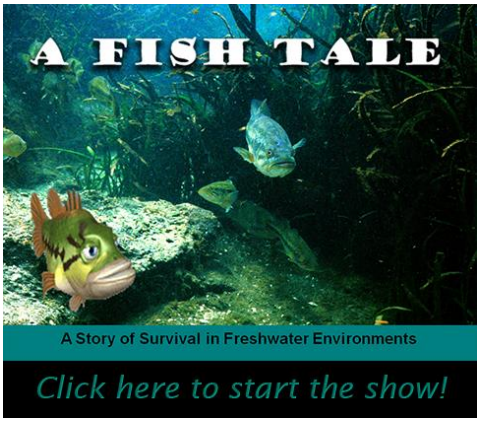
Module 2 ~ A Fish Tale (UE/MS/HS)

Teacher Guide – *A Fish Tale* Audio-Visual Presentation



Overview: *A Fish Tale* audio-visual presentation is the core lesson for Module 2, upon which all other activities and lessons are based. The 15-minute presentation sets the stage with a colorful lesson about Florida's freshwater environments, where the oxygen content is constantly changing, 24 hours a day, seven days a week. Students will learn how non-native invasive plants make things even more difficult, especially for the fish and aquatic organisms that rely on dissolved oxygen for survival.

Pre-requisite: Teachers recommend students have some prior knowledge of photosynthesis and respiration and the keywords/definitions before viewing this presentation. For more information see the "Talking Points" associated with this module.

Essential Questions:

- What causes oxygen concentrations to fluctuate in water?
- What is dissolved oxygen?
- What is the difference between photosynthesis, respiration, and decomposition?
- What function do aquatic plants have in freshwater?
- Why do fish kills happen?
- Why are invasive plants a problem?
- What can I do to help aquatic ecosystems?
- What careers can be found in aquatic ecosystem management?

Subject: Biology, Life Science, Environmental Science, Social Studies, Language Arts

Grade Level: upper elementary *advanced students* (UE), middle school (MS), and high school (HS)

Time Estimate: 45 minutes – 15 minute review of vocabulary; 15 minute presentation; 15 minute discussion

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Learning Objectives:

- Identify factors that influence oxygen concentrations in water
- Identify the role of dissolved oxygen in aquatic ecosystems
- Define photosynthesis, respiration, and decomposition
- Identify the impact invasive plants have in aquatic ecosystems
- Identify positive actions that can be taken to help aquatic ecosystems, including careers in aquatic resource management

Science and Language Arts Standards: See suggested state standards at the end of this document.

Vocabulary: *(Note: Keyword chart and definitions are provided in a separate document.)* algae, aquatic, atmosphere, bacteria, carbon dioxide (CO_2), career, chemical process, climate, decomposition, diffuse, dissolved oxygen (DO), environment, fish kill, invasive plants, management plan, oxygen, parts per million (ppm), photosynthesis, respiration, submersed plants, water monitoring, water temperature, wind and wave action, volunteer

Lesson Summary: Distribute the Guiding Questions and review keywords and definitions before viewing the 15-minute video (audio-visual) presentation. Depending on grade level and available class time, the video can be shown in segments. (Refer to outline on next page.) Guiding questions are provided to students, for reference, while watching the video. Answers are checked at the end as part of the discussion. Talking Points are also available, providing additional background knowledge for the teacher/instructor.

Materials Needed: Classroom computer/projector with internet access to the Florida Invasive Plant Education Initiative website (http://plants.ifas.ufl.edu/education) or computer with DVD of presentation, available from the UF-IFAS Center for Aquatic and Invasive Plants (caip-education@ufl.edu).

Additional Resources: All other activities and lessons for Module 2 are designed to compliment this presentation. Lessons, activities, and accompanying graphs are available for download as PDFs from http://plants.ifas.ufl.edu/education

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Part 1 – Oxygen in water and factors that influence it -- starting with water temperature (slides 4 - 10)

Keywords: aquatic, atmosphere, climate, dissolved oxygen (DO), oxygen, parts per million (ppm), water temperature

Key Points:

- Oxygen is a precious commodity in freshwater habitats – especially for fish and other aquatic animals.
- Dissolved oxygen is affected by five main factors in freshwater: water temperature is the first one.

