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# Photosynthesis: An Integrated, Hands-On Approach Supporting the NGSS and CCSS ELA

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# Photosynthesis: An Integrated, Hands-On Approach Supporting the NGSS and CCSS ELA

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## **Creator(s)**

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# **Photosynthesis and Cellular Respiration (LS1):**

**A Hands-On Approach Supporting  
the NGSS and ELA CCSS**



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UNIVERSITY**

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# Why Science and Literacy Integration?

| NGSS Practices   | CCSS ELA Practices   |
|--|--|
| <p>S1. Ask questions and define problems</p> <p>S2. Develop and use models.</p> <p>S3. Plan and carry out investigations.</p> <p>S4. Analyze and interpret data.</p> <p>S5. Use mathematics and computational thinking.</p> <p>S6. Construct explanations and design solutions.</p> <p>S7. Engage in argument from evidence.</p> <p>S8. Obtain, evaluate and communicate evidence.</p> | <p><b>E1. Demonstrate independence in reading complex texts, and writing and speaking about them.</b></p> <p>E2. Build a strong base of knowledge through content rich texts.</p> <p>E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose.</p> <p><b>E4. Construct viable arguments and critique reasoning of others.</b></p> <p><b>E5. Read, write, and speak grounded in evidence.</b></p> <p>E6. Use technology and digital media strategically and capably.</p> <p>E7. Come to understand other perspectives and cultures through reading, listening, and collaborating</p> |



# Preparing College/Career Readiness through Integrating Science Learning with Literacy in Grades 4-12 (6-12)

A LEA-IHE-Business Partnership Initiative Supported by TN DOE MSP and THEC ITQ Grants (2015-18)



## Local Education Agents

## Institute of Higher Ed

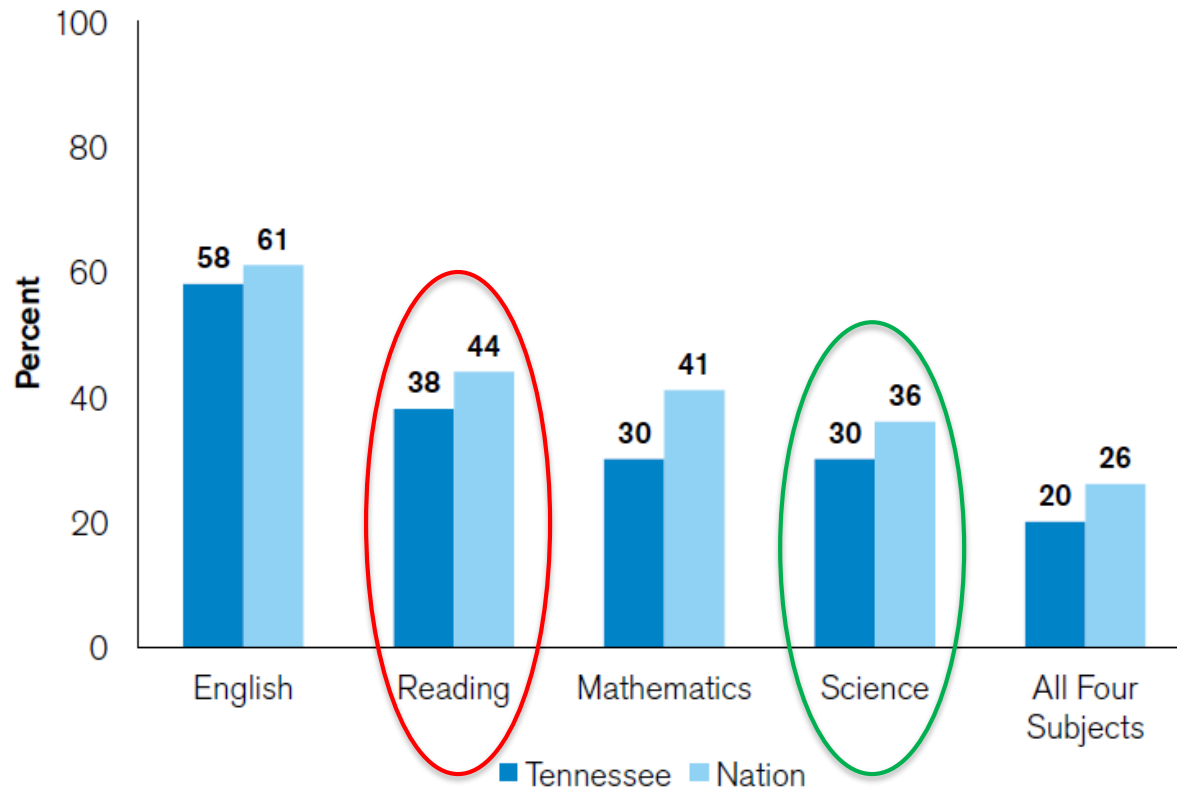
## Business Partners



EAST TENNESSEE STATE UNIVERSITY

# Picture of College Readiness

Percent of 2016 ACT-Tested High School Graduates Meeting ACT College Readiness Benchmarks by Subject



