitants truly live *in* their environment, and see the impacts of their actions



# What has created our world's greatest problems?

- An unhealthy relationship with our environment
- This has guided unsustainable growth and pollution



# How do we fix these problems?


- By building a healthy relationship with our environment
- This principle needs to span all disciplines and all industries



# What career opportunities exist that will help fix these problems?

- Social sciences
- Natural sciences
- Policy
- Advocacy
- Education
- Business, marketing, finance





How can you find a job and  
help heal the world?

Follow your principles and let  
them shape your life!