SAVE THE PLANKTON, BREATH FREELY
Adapted from National Geographic: http://education.nationalgeographic.com/education/activity/save-the-plankton-breathe-freely/?ar_a=1

PURPOSE
In groups of 3, students collect and analyze data to determine the average number of breaths they take in one day and how many of those breaths were full of oxygen produced by phytoplankton.

TEACHER BACKGROUND INFORMATION
Although most students believe that trees on land provide most of our oxygen, it is Prochlorococcus and other ocean phytoplankton (also known as microalgae, are similar to terrestrial plants in that they contain chlorophyll and require sunlight in order to live and grow) that are responsible for 70 percent of Earth's oxygen production. However, some scientists believe that phytoplankton levels have declined by 40 percent since 1950 due to the warming of the ocean.

Ocean temperature impacts the number of phytoplankton in the ocean. Phytoplankton need sunlight and nutrients to grow. Since phytoplankton depend on photosynthesis, they have to live near the ocean surface. Nutrients come to the surface as a result of the global conveyor belt—an upwelling current that circulates cold water and nutrients from deeper waters to warmer surface waters. As the oceans warm, there is less circulation of warm and cold water by the global conveyor belt. As a result, less mixing and circulation is occurring between the ocean depths. As the ocean water gets warmer, there are fewer nutrients for the plankton to eat. This means less photosynthesizing, which decreases phytoplankton's carbon dioxide absorption and oxygen production.

Phytoplankton are extremely important to the Earth’s carbon cycle; they help to process and store carbon (good to remember for later when you get into the Ocean Acidification activities). In addition to oxygen production, phytoplankton are responsible for most of the transfer of carbon dioxide from the atmosphere to the ocean. Carbon dioxide is consumed during photosynthesis and the carbon is incorporated and stored in the phytoplankton. This is similar to how trees store carbon in their leaves and wood. Worldwide, this plankton “biological carbon pump” transfers about 10 gigatonnes (1 gigatonne=1 billion tons) of carbon from the atmosphere to the deep ocean each year. Even small changes in the growth of phytoplankton may affect atmospheric carbon dioxide concentrations, which would cause further climate change and speed up the warming of surface temperatures.

Humans can protect plankton and help overall ocean health by decreasing pollution, overharvesting, and habitat destruction.

Also see What are Phytoplankton? at http://oceanservice.noaa.gov/facts/phyto.html.

MATERIALS FOR GROUPS OF 3
- pencils (teacher/student provides)
- stopwatch
- student worksheet
- balloon (only if you do extension)
- beaker with water (only if you do extension)
**Procedure**

1. **Discuss Earth's oxygen resources.**

   Ask: Where does the oxygen we breathe come from? Explain to students that rainforests are responsible for roughly one-third (28%) of the Earth's oxygen but most (70%) of the oxygen in the atmosphere is produced by marine plants. The remaining 2 percent of Earth's oxygen comes from other sources. The ocean produces oxygen through the plants (phytoplankton, kelp, and algal plankton) that live in it. These plants produce oxygen as a byproduct of photosynthesis, a process which converts carbon dioxide and sunlight into sugars the organism can use for energy. One type of phytoplankton, Prochlorococcus, releases countless tons of oxygen into the atmosphere. It is so small that millions can fit in a drop of water. Prochlorococcus has achieved fame as perhaps the most abundant photosynthetic organism on the planet. Dr. Sylvia A. Earle, a National Geographic Explorer, has estimated that Prochlorococcus provides the oxygen for one in every five breaths we take.

   Here is an excellent 6 min TED video The Secret Life of Plankton, as an intro to what plankton look and act like. This is also good if you do the “The Great Plankton Race” activity. www.youtube.com/watch?t=342&v=xFQ_fO2D7f0

2. **Have students collect and analyze data.**

   Distribute a copy of the worksheet Breath Calculations to each student. Then divide students into small groups of three to measure and record the number of breaths taken in 30 seconds. **(NOTE: It's best to do three trials and have the students find their average breath in 30 seconds first, then do the calculations.)** Ask them to assign roles: timer, breather, and data recorder. After all groups have collected and recorded their data, have students independently calculate how many breaths they take in one minute, one hour, and one day. Finally, have students calculate the number of breaths that come from the phytoplankton, Prochlorococcus.

3. **Discuss the importance of phytoplankton and ways humans can positively influence phytoplankton levels and overall ocean health.**

   Explain to students that phytoplankton form the base of the marine food web. The health of all organisms in the ocean is connected to the health of phytoplankton. Use the provided Carbon Cycle illustration and information in the Background & Vocabulary tab of this activity to build students’ content knowledge about phytoplankton's role in oxygen production and the carbon cycle. Ask: Why is it important that we protect our oceans and the plankton that live in them? What are some ways we can protect the ocean? Explain to students that they can help protect plankton by decreasing pollution, using less energy, urging individuals and companies to stop destroying habitat on land and in the ocean, and encouraging others to stop overharvesting ocean wildlife. An important part of saving the ocean is working together and educating others about why it is important.

4. **Optional: Have students create a t-shirt or bumper sticker.**

   Have students create a t-shirt or a bumper sticker to increase public awareness about the problem with their own ocean health outreach slogan; for example, Save the Phytoplankton—Breathe More Air!

   **Upon completion of lab, allow students time to view multiple samples of phytoplankton under microscopes.**