

Module 2 ~ A Fish Tale (UE/MS/HS)

Dissolved Oxygen Lab



Adapted from materials created by Tom Tidyman (UF Fellow for SPICE Program 2009) and Jennifer Ricky (2013)

PURPOSE: This experiment will test various factors that affect the dissolved oxygen (DO) content in an aquatic environment.

ESSENTIAL QUESTIONS: What do aquatic plants and animals need to breathe? What is Dissolved Oxygen and why is it important to freshwater environments? What factors affect Dissolved Oxygen content?

SCIENCE SUBJECT: Earth/Space Science, Physical Science, Life Science

GRADE LEVEL: 4th – 12th

SCIENCE CONCEPTS: Plants, fish and other aquatic animals need oxygen to breathe just as humans do, and they achieve this by using dissolved oxygen in the water they live in. Temperature and aeration affect dissolved oxygen content and can cause problems for freshwater ecosystems.

OVERALL TIME ESTIMATE: Six days but not necessarily full class periods

LEARNING STYLES: Visual and kinesthetic

VOCABULARY: oxygen, dissolved oxygen (DO), aerator, photosynthesis

LESSON SUMMARY: This lesson works in conjunction with **A Fish Tale** audio-visual presentation found here: <http://plants.ifas.ufl.edu/education>. This is a two part aquarium lab that requires some set-up and management by the teacher. Live plants are used to demonstrate the relationship between dissolved oxygen and aquatic plants in a freshwater habitat; the same processes that occur in nature are emulated in classroom aquariums. Students will take readings from control and manipulated aquariums to find out how temperature, aeration and available light affect the dissolved oxygen content of water. The use of aquatic plants presents an opportunity to teach photosynthesis in conjunction with this lab.

STUDENT LEARNING OBJECTIVES:

- Students will learn what dissolved oxygen is
- Students will learn why dissolved oxygen is important to fish and aquatic plants
- After graphing data from these activities, students will identify how temperature and aeration affect the dissolved oxygen content in freshwater ecosystems, and be able to relate that back to Florida freshwater environments.

MATERIALS:

Essential

- Dissolved oxygen (DO) test kit
- 2 aquariums (10 gallon)
- 12 submersed aquarium plants*
- 1 adjustable aquatic aquarium heater
- 1 adjustable aerator
- Lake/pond water - enough to fill the aquariums two times
- Lakebed material (sediments) - enough to cover the bottom of both aquariums about 3 inches in depth

*It is best to use native plants. Invasive aquatic plants that are on federal or state prohibited lists require permission to possess and transport. For questions or assistance please email us at caip-education@ufl.edu



Florida Invasive Plant Education Initiative • <http://plants.ifas.ufl.edu/education>
A Collaboration of the UF/IFAS Center for Aquatic and Invasive Plants
and the Florida Fish and Wildlife Conservation Commission / Invasive Plant Management Section
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PROCEDURE

Part One: Temperature and Dissolved Oxygen

ADVANCED PREPARATION (TEACHER)

1. Fill both aquariums with 3 inches of lakebed material.
2. Secure 3 submersed plants in the lakebed material in each aquarium.
3. Fill aquariums to the top with lake / pond water.
4. Label aquariums "A" and "B", with A being the control aquarium.
5. The aquatic heater should be added to aquarium B and set to 25 C.
6. The aquariums should be allowed to sit overnight for sediments to settle.

PROCEDURE – DAY 1

1. Using the DO test kit and sampling bottle follow the directions in the test kit to collect water sample from approximately 6 inches below the surface of aquarium A.
2. Run test for DO on water sample from aquarium A. Record data.
3. Using the DO test kit and sampling bottle, collect water sample from approximately 6 inches below the surface of aquarium B.
4. Run test for DO on water sample from aquarium B. Record data.
5. Set aquarium heater to 30 C and allow to stand overnight.

DAY 2

6. Repeat steps 1-4 and record the data.
7. Set aquarium heater to 35 C and allow to stand overnight.

DAY 3

8. Repeat steps 1-4 and record the data.

ACTIVITIES AND DISCUSSION QUESTIONS

1. Using the data collected from this experiment, make a graph for the results from aquarium A and aquarium B. Use different colors on the graph to represent each aquarium.
2. Compare the results of the dissolved oxygen content for each day and ask the class to list possible reasons for the change.
3. Display a monthly temperature chart for Florida. ([m \(usclimatedata.com\)](http://usclimatedata.com)) Ask the class which months Florida water bodies would have the most dissolved oxygen. Why?
4. Lead a class discussion on how temperatures in Florida water bodies could affect the fish and aquatic organisms Additional resources listed below.

