Cooperative Learning Lesson Plan

Name: Lauren Huntington	**Grade level:** 10	**Expected Duration of Lesson (hours, minutes, days):** 90 minutes	**Date:** 4-6-15
Lesson Topic: Respiration and Photosynthesis **Title:** Observing the process of Photosynthesis **Essential Question:** What factors must be in place for photosynthesis to occur, or not to occur? **Lesson Summary:** In this laboratory activity, students examine the processes of respiration and photosynthesis by experimenting with the plant Elodea, and the chemical bromothymol blue in different environments.			

Standards/Benchmarks Addressed (use practicum district's or *Common Core* curriculum standards AND Discipline specific standards from relevant professional organization)**:**

Source	#	Content Area	Standard (write it out)
nextgenscience.org	HS-LS1-5. WHST.9-12.2	HS-LS1 From Molecules to Organisms: Structures and Processes	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Lesson Objectives: Students will be able to:

Using the knowledge gained about photosynthesis and respiration, students will be able to develop and write a hypotheses about the occurrence of photosynthesis with the presence of light and without light in a solution. Students will also be able to make observations and compare the amount of CO_2 present in a solution as well as measure the pH and observe and record their findings on a lab report with 95% accuracy.

Academic Language Objectives

Language students will learn:	**Language students need to already know:**
Elodea: an aquatic plant commonly found in freshwater lakes and and ponds, where it floats in the water column. Because it does not require a root system to survive, Elodea is commonly used in freshwater aquaria and can be purchased at pet stores **Bromothymol blue:** a pH indicator for reactions between strong acids and bases. It is mostly used in applications that require measuring substances that would have a relatively neutral pH, such as managing the pH of pools and fish tanks.	**Photosynthesis:** the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water. Photosynthesis in plants generally involves the green pigment chlorophyll and generates oxygen as a byproduct. **Respiration:** The conversion of oxygen by living things into the energy by which they continue life. Respiration is part of metabolism. Carbon dioxide is a waste product of respiration. **pH:** a measure of the hydrogen ion concentration of a solution. Solutions with a high concentration of hydrogen ions have a low pH and solutions with a low concentrations of H+ ions have a high pH. **Acid:** Aqueous solutions of acids have a pH of less than 7. **Base:** Aqueous solutions of bases have a pH of greater than 7.

Evaluation/Assessment: (Include samples in appendix)

Informal/Formative:	**Formal/Summative:**
Students will be informally assessed throughout the laboratory exercise by observation of group participation, and checking for understanding of the procedure.	Students will turn in a completed lab report as a group (see attached) for a grade to demonstrate completion and understanding of the content. Students will demonstrate individual knowledge of the processes of photosynthesis and respiration on the unit test, as well as turn in a short reflection of the lab.

Primary Instructional Model(s) used:	**Materials and Equipment Needed:**
Cooperative learning: Students will work in groups of 3-4, each with assigned roles to ensure the lab exercise runs smoothly and each student contributes.	100 sprigs of Elodea 2 liters of bromothymol blue solution Aluminum foil Straws Tubes or containers with screw caps (3 per group) Computers or iPads Lab report worksheets/instructions (see attached) Lamp electronic pH probes Erlenmeyer flasks (1 per group)

Step by Step Procedures:

	Expected time frame	What are you teaching? What is the content? What is happening? (include guiding questions and their purposes)	**Standard(s) being met**
Lesson Opening	**2 minutes**	**Anticipatory set:** The teacher will have written roles on the board before students enter class. 1. Typer 2. Materials/Handler 3. Helper/Time keeper 4. Materials/Handler When students are settled into their seats, the teacher will number them off into teams of 3 or 4 for the laboratory exercise, ensuring that at least one extrinsic student and one intrinsic student are in each group. The teacher will explain that their numbers correspond with the roles written on the board. The typer will type up the lab report for the team using the template available in the class's dropbox. Number 2 and 3 will retrieve the necessary materials, and perform the experiments. Number 4 will make sure the team stays on task, and help the rest of the group with their assigned roles.	

