

Name _____

Date _____



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Episode 8: PHOTOSYNTHESIS

Directions: Review the given definitions. Define the remaining vocabulary words as you watch [Cog's Episode 8: Photosynthesis. https://youtu.be/Ta8xmMTnjDg](https://youtu.be/Ta8xmMTnjDg)

Part I. Vocabulary Words

- **Carbohydrates (carbs)** [1:00] Carbs are made of **C**arbon, **H**ydrogen, and **O**xygen bonded together. **CHO**. Carbs are the body's major source of energy and provide fiber.
- **Fats** [1:00] Fats are big molecules called lipids, mostly made of **C**arbon, **H**ydrogen, and **O**xygen. **CHO**. They store energy, maintain body temperature and cushion organs.
- **Proteins** [1:00] Proteins are made of folded strands of amino acids, which are mostly made of **C**arbon, **H**ydrogen, **O**xygen, and **N**itrogen. **CHON**. Proteins do most of the work in your cells.
- **Genetic Material** [5:12] Genetic material is mostly made of **C**arbon, **H**ydrogen, **O**xygen, **N**itrogen and **P**hosphorus. **CHONP**. It includes DNA and RNA. They contain genetic information and control a cells' protein synthesis.
- **Chloroplast** [3:04]
- **Glucose** [4:10]
- **Photosynthesis** [4:10]

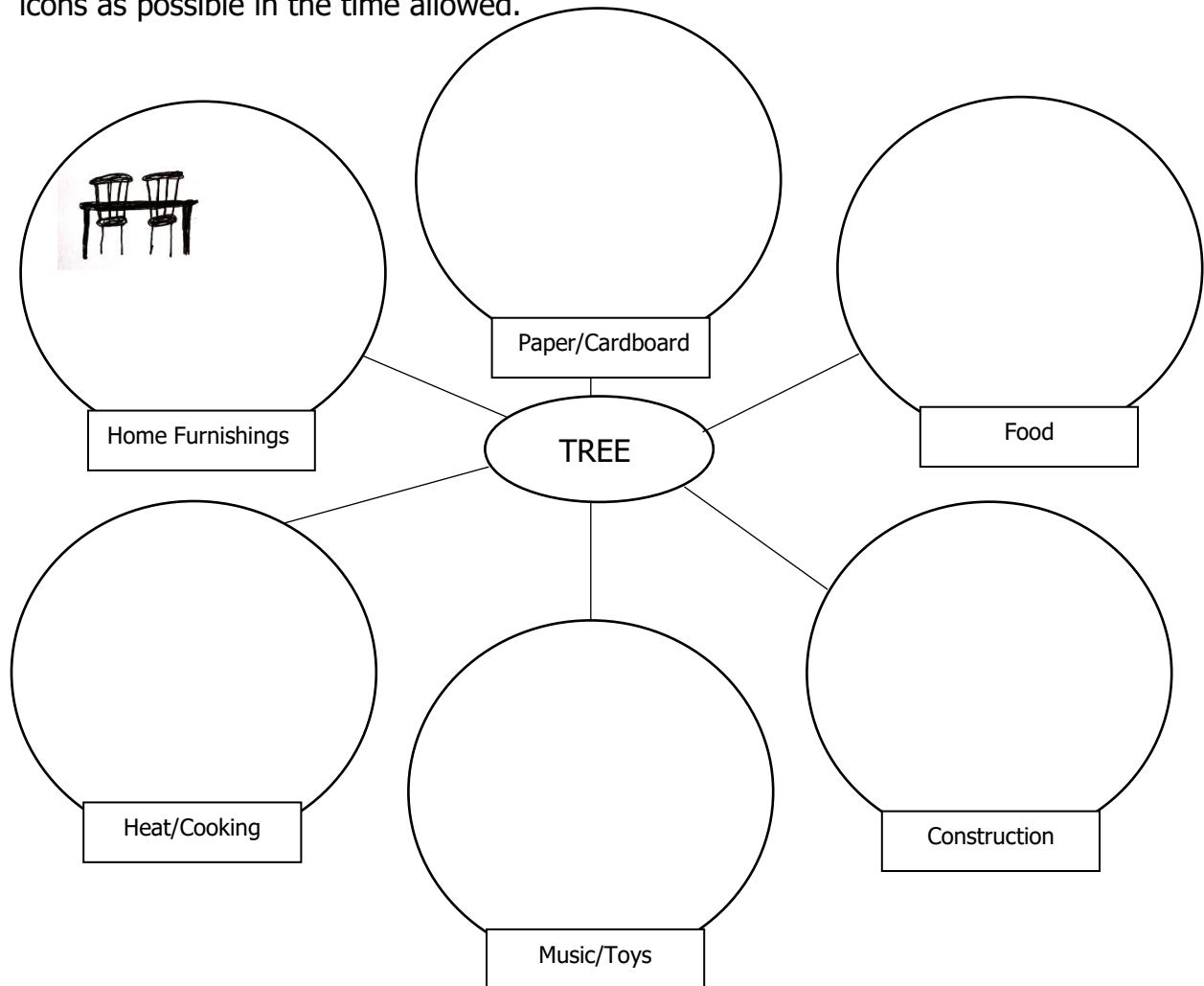
Part II. Answer after viewing the video.

