

Cellular Processes and Aquatic Systems 2

Part 1: Algae Culture Data

Your algae cultures have now had a week to grow and it's time to look at your results!

Follow the same procedures as last week to collect two types of data from your cultures. Be sure to record your data using the data tables you created last week.

Algae Sample Microscopy

1. Obtain a blank slide and cover slips.
2. Shake or otherwise agitate your algae culture to make sure algae is suspended in the water.
3. Place 1 drop of water from your culture on your slide and create a wet mount. You can review how to make a wet mount using the video below:



4. Examine the slide under a compound microscope at 400x. If you need to review how to use the compound microscope, check out this video:



5. Find the area on your slide where algae cells are densest. Count and record the number of algae cells that you can see in your field of vision (i.e. how many algae cells you can count in a single spot without moving the microscope slide).

6. Record qualitative (i.e. non-numerical) observations of your algae sample. What color and shape are the cells? Do they look alive? Do they look healthy? Are they clumped or arranged in a particular way? You may want to make a quick sketch or try to take a picture of your sample.

7. Record the number of algae cells you were able to count on your slide. You may want to make a data table to keep track of the number of cells counted by each member of your group.

8. Calculate the average of the cell counts from your lab group, then report that value to your TA. (Were there any outliers you felt you should exclude from this number?)

Spectrophotometer Procedure

1. Check that the sample compartment in the spectrophotometer is empty, then turn on the spectrophotometer using the toggle switch near the power cord. Allow 20

minutes for the spectrophotometer to warm up--do not press any buttons until the initialization sequence is complete.

2. Obtain 2 cuvettes and clean them with a KimWipe. Once the cuvettes are clean, try to only touch them by the top and bottom. Any fingerprints or other smudges on the sides of the cuvettes may influence the spectrophotometer's measurements.

3. Use a pipette to fill 1 cuvette with pure culture media. Fill the second cuvette with a sample from your algae culture. Be sure to shake or otherwise agitate the culture to suspend the algae before taking your sample.

4. Press the blue "A/T/C" button until "A" appears on the right side of the display window.

5. Use the blue "nm ▼" (nanometers down) or "nm ▲" (nanometers up) keys to set desired wavelength (450 nm).

6. Press the blue "0 ABS/100%T" button. Make sure sample compartment is empty and the cover is closed.

7. Insert your pure culture media cuvette into the sample compartment. Make sure the guide mark on the cuvette faces toward the front of the machine and the cuvette is seated firmly in the compartment. Gently lower the lid on the sample compartment.

8. Press the blue "0 ABS/100%T" button. The display should read "0.000 A". You have now calibrated or "zeroed" the spectrophotometer.

9. Remove the pure culture cuvette from the sample compartment and replace it with the cuvette containing a sample from your algae culture. Make sure the guide mark on the cuvette faces toward the front of the machine and the cuvette is firmly seated in the compartment. Gently lower the lid on the sample compartment.

10. Read and record the percent absorbance value from the digital readout. Remove the algae culture cuvette and close the compartment lid. Report the percent absorbance value to your TA.

If you need to review how a spectrophotometer works and what it measures, look back at last week's lab activity. Remember that you need to calculate the difference between your original values (from the last lab) and your values after a week of growth (from this lab).

Once every group in your lab section has collected and reported their data, your TA will compile it into one Excel or Google Sheets document. You will then use this data to create at least two graphs, either with your lab section or in your individual lab group.

Part 2: Graphing and Interpreting Results

Now you will take a look at the results for both your algae experiment and the ocean pH experiment that you participated in last week. You can also view the final seashells from the ocean pH experiment.

Your TA will provide you with these datasets in an Excel or Google Sheets document. Either as a lab section or in your individual lab groups, create at least one graph for each set of data.

When deciding how to represent your data with a graph, consider the possible functions of a graph. Which function is your data serving? Which kind of graph would be best to use for each of these functions?

- Following changes over time
- Comparing parts of a whole
- Looking for a relationship between two variables
- Comparing two values

After you have finished creating and interpreting your graph, discuss and answer the following questions with your lab group:

1. How did you decide which type of graph to make for each set of data?
2. Did the results of your experiment match what you predicted? If not, do you have any ideas about why there was a difference?
3. Why did you need to report the difference between your original value and the value after one week of growth instead of reporting the raw numbers?
4. Did you see similar trends in both the cell count and absorbance data? If there were differences, why do you think that was?
5. What flaws can you identify in your experiment? If you were to do this experiment again in the future, what improvements would you make?

