

Name: \_\_\_\_\_ Period: \_\_\_\_\_ Group Members: \_\_\_\_\_

**STUDENT WORKSHEET**  
**Lesson 2: Yeast Experiment**

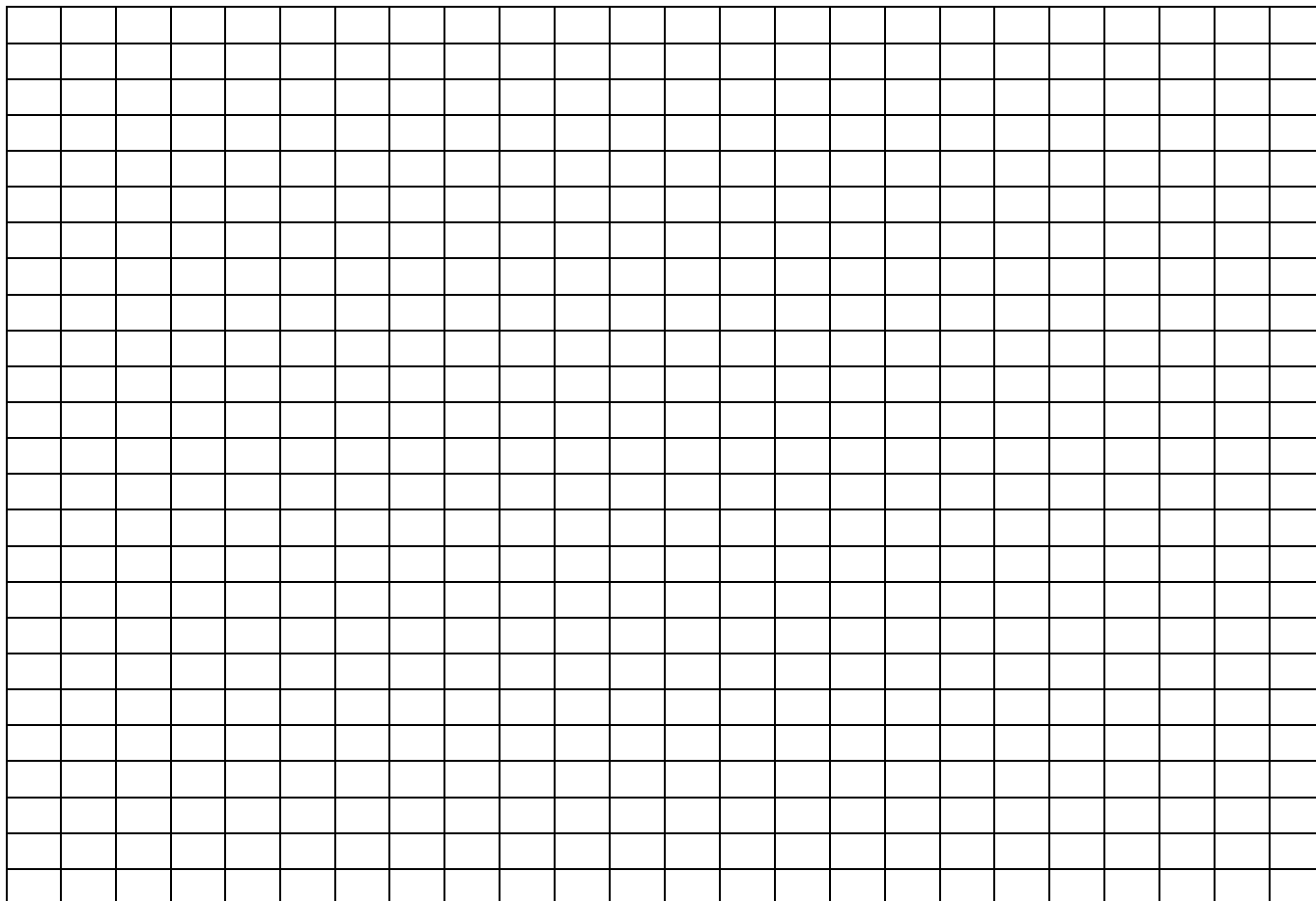
1. Make a prediction! After the yeast is activated, what will happen to the pH and CO<sub>2</sub> levels over time? Record your hypothesis here:
  
2. Record the readings from your sensor in the following table. Record a reading every 3 minutes. The value may jump around on the LabQuest, so watch it for 5 seconds, and record the highest value it gives you. You will be recording pH **OR** CO<sub>2</sub> concentration. After the experiment, get the data for the other measurement from the other members of your group. Record any observations for each time period.