What is food made of?	Describe Van Helmont's 1639 tree experiment.
Why are sugars from photosynthesis important?	What are the approximate percentages of carbon, oxygen, and hydrogen in a tree? • Carbon • Hydrogen • Oxygen

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Take a deeper dive after viewing the video:

Part III. Think about the surprising information that trees are made of 92% carbon and oxygen, from thin air. Now draw icons showing how we use trees (Example: table and chairs.) The website <https://thenounproject.com> can help you envision icons to draw. Draw as many icons as possible in the time allowed.

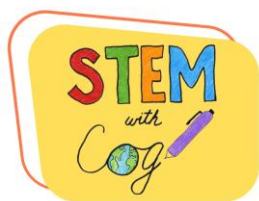


Part IV. Write a label next to each image you drew above.

- Write "CE" if the use makes trees "carbon emitters": For example, fire emits carbon.
- Write "CS" if the use results in "carbon storage": For example: guitars store carbon.
- Write "CM" if the use results in "carbon movement" from one organism to another: For example, fruits being eaten.

Part V. Think Big:

1. What are a few more ways that we use or enjoy trees?
2. When wood decomposes or burns, it releases CO₂ and water. Do you think trees are a good place to store carbon? Why or why not?



Episode 8: PHOTOSYNTHESIS

Directions: Define the vocabulary that are not already defined for you as you watch [Cog's Episode 8: Photosynthesis](#).

Part I. Vocabulary Words

- **Carbohydrates (carbs)** [1:00] Carbs are made of **Carbon**, **Hydrogen**, and **Oxygen** bonded together. **CHO**. Carbs are the body's major source of energy and provide fiber.
- **Fats** [1:00] Fats are big molecules called lipids, mostly made of **Carbon**, **Hydrogen**, and **Oxygen**. **CHO**. They store energy, maintain body temperature and cushion organs.
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- **Genetic Material** [5:12] Genetic material is mostly made of **Carbon**, **Hydrogen**, **Oxygen**, **Nitrogen** and **Phosphorus**. **CHONP**. It includes DNA and RNA. They contain genetic information and control a cells' protein synthesis.
- **Chloroplast** [3:04] A chloroplast is the cell organelle (site) where photosynthesis occurs. Chlorophyll in the chloroplast makes it appear green.
- **Photosynthesis** [4:10] $6 \text{ H}_2\text{O's} + 6 \text{ CO}_2\text{'s} \rightarrow$ (in the presence of sunlight) produce 1 glucose molecule and 6 $\text{O}_2\text{'s}$ or oxygen molecules. Photosynthesis turns CO_2 into food and oxygen in the presence of sunlight.
- **Glucose** [4:10] Glucose, and other simple sugars are the food the plant makes to capture the sun's energy. Simple sugars like glucose are also rearranged to make carbs, fats, proteins, and genetic material.