6. What did this data tell you about the optimal conditions for culturing *Chlorella* algae? If you were going to start an algae culture, what conditions would you utilize to promote maximum growth?

Part 3: Observing Aquatic Systems

Over the past two labs, you have learned a lot about how cellular respiration and photosynthesis can impact and be impacted by their environment. Today, you will take your knowledge and apply it to making predictions about actual mini "ecosystems".

There are four aquariums set up in your lab room. Each aquarium contains dechlorinated water (to make it safe for aquatic organisms), a LED light, and a water heater. Some aquariums have additional organisms added to them.

Aquarium 1	No organisms
Aquarium 2	Animals (mystery snails) only
Aquarium 3	Plants (<i>Elodea</i>) only
Aquarium 4	Animals (mystery snails) and Plants (<i>Elodea</i>)

Below you will find some brief information about the organisms in these aquariums:

Mystery Snails

Mystery snails are gastropod mollusks found in freshwater environments. The species you will be working with in lab (*Pomacea diffusa* aka the spike topped mystery snail) is native to the Amazon basin but has also been introduced outside its native range by human activity.



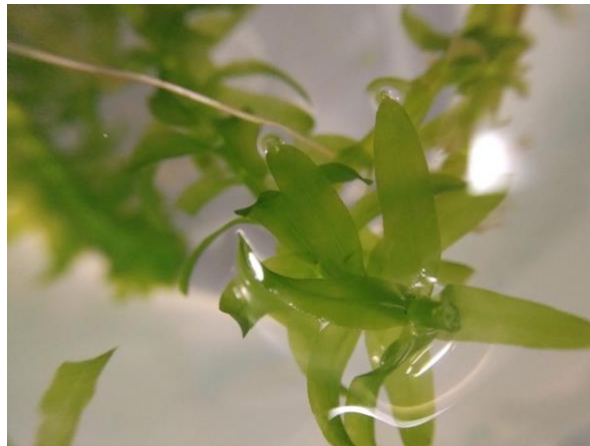
Mystery snail

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Mystery snails are very hardy and can adapt to a wide range of environmental conditions. They are able to obtain oxygen from both water and air thanks to having both gills and a lung. If you see a snail extending its siphon out of the water, it is breathing through its lung. These snails are primarily herbivores (plant-eaters) but will also eat decomposing organic matter. If you notice a cluster of pink dots on the glass above the water line, those are snail eggs.

Elodea

Elodea is a genus that contains several closely related species of freshwater plants. All *Elodea* species are native to the Americas, but some have been introduced to other continents due to human travel. Similar to mystery snails, *Elodea* is very hardy and adaptable.



Elodea

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Elodea is very fast growing, which means it requires high amounts of sugar and energy generated via photosynthesis and cellular respiration respectively.

Remember: These aquariums may contain other organisms that were not intentionally added--for example, algae and various types of bacteria (including nitrifying bacteria and bacteria that decompose dead tissue).

Discuss and answer the following questions with your lab group:

1. What kinds of metabolic processes would each of these organisms be carrying out? What are the inputs and outputs for each organism (consider carbon dioxide,

oxygen, and nitrogenous wastes). It may help to organize this information in a table or mind map.

2. Briefly sketch or diagram each of the aquariums and the organisms within. Now draw the molecular outputs and inputs of each organism. Do any of these outputs and inputs overlap or interact with each other?

Water Tests

You will be provided with chemical tests to measure each aquarium for the following items:

- pH
- dissolved oxygen (O₂)
- ammonia (NH₃--nitrogenous waste)

Before you continue, discuss and answer the following questions with your group:

1. What does pH allow you to indirectly measure (think back on last week's lab activities)? Explain.
2. Predict what the relative levels of pH, dissolved oxygen, and ammonia will be for each aquarium (you do not have to write exact values--"low" or "higher than aquarium X but lower than aquarium Y" is fine). Briefly justify each prediction. Looking at the diagrams you drew earlier may help.
3. How confident do you feel about your predictions? Are there any that you feel more or less confident about? Why?
4. Come up with a question that you have about these aquariums that you might be able to answer with the results of your chemical tests. The question can be about anything related to lab content. What kind of data would you need to answer your question?