		Decisions: **Team size:** 3-4 students **Group dynamics:** Students will be purposefully numbered to try to include at lease one extrinsic student and one intrinsic student. **Roles:** 1. **Typer/Photographer:** This student will complete the lab report fro the team on his/her computer or iPad. (If the class does not have computers or iPads, a written lab report is acceptable.) This student is also responsible for taking pictures of each step of the experiment to put into the lab report. 2. **Materials/Handler:** This student will retrieve the necessary materials as shown on the lab instructions (attached). This student will also handle the materials and prepare the experiment. 3. **Helper/Time keeper:** This student will make sure the team is on task to complete the lab on time, as well as help other teammates complete their tasks. 4. **Materials/Handler:** This student will retrieve the necessary materials with team member number 2 as shown on the lab instructions (attached). This student will also handle the materials and prepare the experiment.	
Transition	**1 minute**	The teacher will allow the students to gather into their groups and settle into a lab spot in the classroom.	

Body of Lesson (note important transitions)	10 minutes	**The Lesson:** **Introduction:** The teacher will hand out the lab packet which includes step-by-step directions for the experiment as well as the lab report worksheet (attached). The teacher will explain the lab and go over the directions for the experiment. The teacher will explain that the purpose of the lesson is to examine the processes of respiration and photosynthesis, both of which they are familiar with from earlier classes. The teacher will introduce the materials including the plant *Elodea*. The teacher will explain that Elodea is an aquatic plant without a root system. It floats in the water column and is commonly found in lakes and ponds. When it is exposed to sunlight, the plant will begin photosynthesizing. The teacher will then introduce the bromothymol blue solution. The teacher will explain that bormothymol blue is used to measure pH. When CO2 is added to the solution, the pH changes and the solution changes color to a green or yellow. The teacher will explain that each team will retrieve three sprigs of Elodea, three tubes/ containers with lids, 75 ml of bromothymol blue in an erlenmeyer flask, enough aluminum foil to cover one tube/container, an electronic pH probe, and two or three straws. The teacher will briefly cover the steps of the experiment by explaining that the students will be using the straws and their own lungs to blow CO2 into the solution. Once they believe they have altered the color enough, they will use the electronic probe to measure the pH. Remind them to recored EVERYTHING!	

	15 minutes **50 minutes**	They will then poor the solution into the three containers evenly. They will place one sprig of Elodea in one tube and cap it, making sure the entire sprig is completely submerged. They will place two sprigs in one of the containers, and cover that one with aluminum foil so no light can enter. They will cap the third container with no Elodea, and place all of them under the lamp that has been set up. While the containers sit under the lamp, the students will work on their lab report. The teacher will then ask the students if they have any questions, and then allow them to begin on the team experiment. The students will read through the lab instructions and settle into their roles. The students in charge of getting the materials, will retrieve what is necessary (Elodea, containers, solution, straws, aluminum foil) from the front of the classroom and bring them back to their lab stations. The students will measure the pH of the original solution and the writer will record it. The will then take turns (with their own straws) blowing CO2 into the solution. The students will most likely ask if their solution has changed color enough for the experiment to be successful. The teacher will tell them that that is a decision for them to make and they can check the pH and make the judgement of whether or not it has changed enough. The students will complete all three containers of solution, take pictures of the containers, then place them under the lamp. As a team, the students will begin the lab report.	

	10 minutes	The designated typer, team member number 1, will open the lab report from the class's dropbox (all students have access). The team will hypothesize what they think will happen within each tube of solution. They will label the control and the variables, insert the photos, and answer the questions they can on the lab report. The students are allowed to use class notes, books, or other research materials and methods to answer the questions on the worksheet. After 50 minutes, the students will retrieve their containers from underneath the lamp. They will observe the changes in the color of the solution, and record the results of the final colors. They will photograph the final product, as well as use the probe to record the final pH of each solution and compare the results to their hypotheses. (If the solution turned back to blue, it indicates photosynthesis has occurred, if it remains greed then CO2 is still present.) The teacher will instruct the teams to clean up their stations, dumping the solution in the sink, throwing the Elodea in the trash can, rinsing the containers, and returning everything to their proper places. The teacher will instruct the teams to save their lab reports with every team members name and turn it into dropbox if they are finished. Time can be given in the next class period to finish if some teams have not. The teacher will then assign each student to do a short reflective summary about the lab. What they learned, if they enjoyed it, what they thought about the roles, and anything they would like to add. This will be independent homework.	HS-LS1-5. WHST.9-12.2