Part Two: Aeration and Dissolved Oxygen

ADVANCED PREPARATION (TEACHER)

1. Fill both aquariums with 3 inches of lakebed material.
2. Secure 3 plants in the lakebed material in each aquarium.
3. Fill each aquarium to the top with lake / pond water.
4. Label aquariums "A" and "B", with A being the control aquarium.
5. The aquatic aerator should be placed in aquarium B and then turned on to the lowest setting.
6. The aquariums should be allowed to sit overnight for sediments to settle.



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PROCEDURE – DAY 1

1. Using the DO test kit and sampling bottle follow the directions in the test kit to collect water sample from approximately 6 inches below the surface of aquarium A.
2. Run test for DO on water sample from aquarium A. Record data.
3. Using the DO test kit and sampling bottle, collect water sample from approximately 6 inches below the surface of aquarium B.
4. Run test for DO on water sample from aquarium B. Record data.
5. Adjust the aerator to the middle/medium level setting on the aquarium aerator and allow to stand overnight

DAY 2

6. Repeat steps 1-4 and record the data.
7. Adjust the aerator to the highest level setting on the aquarium aerator and allow to stand overnight

DAY 3

8. Repeat steps 1-4 and record the data.

ACTIVITIES AND DISCUSSION QUESTIONS

1. Using the data collected from this experiment, make a graph for the results from aquarium A and aquarium B. Use different colors on the graph for the aquarium with the aerator and the one without an aerator.
2. Compare the results of the dissolved oxygen content for each day and ask the class to list possible reasons for the change.
3. Discuss wind and wave action in Florida waterbodies. How could this affect the fish and aquatic organisms who live in these waterbodies?
4. Lead a class discussion on Florida weather (<http://iwin.nws.noaa.gov/iwin/fl/fl.html>). How does the weather affect fish and aquatic organisms?
5. Have the class write to explain their data and results. Explain how dissolved oxygen is important for survival. Include how aquatic animals and plants are interdependent.

ALTERNATIVE PROCEDURES

For more advanced classes, or if pressed for time, these two parts can be run simultaneously if 3 aquariums are available (one control, one where the temperature is changed, and one where aeration is added).

For high school students: Instead of providing them with the lab procedure, have them create their own. Provide them with the background information in this lesson plan (and additional resources listed) and materials. Instruct students to develop lab procedures to test the effects of temperature and aeration on dissolved oxygen.

ASSESSMENT SUGGESTIONS:

Students could produce a lab write-up in the form a short essay that adheres to Florida Standards for informational/explanatory writing. The piece should include discussion of how temperatures and aeration might affect a lake or body of water close to them. Students could also write a creative story identifying how important dissolved oxygen is to fish and plants in aquatic ecosystems. This piece could be built around Florida Standards for narrative writing, including elements such as detailed descriptions, dialogue and monologue, and character reflection. Students could also produce a short piece of persuasive writing that expresses their opinions and presents arguments about ways that humans should or should not change the behaviors that contribute to DO depletion in Florida waters.



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BACKGROUND INFORMATION:

Oxygen is a natural element. No animal can live without oxygen in its gaseous state. Fish and other aquatic animals are as dependent on gaseous oxygen dissolved in the water as people are dependent on gaseous oxygen surrounding us in the air.

In fact, many people are surprised to learn that fish and other aquatic organisms don't actually use oxygen from water molecules themselves (H_2O). This is because the single oxygen molecule (O) is bound to the two hydrogen molecules (H_2) and is not "available" for use. Instead, aquatic organisms are dependent on dissolved oxygen gas (O_2), a colorless, tasteless and odorless substance that is continuously entering water from aquatic plants and the atmosphere above the surface of the water.

Water's unique ability to hold and release oxygen makes it possible for plants, fish, and other animals to breathe or "respire" underwater. The downside is that oxygen concentrations in aquatic environments are rarely stable. When the sun is shining and aquatic plants (including algae) are photosynthesizing at full capacity, there's plenty of oxygen to go around. However, after the sun sets each evening, photosynthetic activity is greatly reduced and so is the oxygen concentration, as both plants and animals continue respiring.

