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Name _____

Episode 2: CELLULAR RESPIRATION AND THE FAST CARBON CYCLE

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch Cog's [Episode 2: Carbon from Cellular Respiration and the Fast Carbon Cycle](https://youtu.be/eUdaFqu58P4) <https://youtu.be/eUdaFqu58P4>.

1. **Cellular respiration** [1:00] is the process in cells in which oxygen is used to break down carbohydrate (food) molecules to produce chemical energy stored in the bonds of adenosine triphosphate (ATP) molecules.
2. **Glucose** [1:40] is a 6-carbon sugar, $C_6H_{12}O_6$, that comes from foods we eat and is the major source of energy for our cells.
3. **Cellular respiration pathway** [1:46] is the series of steps that breaks down glucose and produces ATP molecules which store energy for the cell.
4. **Chemical energy** [2:18] is the energy stored in bonds of molecules.
5. **Carbohydrates** [3:40] (carbs) are naturally occurring compounds made of carbon, hydrogen, and oxygen. They include simple nutrients like sugars, starches, and fiber.
6. **Simple carbs** [3:45]
7. **Complex carbs** [4:27]
8. **Fats** [4:48] are molecules made of carbon, hydrogen, and oxygen. They are essential nutrients for our bodies that store energy for our cells.
9. **The pH scale** [6:30]

Part II. Answer after viewing the video.

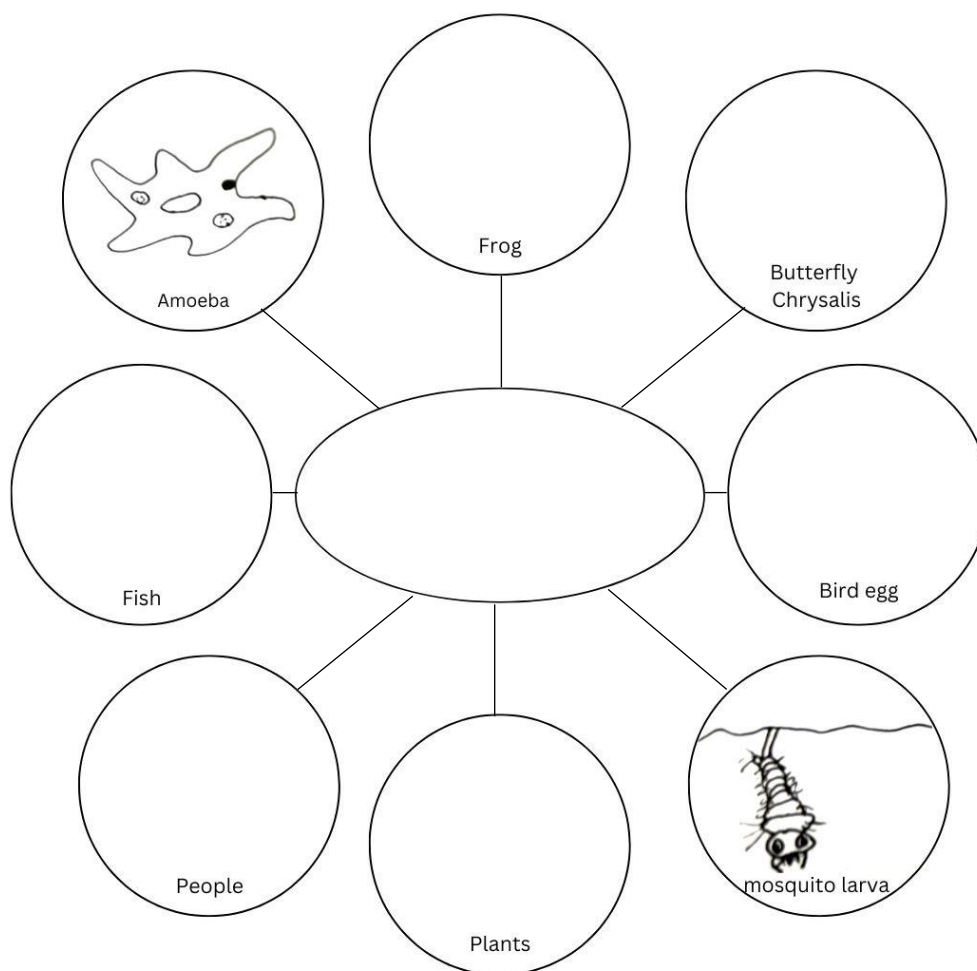
Where does the carbon in the carbon dioxide (CO_2) we exhale come from?	How much more CO_2 is in the air we exhale than in the air we inhale?
Food and oxygen enter the cellular respiration pathway. What comes out?	Why doesn't the CO_2 we exhale cause climate change?

Name _____

Take a deeper dive after viewing the video:

Part III. Draw icons to represent these organisms and/or stages of life.

If you have access to a computer, visit <https://thenounproject.com> for icon ideas.



Part IV. Analyze

This mind map is missing a label at the center that tells us what all these organisms have in common. Add a label that describes all these organisms.

