Grade: 7th Grade Life Sciences (or Biology)
Lab set-up: 15 minutes
Lab duration: Two 50 minute labs
Total of 3 in class days

Plant and Animal Respiration Cycles (5-E Model)

Lesson Design by Ashley Grapes, with input from two other MAED graduates

Purpose: The purpose of this lesson is for student's to understand through experimentation that plants and animals are interconnected through their respiration cycles. Students will understand that the byproduct of animal respiration is the starting product of plant respiration and vice versa. They will deduce from these findings that a healthy ecosystem contains both plants and animals as they support each other. Students will also understand that air has volume and there are gases in water, which means that the processes that occur on land occur the same way in water. Students will learn that gilled animals under water need oxygen to live but their physiological mechanisms to obtain the gas differ from lunged animals. Students will discuss the detrimental effects of global warming on the ocean, as oxygen levels are lower in warmer water. They will also discuss the effects of pollutants on water quality and ecosystem stability. Students will learn these things by measuring oxygen and carbon levels with Probeware. By utilizing such technology, the student will gain laboratory and computer-based skills, which are a critical component of modern science. The lesson is designed to explore the interdisciplinary and interconnectedness of science and life in a critical and inquiry-based manner to help develop a scientifically literate individual.

SOLs:

LS.1 The student will plan and conduct investigations in which data are organized into tables showing repeated trials and means; variables are defined; metric units (SI—International System of Units) are used; sources of experimental error are identified; dependent variables, independent variables, and constants are identified; variables are controlled to test hypotheses, and trials are repeated; continuous line graphs are constructed, interpreted, and used to make predictions; interpretations from a set of data are evaluated and defended; and an understanding of the nature of science is developed and reinforced.

LS.4 The student will investigate and understand that the basic needs of organisms must be met in order to carry out life processes. Key concepts include plant needs (light, water, gases, and nutrients); animal needs (food, water, gases, shelter, space).

LS.6 The student will investigate and understand the basic physical and chemical processes of photosynthesis and its importance to plant and animal life. Key concepts include transformation of water and carbon dioxide into sugar and oxygen; and photosynthesis as the foundation of virtually all food webs.

LS.7 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment. Key concepts include the carbon, water, and nitrogen cycles.

LS.9 The student will investigate and understand interactions among populations in a biological community. Key concepts include the relationships among producers, consumers, and decomposers in food webs.

LS.10 The student will investigate and understand how organisms adapt to biotic and abiotic factors in an ecosystem. Key concepts include adaptations that enable organisms to survive within a specific ecosystem.

LS.11 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and change over time (daily, seasonal, and long term). Key concepts include climate changes, and catastrophic disturbances.

LS.12 The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include change in habitat size, quality, or structure; population disturbances and factors that threaten or enhance species survival; and environmental issues (water supply, air quality, energy production, and waste management).

NSES Standards: Understanding of the nature of science. Change, constancy, and measurement, skills necessary to become independent inquirers about the natural world, The dispositions to use the skills, abilities, and attitudes associated with science, Interdependence of organisms, Natural hazards risks and benefits, Organisms and environments, Populations and ecosystems

Materials (per group) and Resources:

Probeware
8 test tubes
About 10-15 small snails (or 4 large ones)
4 Elodea pieces (about 5 inches)
Windex
pH probe
Thermometer
2 test tube racks
Gloves
Goggles
Hotplate or ice
2 Beakers
Tongs
Graduated cylinder
oxygen probe if available
Graph paper

Important Water Quality Factors: http://www.h2ou.com/h2wtrqual.htm

Safety: Students will be heating water on a hot plate and handling household chemicals. Goggles should be worn during the second lab period when students are heating water and handling this chemical. The instructor should be aware of any student allergies that may be in the cleaning product.