# Research Questions

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- **RQ1**: How does cross-discipline instruction benefit and enrich each subject discipline?
- **RQ2**: How does integration of science learning with literacy in G4-12 impact students' learning in schools?





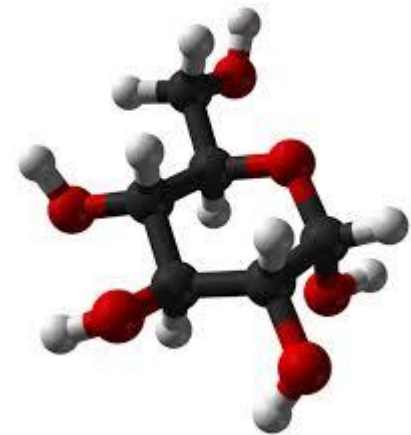
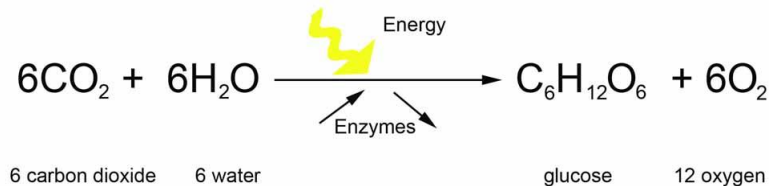
# Leaf Observation

- Qualitative observations:
  - Describe the colors, shapes, and textures of the leaves.
  - How are the leaves arranged on the stem?
- Quantitative observations:
  - What is the size of a typical leaf? Number of visible veins?
  - How many leaves are on your sample?

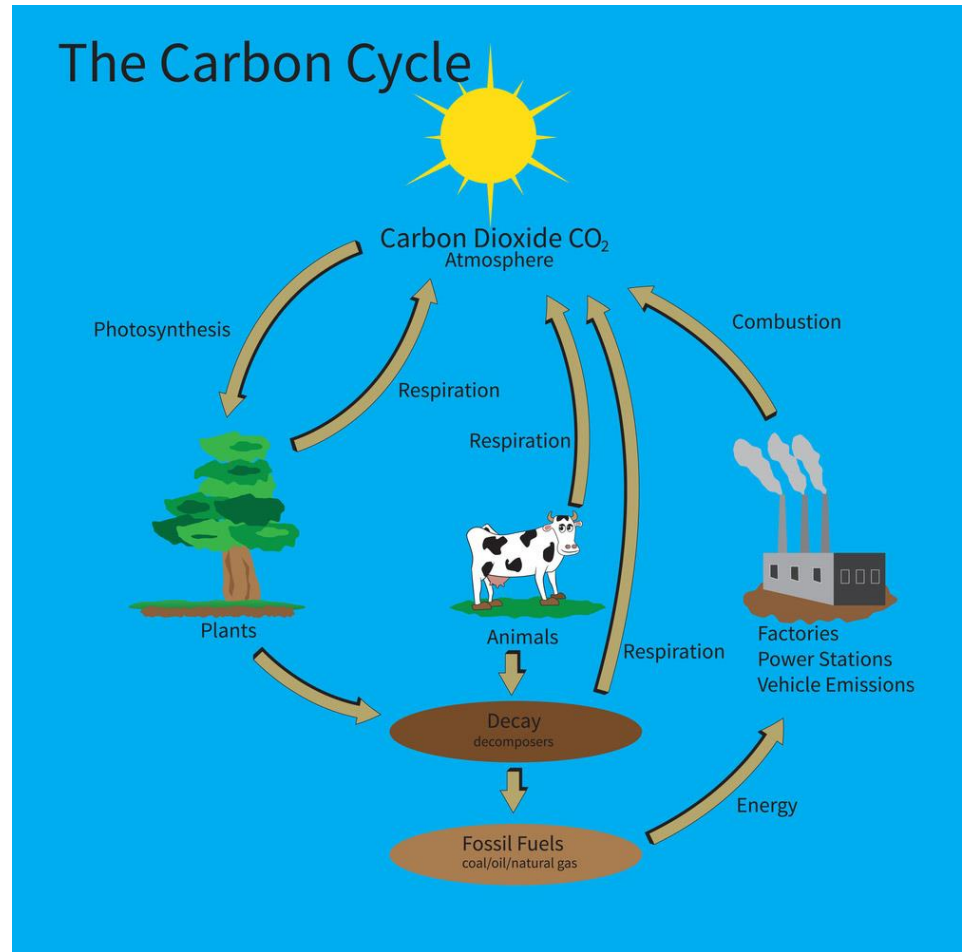
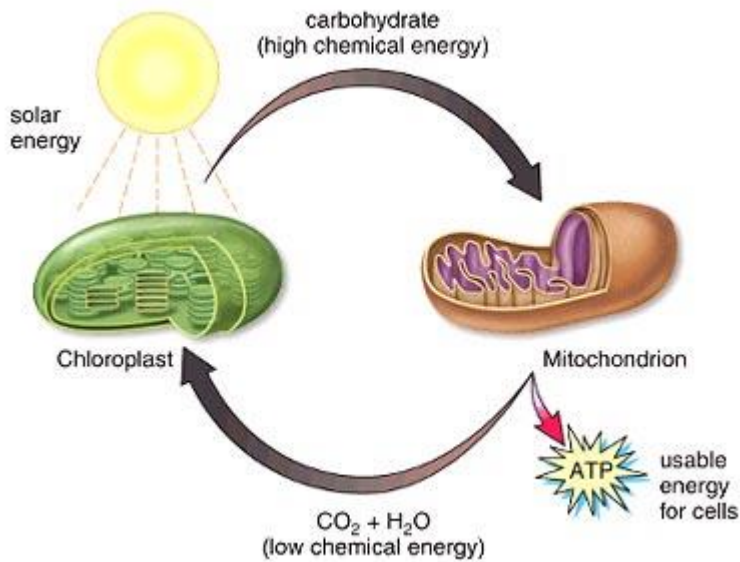