Part V. Think Big: In the “Fast Carbon Cycle” plants and plankton turn CO_2 and water into sugars through photosynthesis. Cellular respiration uses oxygen to break those sugars down into CO_2 and water. As carbon travels around the cycle, through the organisms in the circles above, the amount of carbon on Earth doesn’t change. Its location changes. Burn fossil fuels adds ancient carbon, in the form of CO_2 , to our fast carbon cycle. Explain why we might call that carbon “excess” carbon.



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- 1. Cellular Respiration** [1:00] is the process in cells in which oxygen is used to break down carbohydrate (food) molecules to produce chemical energy stored in the bonds of adenosine triphosphate (ATP) molecules.
- 2. Glucose** [1:40] is a 6-carbon sugar, $C_6H_{12}O_6$, that comes from foods we eat and is the major source of energy for your cells.
- 3. Cellular Respiration Pathway** [1:46] is the series of steps that breaks down glucose and produces ATP molecules which store energy for the cell.
- 4. Chemical Energy** [2:18] is the energy stored in bonds of molecules.
- 5. Carbohydrates** [3:40] (carbs) are naturally occurring compounds made of carbon, hydrogen, and oxygen. They include simple nutrients like sugars, starches, and fiber.
- 6. Simple carbs** [3:45] *fast-acting carbs like glucose in veggies, fructose in fruit, galactose in milk, and sucrose in table sugar.*
- 7. Complex carbs** [4:27] *are long chains of simple carbs found in things like peas, rice beans, sweet potatoes, and bread.*
- 8. Fats** [4:48] are molecules made of carbon, hydrogen, and oxygen. They are essential nutrients for our bodies that store energy for our cells.
- 9. The pH scale** [6:30] *measures how acidic (or basic) a liquid is. Seven is neutral. Strong acids have low numbers, for example, lemons measure 2 on the pH scale.*

Part II. Answer after viewing the video.

Where does the carbon in the carbon dioxide (CO_2) we exhale come from? <i>The carbon in the air we exhale comes from the carbons in glucose or other simple carbs that go through cellular respiration. Many of these simple sugars came from the carbohydrates and fats in our food.</i>	How much more CO_2 is in the air we exhale than in the air we inhale? <i>The air we exhale or breathe out has 100 times more CO_2 in it than the air we inhaled or breathed in.</i>
Food and oxygen enter the cellular respiration pathway. What comes out? <i>Carbon dioxide, water, and (very importantly) chemical energy that is held in the bonds of ATP molecules. Energy from the bonds in our food molecules are used to form bonds in ATP molecules.</i>	Why doesn't the CO_2 we exhale cause climate change? <i>The CO_2 we exhale is part of the carbon cycle. Plants will use that CO_2 to photosynthesize, making more food.</i>

Take a deeper dive after viewing the video:**Part III.** Draw icons to represent these organisms and/or stages of life.If you have access to a computer, visit <https://thenounproject.com> for icon ideas.Drawings will vary. After they've labeled the diagram, share this interesting info with them.**Part IV. Analyze**

This mind map is missing a label at the center that tells us what all these organisms have in common. Add a label that describes all these organisms. **Students might think that a plant, bird embryo, or chrysalis does not need oxygen because they aren't breaking down food, but they are hard at work growing and need energy, so they rely on cellular respiration, taking in O₂, then releasing CO₂ and water.**

Part V. Think Big: In the "Fast Carbon Cycle" plants and plankton turn CO₂ and water into sugars through photosynthesis. Cellular respiration uses oxygen to break those sugars down into CO₂ and water. As carbon travels around the cycle, through the organisms in the circles above, the amount of carbon on Earth doesn't change. Its location changes. Explain why we might call that carbon "excess" carbon. **Answers will vary, but may include the idea that the carbon in fossil fuels was taken out of the fast carbon cycle millions of years ago when those trees or plankton were buried. When we burn fossil fuels, the carbon dioxide released goes into our atmosphere where it disrupts our previously balanced Fast Carbon Cycle. It is too much carbon, and therefore "excess."**

TEACHER RESOURCES

NGSS Standards:

[MS-PS1-1](#) Atomic composition of carbs and fats

[MS-PS1-2](#) Substances before and after interaction (cellular respiration)

[MS-LS1-6](#) Role of photosynthesis in matter and energy cycling

[MS-LS1-7](#) Food is rearranged through chemical reactions releasing energy

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

Experiment Resources:

Find directions to conduct the [demonstration of carbon dioxide in breath](#) at

[Test for Magical Breath with a Dementor's Kiss - chemistry and ph indicators - Rosie Research](#)

Description: This worksheet goes along with the Cog's Episode 2 video about Cellular Respiration [8:43]. 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 in

[Episode 2: Carbon from Cellular Respiration](#)

<https://youtu.be/eUdaFqu58P4>

The 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. Pages can be used separately or printed front-to-back to make a 2-page worksheet.

Directions:

Before viewing the video, hand out 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 them the final sketchnote, page 7 of this document or [7:58] in the video. If time permits, share student answers. Ask students to jot down any new information they've gathered from the discussion.