Normally, this is not a problem, as there is usually enough of a dissolved oxygen buffer available in the water to last until morning, when the process begins all over again. However, if something should alter that pattern, things can go awry.

ADDITIONAL RESOURCES:

Dissolved Oxygen in Florida Waters ~

<http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/water-quality/dissolved-oxygen>

Dissolved Oxygen and Water Temperature ~

http://lakewatch.ifas.ufl.edu/circpdf/Circ109_OxygenTemp.pdf

Photosynthesis ~

<http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/water-quality/photosynthesis>

Freshwater Fish ~

<http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/fish-and-wildlife/freshwater-fish>

Fish Kills ~ <http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/fish-and-wildlife/fish-kills>

Investigating the Science of Fish Kills from Purdue University Extension ~

<https://www.extension.purdue.edu/extmedia/PPP/PPP-79.pdf>



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The following is a list of suggested standards that pertain to this activity. The list is provided as a reference to incorporate and expand upon as needed.

NEXT GENERATION SUNSHINE STATE STANDARDS:

4th Grade:

SC.4.E.6.6: Identify resources available in Florida (water, phosphate, oil, limestone, silicon, wind, and solar energy).

SC.4.L.17.4: Recognize ways plants and animals, including humans, can impact the environment.

SC.4.N.1.1: Raise questions about the natural world, use appropriate reference materials that support understanding to obtain information (identifying the source), conduct both individual and team investigations and generate appropriate explanations.

SC.4.N.1.4: Attempt reasonable answers to scientific questions and cite evidence in support.

SC.4.N.1.6: Keep records that describe observations made, carefully distinguishing actual observations from ideas and inferences about the observations.

SC.4.N.1.8: Recognize that science involves creativity in designing experiments.

5th Grade:

SC.5.N.1.1: Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types.

SC.5.N.1.3: Recognize and explain the need for repeated experimental trials.

SC.5.N.1.4: Identify a control group and explain its importance in an experiment.

SC.5.N.1.6: Recognize and explain the difference between personal opinion/interpretation and verified observation.

SC.5.N.2.1: Recognize and explain that science is grounded in empirical observations that are testable, and explanation must always be linked with evidence.

SC.5.N.2.2: Recognize and explain that when scientific investigations are carried out, the evidence produced by those investigations should be replicable by others.

SC.5.P.9.1: Investigate and describe that many physical and chemical changes are affected by temperature.

6th Grade:

SC.6.N.1.4: Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

SC.6.N.1.5: Recognize that science involves creativity, not just in designing experiments, but also in creating explanations that fit evidence.

7th Grade:

SC.7.E.6.6: Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water.

SC.7.N.1.4: Identify test variables (independent variables) and outcome variables (dependent variables) in an experiment.

8th Grade:

SC.8.L.18.1: Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll in the production of food and release of oxygen.

SC.8.L.18.2: Describe and investigate how cellular respiration breaks down food to provide energy and releases carbon dioxide.

SC.8.P.9.3: Investigate and describe how temperature influences chemical changes.



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9th – 12th Grade:

SC.912.E.7.1: Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

SC.912.L.17.3: Discuss how various oceanic and freshwater processes, such as currents, tides, and waves, affect the abundance of aquatic organisms.

SC.912.L.17.4: Describe changes in ecosystems resulting from seasonal variations, climate change and succession.

SC.912.L.17.8: Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.

SC.912.L.18.6: Discuss the role of anaerobic respiration in living things and in human society.

SC.912.L.18.7: Identify the reactants, products, and basic functions of photosynthesis.

SC.912.L.18.8: Identify the reactants, products, and basic functions of aerobic and anaerobic cellular respiration.

SC.912.L.18.9: Explain the interrelated nature of photosynthesis and cellular respiration.

SC.912.N.1.1: Define a problem based on a specific body of knowledge and: 1) pose questions; 2) conduct observations; 3) examine sources; 4) review evidence; 5) plan investigations; 6) use tools to gather, analyze, and interpret data; 7) pose answers, explanations, or descriptions; 8) generate inferences; 9) communicate results; 10) evaluate the merits of explanations

SC.912.P.8.10: Describe oxidation-reduction reactions in living and non-living systems.