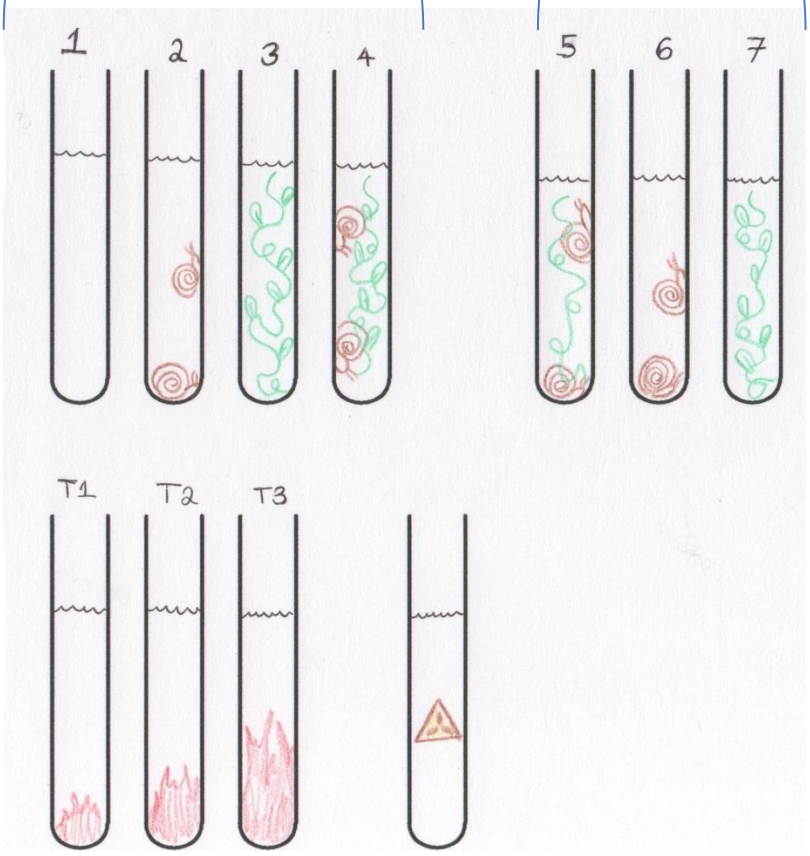
Diagram of Overall Experiment:

Day 1.A
Variable is the organism

Day 1.B
Variable is light (add control)

Lab Day 1

Lab Day 2



Testing for Oxygen [ ]

1. Control (room temp)
   T1 _°C
   T2 _°C
   T3 _°C
2. Snails Only
3. Plant Only
4. Snails and Plant
5. Snails & Plant in dark
6. Snail in dark
7. Plant in dark
8. Control in dark

Biohazard tube: cleaning product

Engage: Ask students how one could poor water from one jar to another. Demonstrate filling a jar with water and pouring it into another bottle. Now ask the students how you could poor air from one jar to another (and visualize it). Fill a large plastic tub with water. Put one jar face-down straight into the water (so it has air trapped in it) and put one jar in straight up (so it fills completely with water. Turn both upside down and "pour" the air filled jar into the water-filled jar. After performing this discrepant event explain that air has substance/weight and is made of particles. Talk about what types of molecules make up air and why they are important for living things. Discuss as a group that there is gases in water but we cannot see them and that the freshwater and marine ecosystems use the same basic oxygen/carbon dioxide cycles as on land.

Explore: The students will now investigate underwater respiration systems by using Probeware to measure oxygen levels in different test tubes. (Test tubes 1-4). This can either be done using the pH probe or the oxygen probe. The pH probe will allow a more inquiry-based experience as they explore how pH can indicate carbon dioxide levels. Test tubes 1-4 examine the interrelationship between animals and plants in an ecosystem and test tubes 5-8 illustrate that plants are producers and need sun to produce oxygen but animals do not.

Explain: Discuss what the results from the experiment mean (interconnection of plants and animals, photosynthesis, respiration, ecosystems, cycles).

Elaborate: After determining the importance of light on plants and the interconnection of respiration cycles, students will realize the importance of a balanced ecosystem. The students will investigate what happens when this stability is interrupted by human activities such as global warming and pollution during the second lab period (no live organisms required). The global warming process is heating our oceans and destroying sensitive coral reef areas. Have students heat a test tube and record the oxygen levels (with oxygen or pH probe) at different temperatures (test tubes 1-1.3). Have group's measure different temperatures and then share data to make a graph. Have students pour a common household product into a test tube and record the oxygen levels (test tube 7). Discuss how the changes in oxygen levels in the tube correspond to the deterioration of our oceans and freshwater systems. Discuss how snails and other gilled water-dwelling animals breathe and why clean water is vital for their fitness. This lab could be followed by a water quality field lab in which right-handed and left-handed snails are used as biological indicators.

Evaluate: The lab activity sheet and general lab behavior will be evaluated using the rubric entitled "Lab Activity Sheet Rubric." Included in this evaluation is safety protocol, animal treatment, lab cleanliness, attitude, group dynamic, and general effort along with the answered questions on the actual sheet. A great scientist is collaborative, respectful, inquisitive, and intricate in his research. This should be weighted just as heavily as correct answers, understanding and completeness of the lab. There will be a second rubric to evaluate the graph they must draw on the 3rd day of lab. This lab may be modified for students with IEP's. They could help obtain the data and explain orally the concepts outlined in the lab objectives. The lab worksheet could also be reduced to fit certain needs.