Suggested Resources:

- Plant Management in Florida Waters ~ http://plant.ifas.ufl.edu/manage
  - Section 2, see Dissolved Oxygen under Water Quality
- See U.S. EPA Volunteer Lake Monitoring Methods Manual (Chapter 2) for more information about dissolved oxygen in water: http://www.epa.gov/volunteer/lake/lakevolman.pdf

Part 2 – Three more factors: photosynthesis, respiration, decomposition (slides 11 - 21):

Keywords: algae, bacteria, carbon dioxide (CO_2), chemical process, decomposition, photosynthesis, respiration, submersed plants

Key Points:

- Dissolved oxygen is also influenced by respiration, photosynthesis, and decomposition.
- Submersed aquatic plants are a major source of oxygen in freshwater habitats (via photosynthesis). However, they also **USE** oxygen.

Suggested Resources:

- Plant Management in Florida Waters ~ http://plant.ifas.ufl.edu/manage
  - Section 2, see Dissolved Oxygen under Water Quality
  - Section 2, see Photosynthesis under Water Quality
  - Section 1, see Algae under Aquatic and Wetland Plants in Florida
  - Section 1, Native (Aquatic) Plants

Part 3 – Oxygen Factor #5: wind and wave action, and invasive plants (slides 22- 31)

Keywords: diffuse, fish kill, invasive plants, wind and wave action

Key Points:

- Wind and wave action is the 5th factor that affects oxygen in water.
- Under certain conditions, an abundance of plants or algae can result in oxygen shortages, which cause problems for animals inhabiting these environments.
- Invasive plants can make things worse, causing serious environmental and/or economic harm.

Suggested Resources:

- Plant Management in Florida Waters ~ http://plant.ifas.ufl.edu/manage
  - Section 2, Fish and Wildlife
  - Section 2, see Fish Kills under Fish and Wildlife
  - Section 1, Non-native Invasive Plants – An Introduction

Part 4 Ways to Get Involved! (slides 32 – 35)

Keywords: career, environment, management plan, water monitoring, volunteer

Key Points:

- We're all responsible for taking care of our freshwater systems.
- There are many ways to help: participate in the management of a local lake or participate in a water monitoring program.
- Many great careers can be found in water management (biologists, field techs, plant managers, etc.).

Suggested Resources:

- Volunteer Lake Monitoring Manual ~ http://www.epa.gov/volunteer/lake/lakevolman.pdf
- Florida LAKEWATCH Volunteer Monitoring ~ http://lakewatch.ifas.ufl.edu/
- Citizen Involvement and Stewardship ~ http://plants.ifas.ufl.edu/manage/research-and-outreach/citizens
- ***The TEAM Approach: Together for Environmental Assessment and Management.*** A Process for Developing Effective Lake Management Plans or Water Resource Policy. http://plants.ifas.ufl.edu/publications/Canfields1994TEAM.pdf

CREDITS and Guiding Questions for discussion (slides 36 – 41)

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Background Information

(Note: The following information was excerpted from these web pages: http://plants.ifas.ufl.edu/manage/, and http://plants.ifas.ufl.edu/manage/overview-of-florida-waters/water-quality)

Oxygen in freshwater

***Imagine** for a moment what life would be like for us terrestrial creatures if the oxygen content of our air was constantly changing, 24 hours a day, seven days a week. Visualize living in an environment where oxygen concentrations fluctuated with available sunlight, air temperature, or the number of people breathing nearby. What if oxygen levels began to suddenly drop in your home or office, causing everyone to scurry from room to room searching for pockets of "breathable" air? What if there were none available and you had to leave the building all together in search of this valuable life-sustaining gas?*

Where would you go? What would you do?

While this little mental exercise may seem absurd, it's a daily reality for fish and other aquatic animals. Dissolved oxygen is indeed a precious commodity in the underwater realm, a place where things can change quickly with very little warning.

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 plants and the atmosphere above.

In Florida's warm-water lakes, oxygen-related problems are one of the most common causes of fish kills. While such events are upsetting to many people, the good news is most are the result of naturally occurring processes. And, as you are about to learn, many of these processes are inextricably linked with the presence of plants.

