https://www.stemwithcog.org

Name _____

Date _____

CRUDE OIL FUELS AND TRANSPORTATION

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch Cog's *Episode 5: Carbon From Crude Oil Fuels*, https://youtu.be/O4cKgTaqRZ8

- **Plankton** [0:30] are minute organisms that float or swim weakly near the surface of bodies of water.
- **Phytoplankton** [0:35]
- **Zooplankton** [0:40]
- **Porous rock** [1:18] contains empty spaces between the grains that can hold liquid or gas. Porous rock with connected spaces liquid or gas can flow through is "permeable."
- **Impermeable rock** [1:26]
- **Reservoirs** [1:28] are natural formations in rock where gas or oil accumulate and are stored.
- **Hydrocarbons** [1:45]
- **Pistons** [4:28] are metal disks that slide up and down or side to side in an engine.
- **Ring gears** [5:32] are cut on a ring-shaped rim and operate in pairs to modify the direction of rotary motion around an axis.

Part II. Answer after viewing the video.

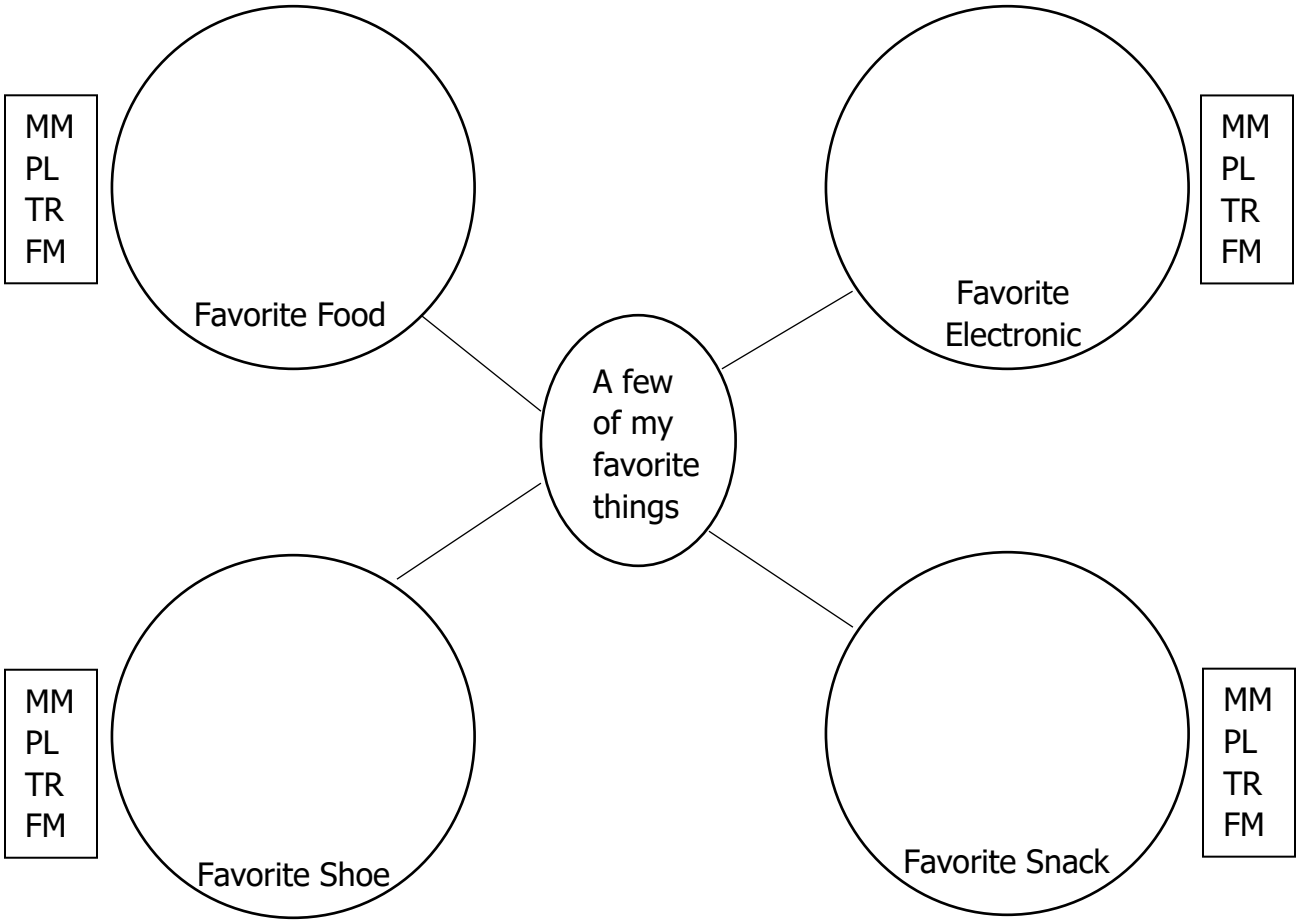
What happens in an oil distillation tower?	What 2 compounds are formed when hydrocarbons are burned in a car?
List the 4 steps a jet engine goes through.	What are 5 modes of transportation that might burn crude oil products.