<b>Time (minutes)</b>	<b>pH</b>	<b>CO<sub>2</sub> (ppm)</b>	<b>Observations</b>
0			
3			
6			
9			
12			
15			
18			
21			
24			

3. What do the following parts of the experimental setup represent?  
Round 500 ml bottle:  
BioChamber:  
Square 125 ml bottle:

4. What gas does the yeast produce?

5. Create a graph of the change in pH or CO<sub>2</sub> concentration (depending on which data you collected) over time using the grid below. Label your axes, and include units. Time (in minutes) will be on the x-axis.



6. Examine your graph and the graph created by the other members of your group. Interpret the graphs. Did the CO<sub>2</sub> concentration increase or decrease? What about the pH?

7. What is the relationship between CO<sub>2</sub> and pH? Explain.

8. What do the results of your experiment mean for the oceans?

Use the graphs on the next page to answer the following questions.

9. In Figure 1:

- a. How much carbon dioxide was in the atmosphere in 1988? \_\_\_\_\_ 2011? \_\_\_\_\_
- b. How much carbon dioxide was in the ocean in 1988? \_\_\_\_\_ 2011? \_\_\_\_\_
- c. What was the pH of the ocean in 1988? \_\_\_\_\_ 2011? \_\_\_\_\_

10. How do the data in the Station ALOHA curve compare to the data you collected?

11. In May 2014, the measured concentration of CO<sub>2</sub> at Mauna Loa reached 400 ppm for the first time, and exceeded 400 ppm between March and July 2014. How do the predicted CO<sub>2</sub> values from the models in Figure 2 compare with these measured values of Atmospheric CO<sub>2</sub>? Are the models right on, pretty close or way off?

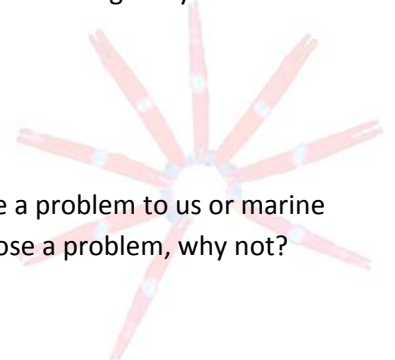
12. How do the predictions in Figure 2 compare with the station ALOHA data in Figure 1?

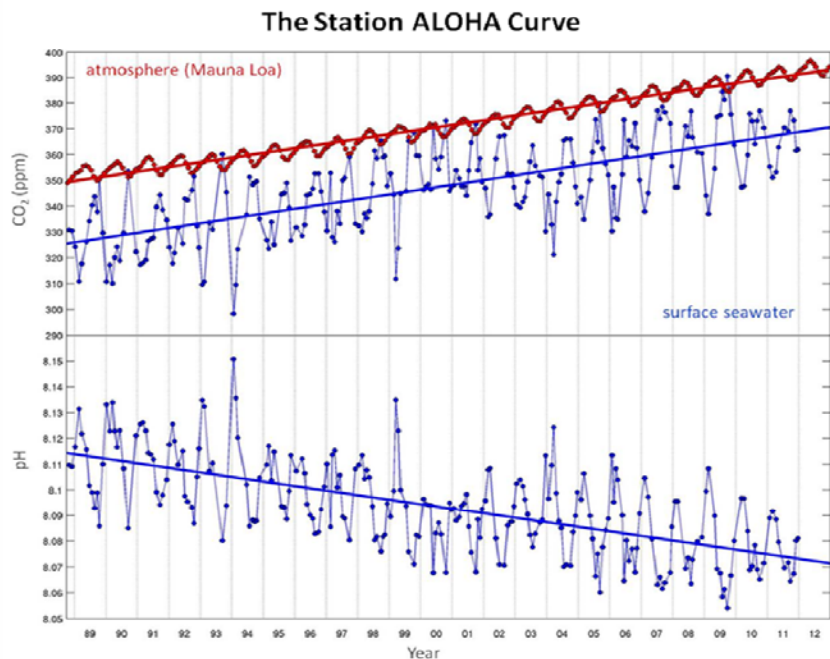
13. How do the different model predictions compare between 2000 and 2040? How do they compare between 2040 and 2100?