Oxygen from Plants

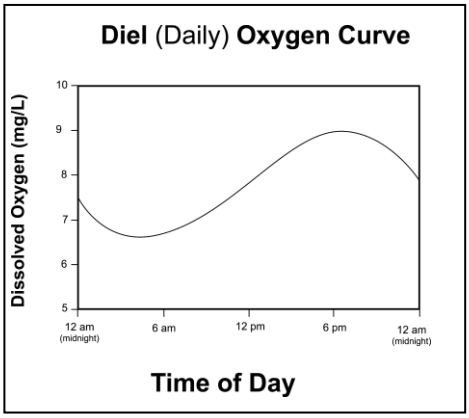
Using nothing more than carbon dioxide, water and light energy, earth's innumerable plants — both aquatic and terrestrial — are continuously generating new cells and repairing damaged ones using a process known as **photosynthesis**. As "luck" would have it, dissolved oxygen gas is continually being released as a by-product. In aquatic environments, free-floating microscopic plants known as algae and larger submersed plants (macrophytes) release oxygen directly into the water where it is used by myriad animals and organisms including the plants themselves.

Oxygen from the Atmosphere

In addition to plant-generated oxygen, the earth's atmospheric pressure is constantly "pushing" tiny molecules of dissolved oxygen gas into the surface waters of our lakes, ponds, oceans, swimming pools — even that glass of water on your kitchen counter. The process is known as **diffusion** and it's a never-ending cycle. As oxygen gas is being pushed into water, excess oxygen from the water is simultaneously being released back into the air. Wind and wave action or man-made aerators can accelerate diffusion by creating more surface area for oxygen to enter the water.

Water's unique ability to hold and release oxygen makes it possible for 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. 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.

Weather patterns are a common culprit, particularly in Florida's subtropical climate. Several consecutive days of cloudy weather reduces the amount of sunlight available for algae and plants to use for photosynthesis. Meanwhile, the algae, plants and animals are still using up a dwindling oxygen supply. Once the buffer is used up and oxygen levels dip below 2 mg/L, fish and other animals become stressed, increasing the chances for illness or, if conditions last long, a fish kill can occur. This usually happens in the early morning hours or just before dawn (4 to 6 am) and often during hot weather when there is less oxygen in the water to begin with. But that's just one example.



FISH OXYGEN REQUIREMENTS

Fish usually die at oxygen concentrations of 2 mg/L or less.

For optimum health, warm water fish - like those found here in Florida - generally require dissolved oxygen concentrations of five parts per million (5ppm). While this amount of oxygen is often available in most water bodies, it is never constant.

Sometimes there can be surplus of dissolved oxygen and at other times, it can drop dangerously low - so low that fish and other organisms will become stressed, sick, or even die (i.e.fish kill).

Of course, different organisms have different thresholds and tolerances for low oxygen.

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Aquatic plants, oxygen and fish

Fish utilize aquatic vegetation for spawning and nursery areas. Some fish, and/or their young, even eat aquatic plants and/or the algae and small animals attached to the stems and leaves. Aquatic plants also serve as fish sanctuaries, offering refuge from aquatic predators such as larger fish and water birds.

Submersed aquatic plants also generate oxygen, which helps keep the oxygen content high enough for fish and other submersed life. There are certain conditions however, that can change this dynamic. Overabundant submersed aquatic plant growth can consume oxygen and suffocate fish. One of the worst recorded fish kills in Florida public waters occurred when hyrdilla covered Rodman Reservoir in 1985. Several cloudy days combined with a water column full of hydrilla consumed most of the oxygen in this 10,000-acre reservoir resulting in the death of more than 8 million fish.

Plant infestations and fish

Were it not for the concerted management of invasive aquatic plants, especially floating water hyacinth and water lettuce and submersed hydrilla, there wouldn't be much fishing going on in Florida. When invasive plants take over a lake or river, certain things happen to the fish, and to the fishing.

It's true; some invasive aquatic plants are beneficial to fish in some ways especially when the plant is first established. As do native plants, non-native invasive plants provide surface area for algae and small animals to attach to and live on (fish food). And non-native invasive plant infestations do provide room for baby fish to hide from predators as well as the "edge effect" -- a place where fish are more likely to be caught. This does attract fish and increases the likelihood of catching them.

HOWEVER, fisheries research and closer analysis also reveals that invasive plant infestations that go beyond a certain extent actually stunts fish growth. Research shows that sometimes there may be more fish in a hydrilla infestation, but they are often smaller fish. Also, invasive plant infestations make it difficult to catch fish. Ever try dragging a lure through a mat of hydrilla? or tossing a hook into a 10-50 acre mat of water hyacinth?