1. 2. 3. 4.	1. Passenger travel on roads (cars, buses, etc.) 2. 3. 4. 5.

Name _____

Take a deeper dive after viewing the video:

Part III. Draw icons in the circles that represent your favorite things. You can get help visualizing your icon from https://thenounproject.com if you have access to a computer.



Part IV. Think – Pair - Share

Think about your items above. Listed below are some of the ways crude oil's components may have been used to make and deliver them. Circle those that apply to each item.

- MM – Mining machinery used to extract the metals in this item. Ores were transported.
- PL – Plastics (which are made from crude oil) were used in packaging or in storage containers.
- TR – Travel of item and/or its components over roads, oceans, rivers, or by air freight.
- FM – Farm equipment like tractors, harvesters or other farm machinery were used.

Pair with another student. **Share** how crude oil was used in your items.

Part V. Think Big: Write down some lifestyle changes would you have to make if you could only use/consume products that were grown or manufactured locally?

Answer Key

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Episode 5: CRUDE OIL FUELS

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch Cog's *Episode 5: CARBON FROM CRUDE OIL FUELS*, https://youtu.be/O4cKgTaqRZ8

- **Plankton** [0:30] are minute organisms that float or swim weakly near the surface of bodies of water.
- **Phytoplankton** [0:35] are minute organisms that can photosynthesize.

- **Zooplankton** [0:40] eat other organisms. These consumers are tiny animals or animal-like organisms.

- **Porous rock** [1:18] contains empty spaces between the grains that can hold liquid or gas. Porous rock with connected spaces liquid or gas can flow through is "permeable."
- **Impermeable rock** [1:26] **does not** have connected spaces where fluids or gas flow through it. Impermeable rock stops the flow of liquids or gas.

- **Reservoirs** [1:28] are natural formations in rock where gas or oil accumulate and are stored.
- **Hydrocarbons** [1:45] are molecules made of only carbon and hydrogen atoms.

- **Pistons** [4:28] are metal disks that slide up and down or side to side in an engine.
- **Ring gears** [5:32] are cut on a ring-shaped rim and operate in pairs to modify the direction of rotary motion around an axis. You can see these on the handheld eggbeater demonstration.

Part II. Answer after viewing the video.

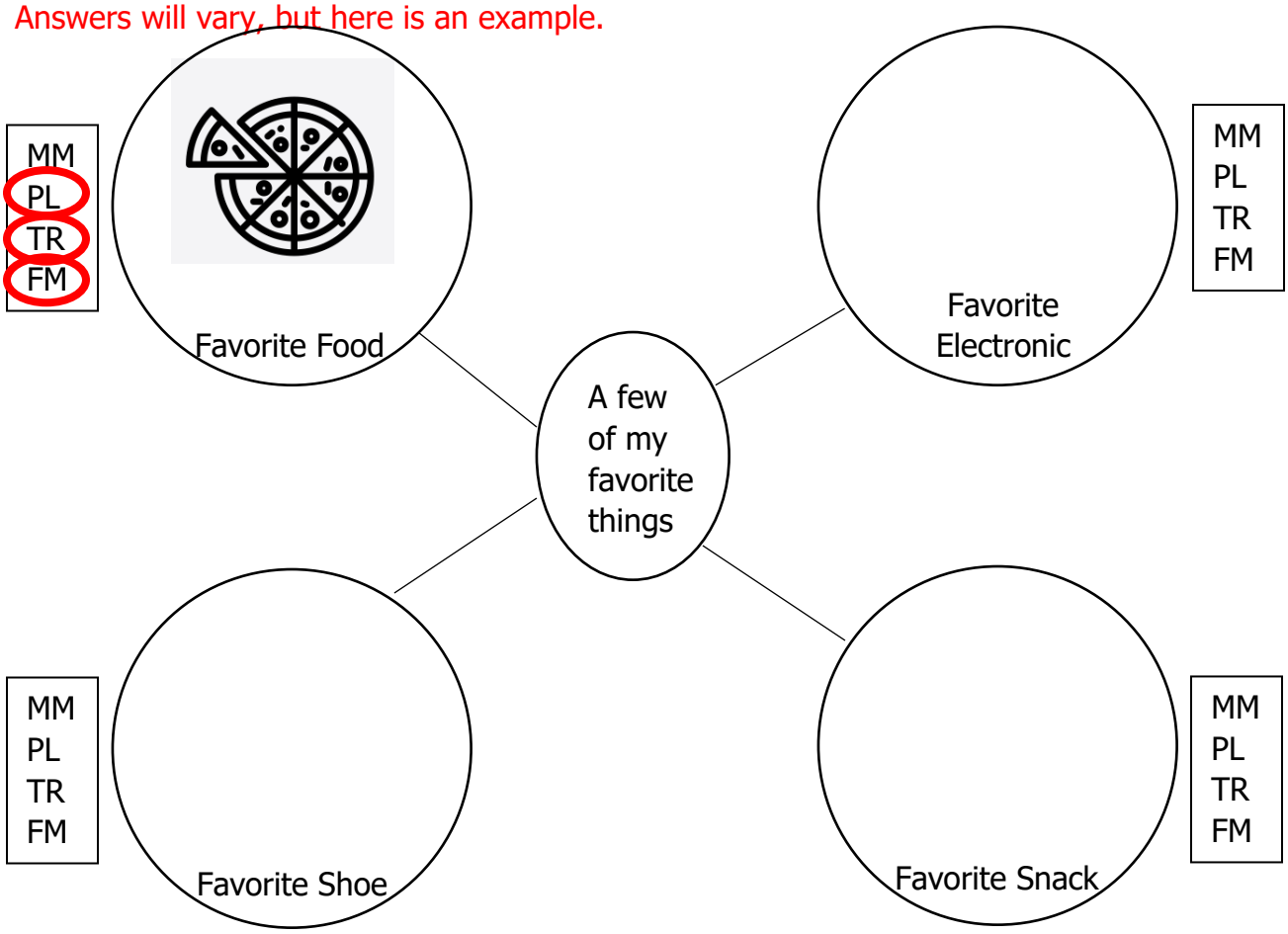
What happens in an oil distillation tower? Crude oil is heated to become gas. Different gases condense at different temperatures, so the gases are separated out by where they condense.	What 2 compounds are formed when hydrocarbons are burned in a car? Gasoline, a hydrocarbon, burns to release carbon dioxide and water. [Note: untuned cars will release black soot or unburned carbon too.]