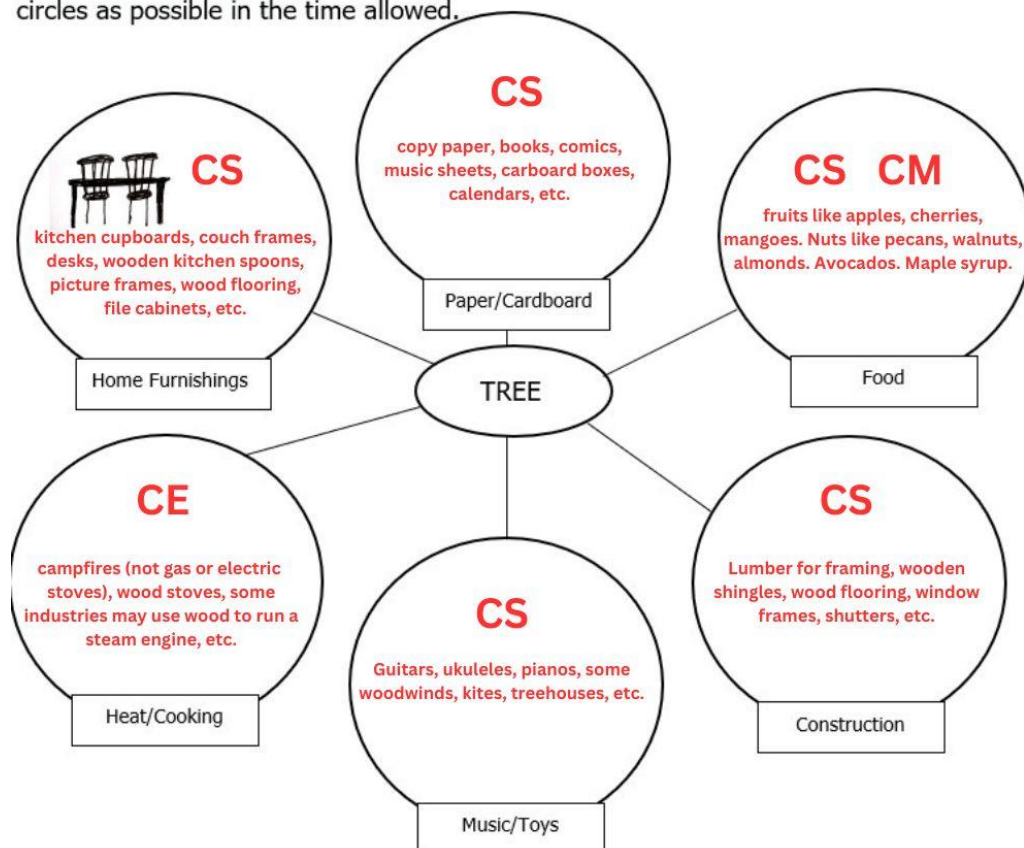
Part II. Answer after viewing the video.

What is food made of? Food is made of carbs, fats, proteins, and genetic material (from the cells of the food we eat). Our food is predominately made of carbon, hydrogen, oxygen, nitrogen, and phosphorus.	Describe Van Helmont's 1639 tree experiment. Van Helmont planted a 5-lb sapling into 200 lbs of dry dirt and gave the tree nothing but water. After 5 years, the tree gained 164 lbs, but the soil still weighed about 200 lbs.
Why are sugars from photosynthesis important? Sugars produced during photosynthesis supply the plant with energy and are rearranged to make carbs, fats, lipids, and genetic material.	What are the <i>approximate</i> percentages of carbon, oxygen, and hydrogen in a tree? • Carbon ~50% • Hydrogen ~6% • Oxygen ~42%

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Take a deeper dive after viewing the video: This answer key has one image from the noun project for each circle, but there are lots of good answers, and students can draw more than one per circle. Ask students to justify why they wrote CE, CS, or CM. As these things decompose or are digested or burned, they all become carbon emitters sooner or later. (Note: Heat/cooking cannot be gas or electric appliances.)

Part III. Thinking about the surprising info that trees are about 92% carbon and oxygen, from thin air, draw icons illustrating how we use trees. An example is given using an icon from <https://thenounproject.com>. This website can help envision and draw icons. Fill in as many circles as possible in the time allowed.



Note that anything made of wood will eventually decompose, releasing CO₂ and water.

Part IV. Write a label next to each image you drew above.