		PITSFACE: **Positive Interdependence:** The students will realize their roles as team members and contribute to the process of the experiment. **Individual Accountability:** In order for the experiment to be successful, each member will need to do their assigned role. Each student will also need to individually know the material covered in the activity for the exam. **Team Processing:** The task cannot be successfully completed without the contribution of each team member. **Social Skills:** The team will use social skills to communicate individual observations throughout the experiment. **FACE:** Each team will establish a lab station and use the allotted class time to complete the lab. **Monitoring and Processing** **Monitoring:** During the lab, the teacher will walk around and observe each team, ensuring each member is contributing. **Intervening:** The teacher will guide each team through any questions they might have. If teams have the same question about a procedure, the teacher will demonstrate for all teams in front of the classroom. **Ending:** The teacher will have each group clean up their stations and bring the class back together for a discussion.	

Lesson Closure		**Processing:** The teacher will ask students if they enjoyed the activity, and have them individually reflect on the process in a short summary. If time remains, the teacher will call the class together for a discussion about what they observed and why. The teacher will ask what happened to the solution of each container. The students will answer that both containers with Elodea reverted back to blue because photosynthesis took place. The teacher will ask how photosynthesis occurred without the presence of light. The students will say that the cells of the plant always need energy so the plant is constantly respiring. The teacher will ask if there was a difference between the containers with 2 sprigs of Elodea on the one with one that was fully exposed to light. The students will have differing answers depending on the original amount of CO_2, but the results should be similar since the light enhances the process of the one sprig, and the darkness still allowed photosynthesis, but at a slower rate. The teacher will remind the students that individually they need to know the processes of respiration and photosynthesis for the exam.	

Classroom Management and Organizational Considerations: Classroom management will be maintained by having already established the class rules and procedures of organizing into groups at the lab stations. This should ensure things run smoothly. Procedures on how to gather materials have already been established. The materials will be lined up at the front of the room for each group to retrieve in an orderly fashion. The materials are to be returned to where they came from unless otherwise noted.	**Differentiation/Special Consideration:** Differentiation will be considered with how the groups are established. Students that need a little more help will be grouped with a more advanced student that can act as a tutor. Students will be purposefully assigned roles that they can handle and won't be too much for them. More advanced students will most likely be assigned the role of the typer/ photographer to ensure a quality report for the team. High school students like freedom and choices, so they are allowed to exchange roles if every team member is in agreement.
Diversity/Cultural Considerations: Heterogeneity of the teams will be considered. It will be best to have an equal number of boys and girls in each team, and to mix up roles the genders. The girls will not always be the typers and the boys will not always perform the experiment. Students who do not feel comfortable working with others, or lack the social skills to do so will considered and will have the option to perform the experiment and turn in a lab report individually.	**Enrichment Activity:** The advanced class will perform the same experiment as the other classes, but, in addition, as a class we will do a second experiment that includes adding goldfish in the solution with the Elodea. One will be kept overnight in the dark, and one will be kept under a lamp. The class will hypothesize what they think will happen to the solution (and the fish) in each container with the addition of respiration.

Rationale/Reflection:

This lesson was developed to fit into the curriculum of the Next Generation Science Standards of life science at the high school level. It is a cooperative lesson plan where students work together to become active participants in their own learning. Through developing hypotheses, students bring what they already have learned in the classroom and relate it to the process of how it actually works. Although in high school, it is still important for students to continue to develop social skills, and working in teams helps with their communication and participation skills which will eventually help them to be successful citizens. It is important for teachers to help students master these skills no matter the grade level. (Arends, 2015).