Part III. Give students 3 minutes to draw an icon for each of the organisms in the graphic. Examples are given for the harder ones. 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 thinking by trying to draw. Stick figures are fine.

Part IV. Analyze: Direct student attention to the center oval. Ask students to look at all the organisms. What do they have in common (in regards to cellular respiration). They may want to work in pairs to discuss this. After 1 minute, ask students to share what they wrote as a label. All of these organisms take in oxygen and release CO₂ and water during cellular

respiration. Afterwards, read them the answer key to illustrate how each organism exchanges O₂ and CO₂.

Part V. Think Big: Ask students to read the paragraph and answer the question. If time allows, ask students to share their answers.

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, which can release CO₂ when heated (volcanoes or cement production) or chemically eroded.)

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

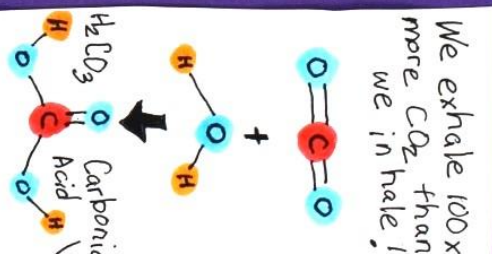
- [Episode 1: Carbon Dioxide: A Greenhouse Gas](#) (Introduction to climate change.)
- [Episode 4: Coal-Fired Power Plants](#) (How coal forms and is burned as a CO₂-generating heat source to create steam that turns a turbine and generator to produce electricity.)
- [Episode 5: Crude Oil Fuels](#) (How 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.)

Cellular Respiration



Cellular Respiration Pathway

	Atoms carbon	hydrogen	Oxygen
In	6	12	18
Out	6	12	18



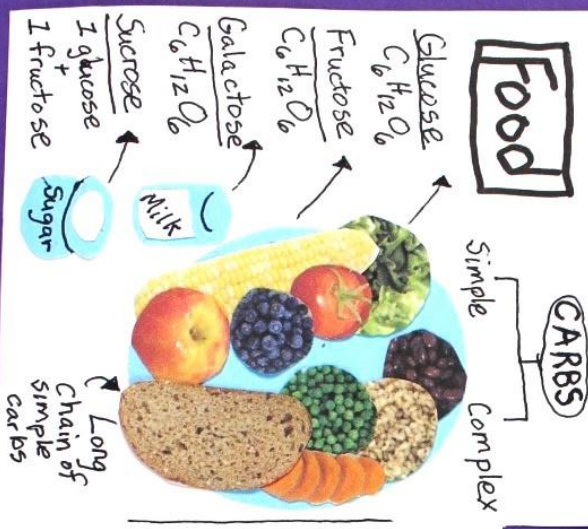
We exhale 100x more CO_2 than we inhale!

Exhaled CO_2

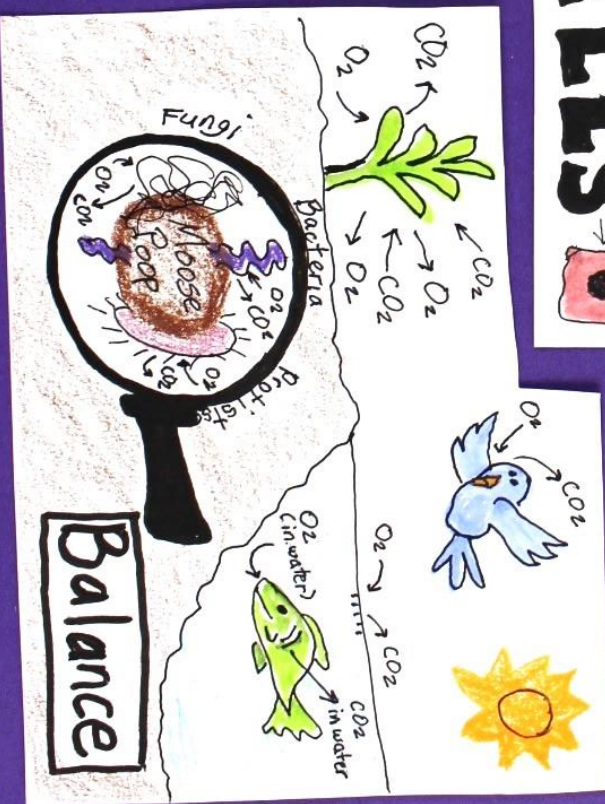
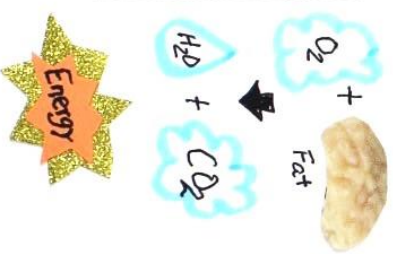
- 1 - Battery Acid
- 2 - Lemon
- 3 - Vinegar
- 4 - Tomato
- 5 - Coffee
- 6 - Milk
- 7 - Water

CO_2 comes from **CELLS**

Food



FATS



Balance