- Write "CE" if the use makes trees "carbon emitters": For example, fire emits carbon.
- Write "CS" if the use results in "carbon storage": For example: guitars store carbon.
- Write "CM" if the use results in "carbon movement" from one organism to another: For example, fruits being eaten.

Part V. Think Big:

1. What are a few more ways that we use or enjoy trees? Ships of wood, for shade, for climbing, for oxygen, keystone species in an ecosystem, so other plants/animals use the tree, etc.
2. When wood decomposes or burns, it releases CO₂ and water. Do you think trees are a good place to store carbon? Jot down your ideas, for a discussion about this question. Answers will vary. Things you might want to get out of a discussion are that trees can capture carbon in the short term, but it's important to plant trees that can survive the new climate conditions. Wild fires happen more often now and often burn hotter and/or cover more ground before they can be controlled. Trees are good at capturing carbon, but not a one-size-fits-all solution.

TEACHER RESOURCES

NGSS Standards:

[MS-PS1-1](#) Simple molecules structures

[MS-LS1-6](#) Photosynthesis in the cycling of matter and flow of energy

[MS-LS1-7](#) Food is rearranged to make new molecules

[MS-LS2-3](#) Cycling of matter and flow of energy among living and nonliving parts.

Experiment resources:

Find the tree measuring activity lesson plans at:

[Measure the mass of carbon, oxygen, and hydrogen in a tree.](#)

<https://teachclimatescience.files.wordpress.com/2018/06/cnc-tree-biomass-activity2.pdf>

Description: This worksheet goes along with the Cog's Episode 8 video about Photosynthesis [9:48] It can be used by teachers or their substitutes (given the answer key) to guide learning, check for understanding, and interpret significance of the information.

[*STEM with Cog's Episode 8: Photosynthesis*](#)

<https://youtu.be/Ta8xmMTnjDg>

The worksheet's first page asks literal questions that can help students understand the material covered in the video. The second page helps students connect the information to their own lives and evaluate or infer meaning by pondering the importance of the information by using higher level thinking skills. Pages can be used separately or print front-to-back to make a 2-page worksheet.

Directions:

Before viewing the video, handout a worksheet to each student if being done individually or a worksheet to each group of 2-4 students if they're working in groups.

Part I. Some vocabulary words have been defined and should be discussed before viewing the video. The remaining vocab words can be defined as you watch the video. The timestamp next to each word alerts you to where the word is used. Stop the video and replay as many times as needed. If students need help, give them the definitions from the answer key.

Part II. Ask students to answer each question. It may help to show the final sketchnote, page 7 of this document or [9:10] in the video. If time permits, share student answers. Ask students to jot down any new information they've gathered from others.

Part III. Warm up by asking students how we use trees in our daily lives. Now give students 3 minutes to draw icons to fill in the circles. If they want to use their own categories for the circles that's fine. They can cross out the provided category and add a new one. The website <https://thenounproject.com> is a great place to get ideas for drawing icons if students have access to tablets or computers. It's okay for reluctant students to use words instead, but

encourage them to expand their learning by trying to draw some. Stick figures are fine. After 3 minutes, ask students to share their ideas, so others can add icons to their worksheet.

Part IV. Go over directions with students and ask if they have any questions. Use the answer key to guide them. Give them 1-2 minutes to write a label next to each of their icons.

Part V: Think Big: (Think-Pair-Share) Give them 1-2 minutes to **Think** and jot down notes about whether or not trees are carbon sinks or carbon emitters. Then assign each student to a **Pair**. Ask the pair to **Share** their work. Remind students to listen respectfully and ask questions if they have any. If time allows bring the class back together and ask students when planting trees to store carbon is a good idea.

WATCH RELATED COG VIDEOS ABOUT THE CARBON CYCLE:

The fast carbon cycle:

- [Episode 2: Cellular Respiration & the Fast Carbon Cycle](#) (Food becomes CO₂ and H₂O.)
- [Episode 3: Campfires](#) (How plants burn, releasing CO₂ and water.)
- [Episode 8: Photosynthesis](#) (How plants turn CO₂ and water into food.)
- [Episode 9: Oceans](#) (How carbon moves through a food web or pyramid.)