The teams are established by the teacher to be as heterogenous as possible. This means that the teams are both culturally and gender diverse, as well as diverse based on achievement level of the students. This can be beneficial to both the higher achieving students and the lower achieving students as the higher achievers take on a tutoring role of the lower achievers and both roles have academic benefits (Arends, 2015).

Within this lesson, students have team goals and individual goals. The students work in teams to master the content, and turn in a report as a group, but are also expected to learn the content on an individual level for the exam, and turn in an individually written summary. It is important that group goals and individual accountability are incorporated into all cooperative learning lessons. (Arends, 2015).

Research shows that there are both social and academic benefits to cooperative learning (Arends, 2015). Learning occurs as learners interact with their environments and through social interaction and when a teacher takes the time to develop a classroom that utilizes the power of cooperative learning, more often than not the result will be a positive one.

Resources

Arends R.I. (2015.) *Learning to Teach*. New York: McGraw-Hill.

Observing the process of Photosynthesis:
A Respiration and Photosynthesis Lab Exercise

Today, you will be examining the processes of respiration and photosynthesis using the aquatic plant, *Elodea*. This plant is found in freshwater lakes and ponds where it floats in the water column. It floats because it does not need a root system to live. You will submerge some Elodea sprigs in a solution with CO2, and observe what happens. Please follow the steps below for your experiment, and complete your lab report that can be found in the class dropbox (or use the attached copy)

Step 1: The person/s in charge of gathering materials for your group with retrieve:

1 125 ml Erlenmeyer flask: Place 75 ml of the bromothymol blue solution into it
3 sprigs of Elodea
Straws for everybody in the group who wants to blow hot air (CO2) into the solution
Aluminum foil (enough to cover one of the lidded tubes)
3 tubes with screw cap lids
1 electronic pH probe

Step 2: After all materials are at your lab station, measure the pH of the solution. Record this on your lab report.

Step 3: Begin to blow CO2 into the solution, using the straws and your lungs. The solution will begin to turn green. When you believe that it is sufficiently acidic, check the pH level again. Record this onto your lab report.

Step 4: Poor an even amount of solution into each of the 3 tubes.

° Cap one of the tubes as is
° Add 1 sprig of Elodea to one of the tubes. Make sure it is fully submerged in the solution. Cap that tube.
° Add the other two sprigs of Elodea to the last tube. Cap that tube, and cover it with aluminum foil so no light can enter.

Step 5: With a cell phone, take photos of each of the tubes for your lab report.

Step 6: Put tape on your tube with your team name on it, and set them on the rack under the lamp in front of the classroom. They will remain here for 50 minutes.

Step 7: While the tubes are under the lamp, your team will work on your lab report.

Step 8: After retrieving your tubes, photograph them and put them in your lab report.

Step 9: Clean up your lab stations. Dump the solution in the sink, throw the Elodea in the trash, and rinse your tubes. Put everything back where you got it.

Observing the process of Photosynthesis: **Names:**
A Respiration and Photosynthesis Lab Exercise

Lab Report

1. **Hypothesize what you think will happen in each of the solutions:**

    ° No Elodea:

    ° 1 Elodea, exposed to light:

    ° 2 Elodea, no light:

2. What is your control in this experiment? What are your variables?

3. What is the reaction for photosynthesis?

4. What is the reaction for cellular respiration?

5. How are you going to measure whether or not photosynthesis took place in your tubes?

	pH Levels
Original Bromothymol Blue	
Bromothymol blue with CO_2	
Solution with no Elodea after 50 minutes	
Solution exposed to light with 1 Elodea after 50 minutes	
Solution not exposed to light with 2 Elodea after 50 minutes	

6. After retrieving your tubes, what did you observe? What happened in each tube? Be as detailed as possible with color description and pH levels for each tube.

7. Why do think are the reasons for the reactions that occurred in your tubes?

8. Were your hypotheses correct? Why or why not?

Insert your lab photos here: