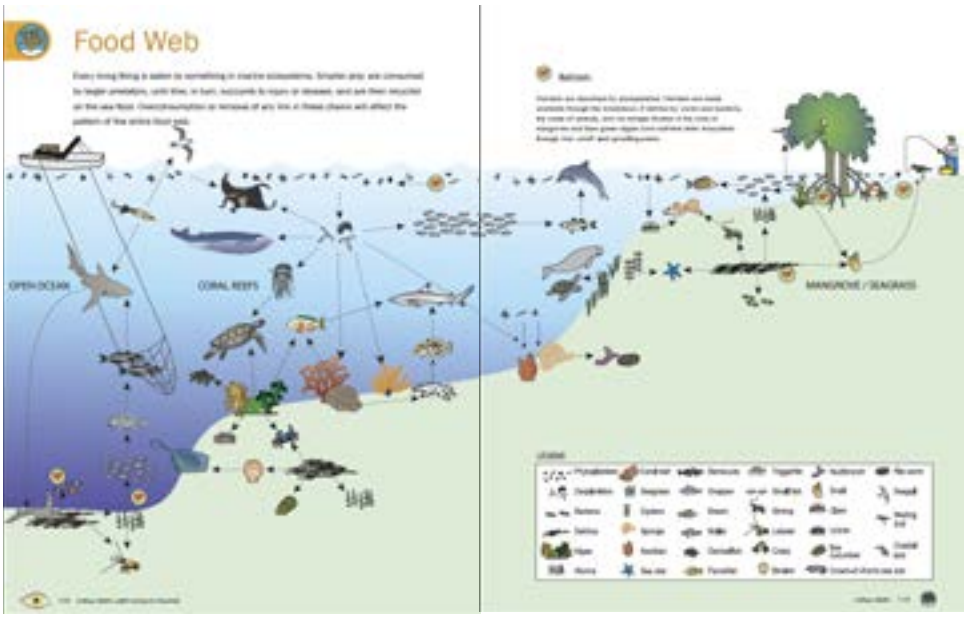
Effect of Ocean Acidification

Subject matter: describe the potential consequences of ocean acidification for coral reef ecosystems.

Recommended reading: Coral Reefs and Climate Change - Ocean acidification (p.68-71), Fish in trouble (p.72-73)
View video: Coral Reefs and Climate Change DVD series - Climate Change

Effect of pH acidification on animals - Classroom

Draw a simple marine food web or use the drawing below. Highlight which animals may be directly affected by ocean acidification? Describe how this will affect other marine organisms?



Effect of pH acidification on Arthemia's eggs - Lab

Prepare two days before:
Eggs of Arthemia (baby brine shrimp) in solutions with different pH or salinity. They will hatch in 18-30 hours. Using a binoccular, count the number of eggs and shrimps. Evaluate the best conditions and list other abiotic factors which influence the hatching. Describe different factors that influence the pH of waters and their effect on shrimps.
See also: http://mylabolog.blogspot.com/2015/02/diy-brine-shrimp-or-artemia-hatchery.html

Artemia eggs
Hatch rates are often touted as high as 95% on many non-decapsulated brands, but the tragic reality is that in many domestic cases only around 40% yield is actually attained. Several factors need to be considered when hatching Artemia eggs. Temperature plays a huge role, with 25°C/77°F consistently showing to be optimal for success. Salinity of water should be very high and a specific gravity of 1.030 should be aimed for at 25°C.
Water needs to be both hard and alkaline, with a pH of 9.0 favourable. Anything below 8.0 has a big impact on hatching and success rates. The most common flaw is failing to provide a light source. Inside the Artemia egg is a chemical called trehalose which is triggered by a light source to turn into glycerol. This is a hygroscopic chemical and draws water through the membrane and into the Artemia itself, starting the hatching process.
Some Artemia have been known to hatch in the dark, but these exceptions not fully understood, and do not represent successful hatches. Adding an artificial light source to San Francisco brine shrimp is known to increase hatches by 50% or more. To successfully produce Artemia from eggs, a volume of water needs to be vigorously aerated for movement with the eggs in it. These will hatch in the conditions as stated in around 18 hours, although a second smaller hatch can also occur afterwards.

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Ocean acidification - Lab

In preparation of this activity, you will need to collect plankton and calcareous algae. To collect plankton, use a plankton net, trawl through the water for 10 minutes and seal the collected plankton in a jar.