Next, take some time to observe each of the aquariums. You may want to take notes on what you observe. How do the organisms look? Do they seem to be actively moving/growing or mostly dormant? Is there any decomposing waste or tissue that you observe? Do you see any evidence of algae or other organisms in

the aquarium? Record your observations in your notebook. How do you think these observations might impact your results? Do they change any of your predictions?

When you have finished your observations, follow the procedure below to conduct your chemical tests.

Procedure

1. Obtain 12 small test tubes with caps. Label four test tubes with the number of each aquarium (for example, label four test tubes "1", four test tubes "2", and so on).
2. Fill each of the three test tubes labeled "1" with 5 mL of water from Aquarium 1 using a pipette. Be sure to use the pipette that corresponds to Aquarium 1.
3. Fill each of the three test tubes labeled "2" with 5 mL of water from Aquarium 2 using a pipette. Be sure to use the pipette that corresponds to Aquarium 2.
4. Fill each of the three test tubes labeled "3" with 5 mL of water from Aquarium 3 using a pipette. Be sure to use the pipette that corresponds to Aquarium 3.
5. Fill each of the three test tubes labeled "4" with 5 mL of water from Aquarium 4 using a pipette. Be sure to use the pipette that corresponds to Aquarium 4.
6. For each chemical test, test one test tube from Aquarium 1 ("1"), one test tube from Aquarium 2 ("2"), and so on. Use the instructions in the provided handouts to carry out your tests. A copy of the chemical test instructions have also been provided [here](#).
7. Record the results of your tests in your lab notebook. You may want to create a data table to organize your findings.

IMPORTANT SAFETY NOTE: Keep the test tube caps on tightly any time you are not actively adding liquid to the test tubes. Avoid getting any of the chemical solutions on your skin or in your eyes. If you do get chemical solutions on your skin or eyes, alert your TA immediately so they can assist you in using the sink or eye wash.

Once you have finished collecting your data, discuss and answer the following questions with your lab group:

1. Did the results match your predictions? If not, how did they differ? Can you identify any reasons this might have happened?
2. What do your results tell you about the molecules cycling through these aquariums? Which "ecosystem" do you think is healthier? Why?
3. Compare your results with other students in your class. Did you all get the exact same results? If not, why do you think this might have happened? What could you have done to get more accurate data?
4. If you have kept an aquarium before, did this lab make you want to try anything new or do things differently? If you don't have any experience with aquariums, did this lab bring up any questions about how maintaining an aquarium works?

Part 4: Solutions and Reflection

During this lab and last week's lab you have seen how biological processes like cellular respiration and photosynthesis can influence a variety of real-world issues.

Split your lab group of four into two "mini groups" of two. For the next activity, one group will focus on the issue of **ocean acidification** and the other will focus on **algae blooms**. If you have a group of three, the person who will be working alone should get their first choice of topic.

With your "mini group", answer the following questions. You will need to use your lab computer or personal device to do outside research (be sure to record your sources!):

1. What are some of the main causes of this problem? Note that there may be multiple causes (and some that we have not covered in lab yet)--you can pick one or two to focus on.
2. What are some solutions to this problem? How are these solutions being utilized and who is utilizing them? Here you may focus on large scale solutions or small-scale, local solutions being used in individual communities.
3. How can you connect the causes of the problem and/or the solutions to biological processes like cellular respiration and photosynthesis?

Once you have answered these questions, share what you have learned with the other half of your lab group. You are welcome to draw pictures or diagrams (or pull up helpful pictures or diagrams from the internet) to help illustrate the information you are sharing. Your TA may also choose some groups to share what they have learned with the rest of your lab section.

As the final part of this activity, write a reflection encompassing the following questions. *Although your entire lab group can collaborate on ideas, each student should write their own reflection*

1. How does a deeper understanding of photosynthesis and cellular respiration change or impact your understanding of issues like ocean acidification and algae blooms?

2. Do any of the real-world issues or biological processes covered in this lab and last week's lab impact or have a connection to your life? Get creative--there may be connections that aren't immediately obvious.

Though not required, you are welcome to include drawings, diagrams, mind maps, etc. in your reflection to help communicate your thoughts.

Aquarium water testing activity adapted from [Interactions Between Photosynthesis and Respiration in an Aquatic Ecosystem](#) by Jane E. Caldwell and Kristi Teagarden.