The bottom line: **native plants provide the same beneficial functions** and have provided these benefits for eons before the invaders came. For example, eel grass (tape grass), pondweeds, bladderwort, the submersed *Sagittaria* species and others are some native plants that provide underwater plant surface area for fish food, such as periphyton and small animals that attach to plant parts. Native plants also oxygenate the water. And native plants are eaten by birds and fish, just as hydrilla is. Native plants on the other hand seldom fill the water column or form impenetrable masses at the water surface, restricting navigation and recreational activities, consuming oxygen or creating flood control problems.

Why Care? The Economy of Fishing

Florida's semi-tropical climate and wide range of diverse aquatic ecosystems results in one of the most abundant assemblages of freshwater fish species in the United States. More than 250 species of fish can be found in nearly 2.5 million acres of lakes, 12,000 miles of rivers and countless springs, wetlands, and canals throughout the state. Most of these aquatic environments host an assortment of sport, commercial, anadromous, and invasive fish species.

In Florida, people spend more time fishing (three times more) than they do visiting Walt Disney World. **Florida is the number-one state visited by anglers** (three million each year), surpassing all other states in fishing retail sales, jobs and salaries, with an overall economic output of $7 billion (2002). Freshwater fishing generates nearly $1.8 billion annually. Besides *catching* fish, resident and tourist snorkelers and divers also enjoy delightful hours of fish watching. In addition to providing pleasurable experiences for people, Florida's fisheries offer food to a wide variety of aquatic and terrestrial wildlife. Fish communities contribute to the health of aquatic ecosystems and are an integral component of maintaining a biological balance underwater.

Oxygenating Plants

While all plants produce oxygen, some are more productive than others. In the aquatic environment, there are a number of aquatic plant species appreciated for their "oxygenating" abilities. Several are especially popular among aquarium and pond enthusiasts. Unfortunately, a few of them are invasive in Florida:

Bacopa caroliniana (bacopa)

Cabomba caroliniana (cabomba, fanwort)

Ceratophyllum demersum (coontail)

Hydrilla verticillata (hydrilla) **invasive**

Juncus repens (rush)

Myriophyllum aquaticum (parrot's feather) non-native

Najas guadalupensis (southern naiad)

Nymphoides aquatica (banana lily)

Nymphoides cristata (water snowflake) **invasive**

Nymphoides peltata (yellow floating heart) **non-native**

Potamogeton diversifolius (waterthread pondweed

Vallisneria americana (tape grass, eel grass)

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.N.1.4: Recognize ways plants and animals, including humans, can impact the environment.
SS.4.C.2.1: Discuss public issues in Florida that impact the daily lives of its citizens.
SS.4.G.1.1: Identify physical features of Florida.

5th Grade

SC.5.P.8.1: Compare and contrast basic properties of solids, liquids, and gases, such as mass, volume, color, texture, temperature.

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.L.15.3: Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.
SC.7.L.17.1: Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
SC.7.L.17.3: Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.

8th Grade

SC.8.18.L.1: Describe and investigate the process of photosynthesis, such as the roles of light, carbon dioxide, water and chlorophyll; production of food; 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.N.1.6: Understand that scientific investigations involve the collection of relevant empirical evidence, the use of logical reasoning, and the application of imagination in devising hypotheses, predictions, explanations and models to make sense of the collected evidence.
SS.8.A.1.2: Analyze charts, graphs, maps, photographs and timelines; analyze political cartoons; determine cause and effect.
SS.8.G.5.2: Describe impact of human modifications on the physical environment and ecosystems of the United States throughout history.

9th - 12th Grades

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.17.7: Characterize the biotic and abiotic components that define freshwater systems, marine systems, and terrestrial systems.
SC.912.L.17.5: Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.
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.17.9: Use a food web to identify and distinguish producers, consumers, and decomposers. Explain the pathway of energy transfer through trophic levels and the reduction of available energy at successive trophic levels.
SC.912.L.17.16: Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.
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.
SS.912.G.5.3: Analyze case studies of the effects of human use of technology on the environment of places.
SS.912.G.5.4: Analyze case studies of how humans impact the diversity and productivity of ecosystems.

Common Core State Standards

Note: Standards in *italics* are touched on briefly and can be fully developed by the teacher

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.
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.

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.6.4	LACC.6.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 6 reading and content, choosing flexibly from a range of strategies.

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.
RST.6-8.1	LACC.68.RST.1.1	Cite specific textual evidence to support analysis of science and technical texts.
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.
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.

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.