1. Look at the algae sample you collected in the field:
   a. Add filtered sea water to the algae, seal it and gently shake.
   b. Tip the water into a plastic beaker and repeat this process twice.
   c. Using a pipette, extract a small amount of the seawater, place on a microscope slide and view it under a microscope.
2. Looking in the water column sample you collected in the field:
   a. Wash the plankton net with filtered seawater to improve extraction of micro organisms.
   b. Tip the jar into a clean plastic beaker.
   c. Using a pipette, extract a small amount of the seawater, place on a microscope slide and view it under a microscope.
3. Use books and websites to identifying what you have found and note the abundance of plankton. Draw and identify two dominant plankton from each section, using identification charts. Also identify and draw your calcareous algae.
4. Take two equal sub samples of plankton-filled seawater from each substrate type. Add 10ml of filtered seawater to one sub sample, add 10ml of soda water, vinegar or another dilute acid in the other. Leave the samples to sit for half an hour. Now use the pipette to prepare a slide of normal plankton and acidified plankton. (This is an extreme case of acidification that does not reflect current realities).
5. Collect two samples of calcareous algae, place one in dilute acid and the other in filtered seawater overnight. Observe any visible changes in the two samples.

Plankton drawings	

Algae drawings	

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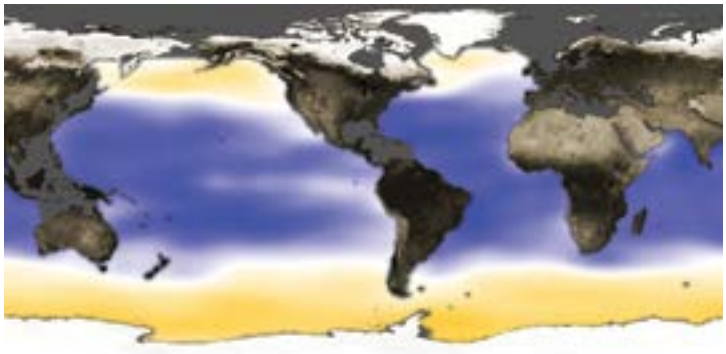
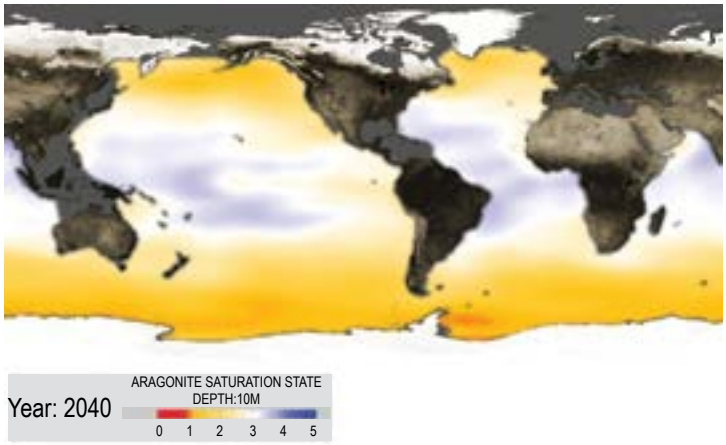
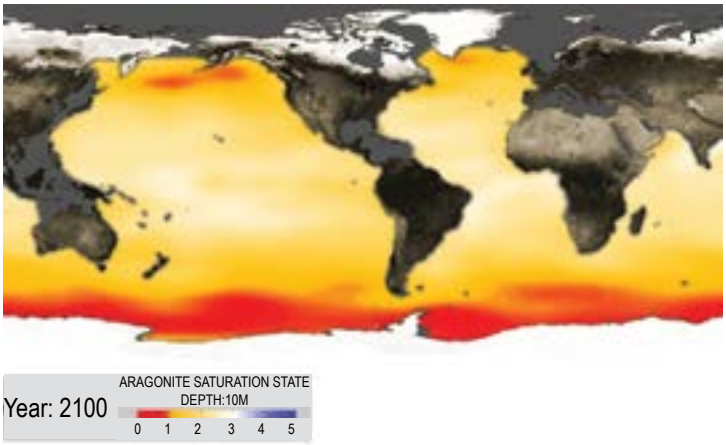
Ocean pH - Classroom

Look at the maps highlighting ocean pH across the globe. Which areas of the oceans are most at risk of ocean acidification? Use your understanding of gas laws and gas solubility in fluids to explain why some oceans absorb more CO_2 than other areas. (Tip: You can search for this answer on the internet or in a textbook).
You can test this effect by looking at soda water. What happens to the carbon dioxide bubbles when soda water is heated?







Aragonite saturation states

Plankton, corals and shell-building organisms all depend upon an ocean that is saturated in aragonite. Its abundance reduces the amount of energy these organisms need to expend to build their calcified skeletons. Aragonite concentrations in the tropical oceans have already fallen from Ω=4.6 to Ω=4.0. This has resulted in reductions in the density of coral skeletons and changes in the structure of some phytoplankton species. As aragonite saturation levels fall, the capacity of corals and many other shell-building species to build their skeletons will be reduced.