Lab Activity Sheet Rubric

Revised by Ashley Grapes from
http://sites.google.com/site/grahamscience/writingscientificlabreports

	3 **Exceeds Standard**	2 **Meets Standard**	1 **Approached Standard**	0 **Does Not Meet Standard**
Lab	• Puts in excellent effort • Great attitude • Great group dynamic • Doesn't rush or cut corners • Lab neat and clean • Animals and equipment treated well • Goggles/gloves remained on	• Puts in effort • Good attitude • May not work well with group or be rushing • Lab mostly clean • Animals and equipment treated well • Goggles and gloves remained on	• Puts in some effort, group may be doing most of the work; rushing • Group not working cooperatively • Lab space a little messy • Animals and equipment treated well • Goggles and gloves remained on	• Puts in little effort • Group not working cooperatively • Lab space messy and unclean • Animals and/or equipment not treated with respect • Rushing • Goggles/gloves did not remain on
Purpose/ **Hypothesis**	• Hypothesis is reasonable and includes a detailed explanation using relevant background information. • Stated in an if/then/because format	• Hypothesis is reasonable and includes a simple explanation using relevant background information.	• Hypothesis is incomplete (doesn't address entire purpose) or does not include an explanation using relevant background information.	• Hypothesis is irrelevant.
Data and/or Observations	• Data is accurate and units are labeled. • Data is represented in an organized table, graph, illustration etc • Observations are detailed and complete. • Calculations, when appropriate, are shown. • Student goes above and beyond by summarizing results and identifying trends.	• Data is accurate and units are labeled. • Data is represented in an organized table, graph, illustration etc. (see graphing rubric) • Observations are complete. • Calculations, when appropriate, are shown.	• Some data is incorrect or missing unit labels. • Data is represented in a table, graph, illustration etc. (see graphing rubric) • Observations are basic.	• Data and observations are missing or incomplete. • Data representation is unorganized (see graphing rubric)
Conceptual Understanding	• Answers based on previous knowledge correct • Pre-question answers and conclusions logical and based on observations from experiment and prior knowledge • All variables and controls identified correctly	• Answers based on previous knowledge correct • Pre-question answers and conclusions slightly off and not completely relevent • All variables and controls correctly identified	• Some answers based on previous knowledge may be incorrect • Student shows little effort in inquiry-based questions. Answers completely off or not complete • Some variables and controls may be identified wrong	• Irrelevant answers and conclusions • Student shows no effort in attempting inquiry-based questions • Blank answers • Variables and controls not identified correctly
Total				

Graphing Rubric

Revised by Ashley Grapes from
http://orchard.sbschools.net/library/tasks/rubrics/5thgrade/graph.htm

CATEGORY	4	3	2	1
Title	Title is creative and clearly relates to the topic. It is printed at the top of the graph.	Title clearly relates to the topic being graphed and is printed at the top of the graph.	A title is present at the top of the graph.	A title is not present.
Units	All units are described (in a key or with labels) and are appropriately sized for the data set.	Most units are described (in a key or with labels) and are appropriately sized for the data set.	All units are described (in a key or with labels) but are not appropriately sized for the data set.	Units are neither described NOR appropriately sized for the data set.
Type of Graph Chosen	Graph fits the data well and makes it easy to interpret.	Graph is adequate and does not distort the data, but interpretation of the data is somewhat difficult.	Graph distorts the data somewhat and interpretation of the data is somewhat difficult.	Graph seriously distorts the data making interpretation almost impossible.
Representation of Data	Exceptionally well designed, neat, and attractive. Colors that go well together are used to make the graph more readable.	Neat and relatively attractive. Colors are distinguishable.	Neat, but the graph appears quite plain. Colors may be distinguishable. Software procedure may or may not be followed.	Appears messy and "thrown together" in a hurry.
Process of Data Collection Technical Requirements (As stated in VT Technology GE Standard IT5- 6:3)	Data was collected. Graph was created to support the data. Spreadsheet was created by manipulation format (e.g. resizing rows and columns, font, colors, hiding grid). Graph representation displays text and numerical data accurately.	Data was collected. Graph supports data. Spreadsheet was created by manipulating format. Text or numerical data may be inaccurately depicted.	Inaccurate data was collected. Spreadsheet was created by manipulating format. Graph does not fully support data. Text or numerical data may be inaccurately depicted.	Inaccurate data was collected. Spreadsheet and graph are inaccurate.

Plant and Animal Respiration Lab Procedure

Day 1

Acquire 8 test tubes and split evenly between two test tube racks. Fill each with 50 mL of distilled water. Label one rack "1" and its test tubes: "1 control, 1 plant, 1 snail, and 1 P&S." Label the other rack "2" and the last four test tubes "2 control, 2 plant, 2 snail, and 2 P&S." Place a small leaf in all of the test tubes. Set-up Probeware and measure pH and oxygen levels in all of them. Record data. Place rack 2 in a dark cabinet or drawer with your groups name on it. Let it sit for 24-48 hours.