The slow carbon cycle:

- [Episode 7: Volcanoes](#) (How volcanoes form and release CO₂)
- [Episode 10: The Slow Carbon Cycle](#) (How CO₂ is absorbed into oceans from atmosphere, incorporated into shells, falls as sediment, lithifies into rock, and releases CO₂ when heated (volcanoes or cement production) or chemically eroded.)

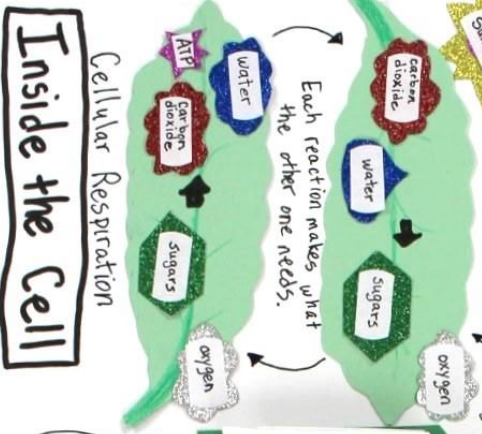
Moving fossil fuels from slow carbon cycle into fast carbon cycle:

- [Episode 1: Carbon Dioxide: A Greenhouse Gas](#) (Intro to climate change.)
- [Episode 4: Coal-Fired Power Plants](#) (How coal forms and is burned as a CO₂-generating heat source to create steam that turns a turbine and generator to produce electricity.)
- [Episode 5: Crude Oil Fuels](#) (How crude oils (petroleum) form, are refined, and burned as transportation fuels that release excess CO₂ into the atmosphere.)
- [Episode 6: Natural Gas and Methane](#) (How natural gas, which is mostly methane, forms and is burned to produce heat, also releasing excess CO₂. Includes fracking info.)

Growth



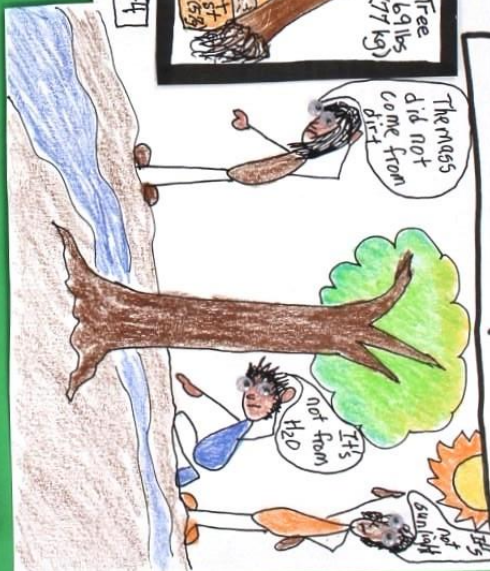
Photosynthesis makes food (sugars)



Inside the Cell

PHOTOSYNTHESIS

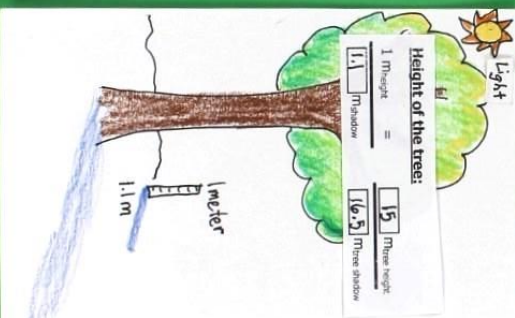
CO₂ goes into



Where did 164 lbs (74 kg) of tree come from?



The Tree Experiment



Volume_{tree} = $\pi r^2 (h)$

APPROX. PERCENT OF ELEMENTS IN TREE BY WEIGHT

$r = 0.25m$ $d = 0.5m$

Volume of tree: $V = \pi r^2 h$

Then $V = 3.14 (0.25)^2 (15) = 1.88m^3$

Volume = $1.88m^3$

Mass of tree: Cottonwood is 410 kg/m³

Mass = Volume $\times$ Density

Mass = $1.88m^3 \times 410kg/m^3 = 771kg$

Mass = $771kg$

Mass = $771kg$

Mass = $771kg$

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