# Big Ideas & Common Misconceptions

- Starting ingredients (CO<sub>2</sub> & H<sub>2</sub>O) are rearranged to form new substances (glucose & O<sub>2</sub>).
- Light energy from the sun is trapped in the chemical bonds of glucose for later use by plants.
- The reactants become the products.
- Plants do not perform photosynthesis as a public service to consumers.
- Plants carry out cellular respiration too.



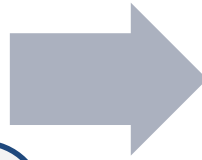
# Visual Models



# NGSS Performance Expectations

## Middle Grades

- **MS-LS1-6. Construct a scientific explanation based on evidence** for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- **MS-LS1-7. Develop a model** to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.



## High School

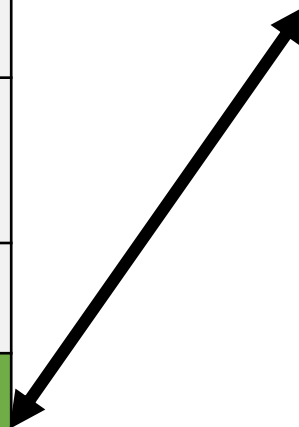
- **HS-LS1-5. Use a model to illustrate** how photosynthesis transforms light energy into stored chemical energy.
- **HS-LS1-6. Construct and revise an explanation based on evidence** for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
- **HS-LS1-7. Use a model** to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.