Common Core State Standards

4th Grade

Common Core Code	FL Common Core Code	Common Core Standard
RI.4.4	LACC.4.RI.2.4	Determine the meaning of general academic and domain-specific words or phrases in a text relevant to a grade 4 topic or subject area.
RI.4.7	LACC.4.RI.3.7	Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
RF.4.3	LACC.4.RF.3.3	Know and apply grade-level phonics and word analysis skills in decoding words.
RF.4.4a	LACC.4.RF.4.4a	Read grade-level text with purpose and understanding.
W.4.1b	LACC.4.W.1.1b	Provide reasons that are supported by facts and details.
W.4.2d	LACC.4.W.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.
W.4.9b	LACC.4.W.3.9b	Apply grade 4 Reading standards to informational texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text”).
SL.4.1c	LACC.4.SL.1.1c	Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
SL.4.2	LACC.4.SL.1.2	Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
L.4.3	LACC.4.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.4.3a	LACC.4.L.2.3a	Choose words and phrases to convey ideas precisely.



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L.4.4a	LACC.4.L.3.4a	Use context (e.g., definitions, examples, or restatements in text) as a clue to the meaning of a word or phrase.
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5th Grade

RF.5.4	LACC.5.RF.4.4	Read with sufficient accuracy and fluency to support comprehension.
RF.5.4a	LACC.5.RF.4.4a	Read grade-level text with purpose and understanding.
RF.5.4c	LACC.5.RF.4.4c	Use context to confirm or self-correct word recognition and understanding, rereading as necessary.
W.5.2d	LACC.5.W.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.
W.5.9b	LACC.5.W.3.9b	Apply grade 5 Reading standards to informational texts (e.g., “Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point[s]”).
SL.5.1	LACC.5.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others’ ideas and expressing their own clearly.
SL.5.1c	LACC.5.SL.1.1c	Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.
L.5.6	LACC.5.L.3.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal contrast, addition, and other logical relationships (e.g., however, although, nevertheless, similarly, moreover, in addition).

6th Grade

RI.6.7	LACC.6.RI.3.7	Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
W.6.2d	LACC.6.W.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.
SL.6.1	LACC.6.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others’ ideas and expressing their own clearly.
SL.6.1c	LACC.6.SL.1.1c	Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.
SL.6.2	LACC.6.SL.1.2	Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.
L.6.3	LACC.6.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.6.4a	LACC.6.L.3.4a	Use context (e.g., the overall meaning of a sentence or paragraph; a word’s position or function in a sentence) as a clue to the meaning of a word or phrase.
WHST.6-8.2d	LACC.68.WHST.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.

7th Grade

RI.7.1	LACC.7.RI.1.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
RI.7.4	LACC.7.RI.2.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of a specific word choice on meaning and tone.

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W.7.2d	LACC.7.W.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.
W.7.9b	LACC.7.W.3.9b	Apply grade 7 Reading standards to literary nonfiction (e.g. "Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims").
SL.7.1	LACC.7.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
L.7.3	LACC.7.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.7.4	LACC.7.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 7 reading and content, choosing flexibly from a range of strategies.
L.7.4a	LACC.7.L.3.4a	Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
WHST.6-8.2d	LACC.68.WHST.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.

8th Grade

W.8.2d	LACC.8.W.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.
SL.8.1	LACC.8.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
L.8.3	LACC.8.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
RST.6-8.1	LACC.68.RST.1.1	Cite specific textual evidence to support analysis of science and technical texts.
RST.6-8.4	LACC.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
WHST.6-8.2d	LACC.68.WHST.1.2d	Use precise language and domain-specific vocabulary to inform about or explain the topic.

9th – 10th Grade

W.9-10.2d	LACC.910.W.1.2d	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
W.9-10.9	LACC.910.W.3.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
SL.9-10.1	LACC.910.SL.1.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
L.9-10.4	LACC.910.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9-10.4a	LACC.910.L.3.4a	Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
RST.9-10.1	LACC.910.RST.1.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.4	LACC.910.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
WHST.9-10.2d	LACC.910.WHST.1.2d	Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.

11th – 12th Grade

SL.11-12.1	LACC.1112.SL.1.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
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SL.11-12.1c	LACC.1112.SL.1.1c	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
L.11-12.4	LACC.1112.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.
L.11-12.4a	LACC.1112.L.3.4a	Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L.11-12.6	LACC.1112.L.3.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
RST.11-12.4	LACC.1112.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
WHST.11-12.9	LACC.1112.WHST.3.9	Draw evidence from informational texts to support analysis, reflection, and research.