14. Why do you think there are bigger differences between in the predictions after 2040?

15. In your experiment, the Biochamber with the CO<sub>2</sub> probe represents the atmosphere. How do your measured values compare with the model predictions? Will the CO<sub>2</sub> in the atmosphere ever be as high as you measured in the experiment? Why or why not?

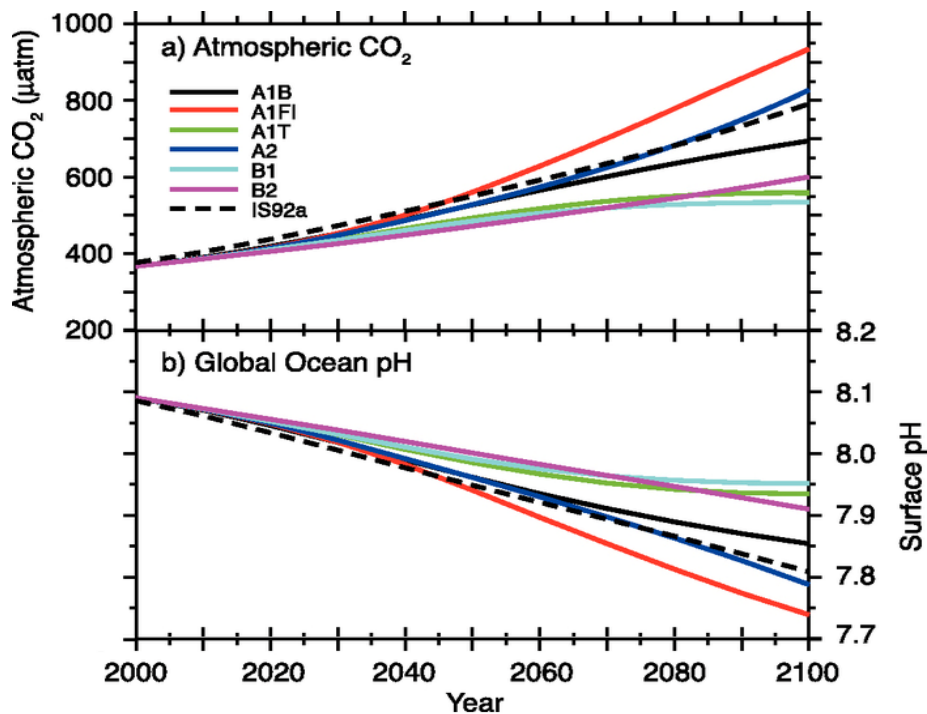
16. Based on your knowledge, does the increase in atmospheric carbon dioxide pose a problem to us or marine organisms? If so, what can you do to help alleviate the problem? If it does not pose a problem, why not?





**Figure 1** shows changes in the levels of atmospheric and oceanic carbon dioxide as well as a corresponding change in ocean pH measured over the past 20 years from the Hawai'i Ocean Time Series (HOT) and the Mauna Loa Observatory. The x-axis shows time in years, from October 1988 until December 2011. The y-axis of the top graph measures CO<sub>2</sub> concentration. This top graph shows how the CO<sub>2</sub> concentration in both the atmosphere (red line) and ocean (blue line) change with time. The actual data collected are shown with dots, and each line is the "best fit" to the data. The y-axis of the bottom graph measures pH of the ocean.

### Computer model CO<sub>2</sub> and pH predictions



**Figure 2** shows computer predictions of future CO<sub>2</sub> and pH levels based on recent data, known relationships in earth systems and our projected fossil fuel use. Each line represents predictions of future atmospheric CO<sub>2</sub> concentrations and the global ocean pH levels through 2100 based on different scenarios. Model projects modified from IPCC 2007 [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/figure-10-24.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/figure-10-24.html)