# Pairing ELA and Science Practices

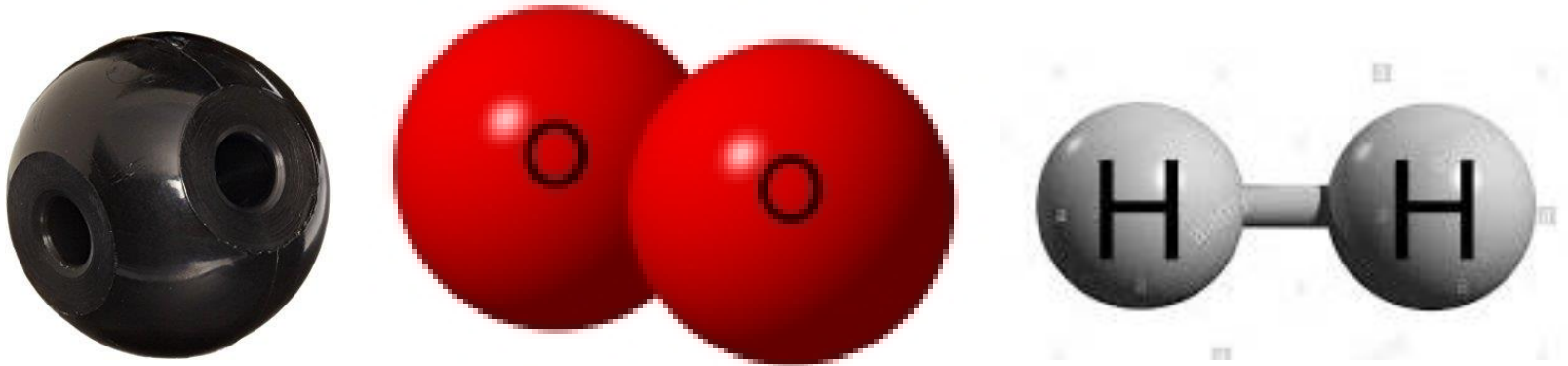
| CCSS ELA Practices  |
|---|
| E1. Demonstrate independence in reading complex texts, and writing and speaking about them.           |
| E2. Build a strong base of knowledge through content rich texts.                                      |
| E3. Obtain, synthesize, and report findings clearly and effectively in response to task and purpose.  |
| E4. Construct viable arguments and critique reasoning of others.                                      |
| <b>E5. Read, write, and speak grounded in evidence.</b>   |
| E6. Use technology and digital media strategically and capably.                                       |
| E7. Come to understand other perspectives and cultures through reading, listening, and collaborating. |

| NGSS Science Practices                           |
|--|
| S1. Ask questions and define problems.           |
| <b>S2. Develop and use models.</b>               |
| S3. Plan and carry out investigations.           |
| S4. Analyze and interpret data.                  |
| S5. Use mathematics and computational thinking.  |
| S6. Construct explanations and design solutions. |
| S7. Engage in argument from evidence.            |
| S8. Obtain, evaluate and communicate evidence.   |



# Mental Modeling

- How do carbon (black), oxygen (red), and hydrogen (white) get into and out of the leaf?
- In what forms do they enter and exit the leaf?



# Epic Journeys

## Epic Hero Traits

Most epic heroes possess most or all of eight general characteristics that can be used to determine whether or not a character is an epic hero or heroine. For the purpose of this assignment, you will be asked to prove whether or not Odysseus is an epic hero based on your analysis of at least six of these traits. You will be required to analyze Trait 8: Character Flaws and then chose five additional traits to analyze.



### Trait 1: A Noble Birth

- Most epic heroes will have an above average station in life.
- They will be kings, princes, or nobles of some sort.
- Commoners usually do not become epic heroes.

### Trait 2: Capable of deeds of great strength and courage

- Basically, this means the hero has the potential for great deeds.
- The magnitude of these actions are well above and beyond what the commoner does.

### Trait 3: Great Warrior

- Before the hero of an epic does his business in the epic, he has usually established himself in combat during a war.
- Sometimes, as in we actually see the hero at war.

- A student video
- <https://youtu.be/aFEn4aO3mc>





# Writing about the Epic Journey of a Carbon Atom

## The Carbon Odyssey: Graphic Organizer

Now that you have evaluated whether or not Odysseus is an epic hero in *The Odyssey*, you should be well-versed in the character traits that make up an epic hero. For this assignment, you need to revisit the character traits listed below, and, to get your juices flowing again, explain in a sentence or two how Odysseus embodies each character trait.

Now comes the difficult part; it will require you to think both creatively and critically for a bit. Imagine that the carbon molecule was an actual living, breathing organism. If our friend Mighty Carbon were to tell the story of photosynthesis from his point of view, how might these character traits show up in him during his journey? Fill out the right-hand column for the Mighty Carbon Atom based on these same character traits. Feel free to be creative! An example has been created for you in the first row.

|  | The Odyssey | The Mighty Carbon Atom  |
|--|-------------|---|
| Trait 1:<br>Capable of deeds of great strength and courage |             | <p><i>Ex: in order for the Mighty Carbon Atom to turn from plant matter into CO<sub>2</sub>, it must find the courage to pass through the harrowing jaws of the cow and face the digestive track of this ravenous beast.</i></p> <p>Your Example:</p> |
| Trait 2:<br>Great Warrior                                  |             |   |
| Trait 3:<br>Travels Across a Vast Setting                  |             |   |

Keep Going! Traits 4 and 5 are on the next page.