Day 2

1.A

1. Answer the 1.A pre-lab questions
2. Read the Probeware directions carefully to set up your probe. We will be using the pH probe in today's lab.
3. Calibrate your probe by placing it into the "green" solution that has a known pH of 7.
4. Take your probe out and rinse with distilled water. Wipe gently with a kim wipe to get any excess pH 7 solution residue off your probe.
5. Place the pH probe in the beaker labeled "1 control". Press "Start" and wait 30 seconds or until the Probeware reading has settled on a number. Record on your data sheet.
6. Take your probe out and rinse with distilled water and wipe with a kim wipe. You must do this between EVERY reading or they will not be accurate!
7. Measure the pH level using the pH probe for the other test tubes in rack one and record answers on worksheet. If possible, record oxygen level following all pH (CO_2) readings.
8. Answer the post 1.A questions.

1.B

9. Answer the pre-lab questions for part 1.B
10. Take your test tube rack labeled "2" out of the dark space.
11. Repeat steps 4-8 for the test tubes in rack B
12. Clean up your lab space and carefully place snails and Elodea plant in designated containers in the front of the classroom. Any mistreatment of animals will result in a 0 for this lab!

Day 3 (gloves and goggles required)

13. Answer the pre-lab questions for Day 3
14. You will be using the dissolved oxygen probe.
15. Fill up two beakers with 50ml distilled water.
16. Put your gloves and goggles on
17. Your instructor should designate 3 temperatures for you to measure the oxygen level at. Use a thermometer to place in one of your beakers and heat up using the heat block (if temperature above room temperature) or cool down using an ice bath (if desired temperatures below room temperature).
18. Measure your water at room temperature. Take a measurement as soon as your temperature reaches the desired level.
19. Place 5 mL of windex in your other beaker and measure the pH and oxygen levels.
20. Clean up your lab space
21. Answer the past lab questions for day 3

Plant and Animal Respiration Cycles

1.A Pre-Lab Questions

1. Why did we put a leaf into every test tube on Day 1?

2. Think about how a snail breathes versus how a plant breaths. What are the two biological processes called?

3. Plants support all life on this planet. Can you think of two important contributions plants make for all life on this planet? HINT: What are the two by-products of photosynthesis?

4. How do you think we can measure carbon dioxide levels in the water using pH? Will a high pH represent a high or low carbon dioxide level? Why? HINT: Think about acid rain.

5. Identify the:
Control Group: _____
Independent Variable: _____
Dependent Variable: _____

6. Rank the test tubes from greatest amount to smallest amount of carbon dioxide and oxygen present. Write a hypothesis based on your ranking and prior knowledge.

Carbon Dioxide	Oxygen
1.	1.
2.	2.
3.	3.
4.	4.

Hypothesis:

Data Table pH for Rack 1 (Dissolved oxygen if available)

Test Tubes	1Control	1Snails	1Plants	1P&S
Day 1				
Day 2				

1.A Post-Lab Questions

7. Why did we take the measurements of the test tubes on day one?

8. Does your data support your hypothesis? Why or why not.

9. Based on your data explain how animals and plants are interconnected in an ecosystem?

1.B Pre-lab questions

10. Take out rack 2.Try to rank all 8 of your test tubes from most carbon dioxide to least carbon dioxide followed by a hypothesis explaining your ranking.

1.
2.
3.
4.
5.
6.
7.
8.

Hypothesis:

11. When measuring pH in 1.A, were you surprised how close the numbers were? Why do you think this is? Think about the different between a pH of 7 and a pH of 8.

12. Identify the following in part B, which you are comparing to part A.
Control group _____
Independent variable _____
Dependent variable _____

Data Table: pH Reading for Rack 2

Test Tubes	2Control	2Snails	2Plants	2P&S
Day 1				
Day 2				

1.B Post-Lab Questions

13.Did your data support your hypothesis. Explain. Was there anything unexpected?

14. Explain the importance of sunlight to plants vs. animals.

Global Implications: Day 3

Think about pollution and climate change.

1. What do you think will happen to the water when it is heated?

2. Coral reefs are a biological indicator of climate change. What do you think a biological indicator is?

	Oxygen levels	Class Data
Room Temp		
Temp 1 ____		
Temp 2 ____		
Temp 3 ____		

Obtain class data from the board. Record other classmates results on another sheet of paper.

3. Was the oxygen level affected by the change in temperatures?

4. How does this relate to global warming, pollution, and other problems that humans have caused?

Make a graph using the classes findings on the grid available on the next page. The title of the graph should be "The Effect of Temperature on Dissolved Oxygen Levels in Distilled Water"

5. What was your dissolved oxygen and pH/carbon dioxide level after adding the windex to the water? What changed and what does this say about pollution.

6. There are two types of snails. Right-handed snails have gills and left-handed snails have lungs. The existence of one or the other is a biological indicator of the pollutant concentration in a stream. Which snail would you expect to see in a polluted water source? Why do you think this is?