## The Mighty Carbon Atom: An Epic Journey



Now that we have discovered what epic hero traits the Mighty Carbon Atom displays throughout its journey, we need to write about it! For this assignment, you will be developing a first-person narrative that explains the journey the Mighty Carbon Atom takes as it travels through the carbon cycle and photosynthesis.

- <https://youtu.be/iWornwboP4>





# Reading Nonfiction

- How many of you have had students struggle with the reading of the textbook or other supplementary reading in your content area?



At first glance reading nonfiction works hard  
NOT to place demands on the readers...

- After all there are rarely
  - Flashbacks
  - Multiple narrators
  - Unreliable narrators

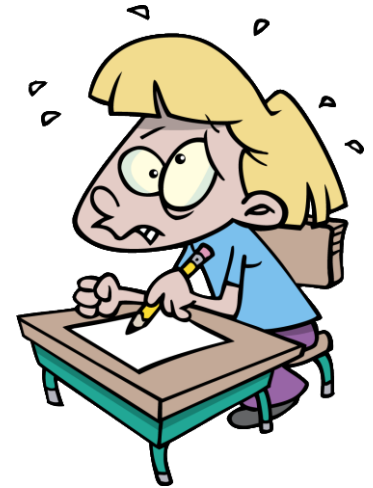
And usually

- Steps are numbered
- Signal words
- Maps, figures, graphs, etc.

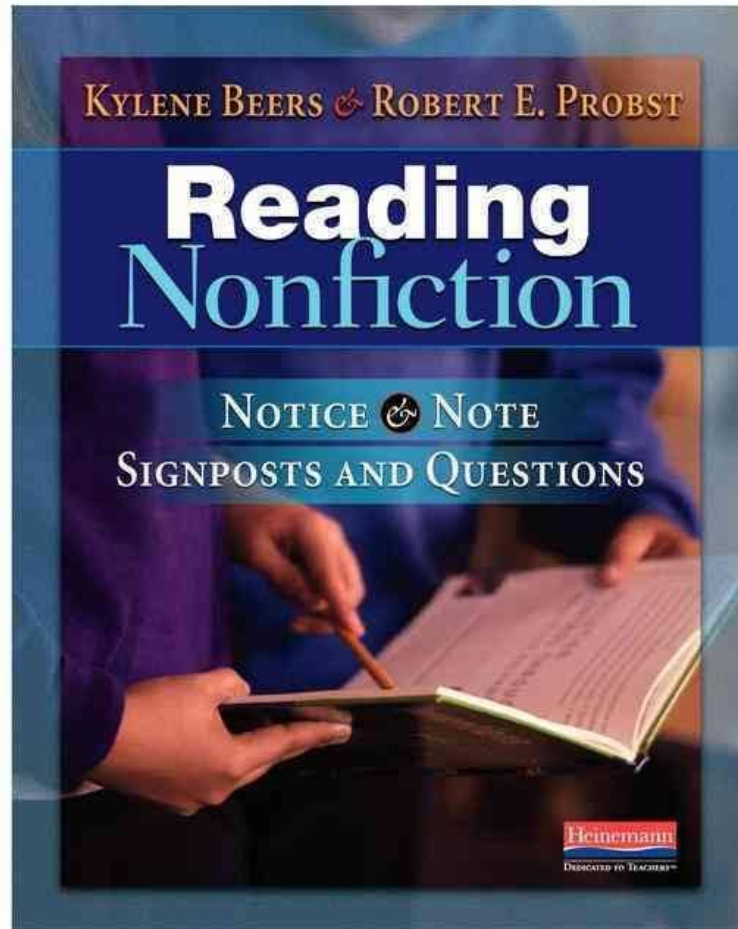


# The reality is nonfiction places many demands on readers

- We must be on the lookout for biases
- Requires more background knowledge
- Required knowledge is technical, specific, and complex
- Vocabulary can be intimidating
- Syntax can be daunting
- Concepts can be abstract



# The signposts



An Excerpt from *American Chestnut:  
The Life, Death, and Rebirth of a  
Perfect Tree* by Susan Freinkel



# Signpost: Numbers and Stats

- Specific quantities or comparisons to depict the amount, size or scale
- Or the writer is vague and imprecise about numbers when we would expect more precision
- Including: numerals, stats, and indefinite quantities (many, most, some, etc.)



# As you read....



- Interact with the text by annotating
- Ask:
  - Why did the author use these numbers or amounts?
  - What purpose do these numbers serve in this context?
  - Is there a lack of clear numbers and if so in what parts of the text could numbers clarify?
  - If you finish early, try another signpost!





# Concluding Video

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**Title:**

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# Questions and Comments

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