List the 4 steps a jet engine goes through. 1. Intake, 2. compression, 3. combustion, and 4. exhaust	What are 5 modes of transportation that might burn crude oil products. See page 7. 1. Road (Passenger travel in cars, buses, etc.) 2. Road (freight as in big trucks, semis, etc.) 3. Aviation 4. Shipping (boats, ships, tankers) 5. Rail

Name _____

Take a deeper dive after viewing the video:

Part III. Draw icons in the circles that represent your favorite things. You can get help visualizing your icon from https://thenounproject.com/s if you have access to a computer. Answers will vary, but here is an example.



Part IV. Think, Pair, Share

Think about your items above. Listed below are some of the ways crude oil's components may have been used to make and deliver them. Circle those that apply to each item.

- MM – Mining machinery used to extract the metals in this item. Ores were transported.
- PL – Plastics (which are made from crude oil) were used in packaging or in storage containers.
- TR – Travel of item and/or its components over roads, oceans, rivers, or by air freight.
- FM – Farm equipment like tractors, harvesters or other farm machinery were used.

Pair with another student. **Share** how crude oil was used. Plastics were used to package the cheese, etc. All ingredients were transported to your home or restaurant. Tractors sowed and harvested tomatoes and grains. (Grains fed milk cows --> cheese. Grains made the crust.)
Part V. Think Big: Write down some lifestyle changes would you have to make if you could only use/consume products that were grown or manufactured locally? Answers will vary. Students would have to limit their diet to what can be grown locally. Clothing choices would become more regional. Electronics wouldn't exist, since all metals would need to be mined locally and it's unlikely we'd find them all in one place.

TEACHER RESOURCES

NGSS Standards:

MS-PS1-1 Hydrocarbons are made of carbon and hydrogen.
MS-PS1-2 Burning hydrocarbons produces carbon dioxide and water, a chemical reaction.
MS-ESS2-1 Phytoplankton become crude oil we burn for energy to run cars, making CO_2, etc.
MS-ESS3-4 More gas-burning cars, trucks, ships, and planes make more greenhouse gases.

Experiment resources:

Here is the link for directions to make Alka Seltzer "pistons" from the video.
Alka Seltzer Rockets – Middle School Chemical Engineering For Girls (tufts.edu)

Description: This worksheet goes along with the Cog's Episode 5 video about Crude Oil Fuels [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 in Episode 5: Carbon From Crude Oil Fuels.
https://youtu.be/O4cKgTaqRZ8

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 examining the importance of the information. Pages can be used separately or printed front-to-back to use together.

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 [8:34] in the video. If time permits, share student answers. Ask students to jot down any new information they've gathered in this discussion.

Part III. To warm them up, tell students about your favorite meal, shoe, electronic and snack. Draw them on the board if you're brave. Now give students a few minutes to draw their

icons. 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. Think Big: (Think-Pair-Share) Give students 3 minutes to **Think** and draw their favorite food, shoe, snack, and electronic device. When time is up, give them a minute to circle the ways crude oil was used to make and transport each item. Assign each student to a **Pair**. Ask the pair to verbally **Share** by explaining precisely how crude oil was used. For example, instead of "it came from China," explain that it probably travelled by ship to the US, where it was offloaded onto to trucks or trains (rail) to be delivered to stores. Instead of "farm equipment was used to make grains," explain "tractors and harvesters were used to grow grain or hay to feed cows that were milked to make the cheese." Remind students to listen respectfully and ask questions if they have any. If time allows bring the class back together and ask what questions came up in their discussion. Write their answers on the board.

Part V. Give students 2 minutes to jot some notes in answer to the question. If time allows, ask students to share with the class the hardest lifestyle change they would have to make.

WATCH RELATED COG VIDEOS ABOUT THE CARBON CYCLE:

The fast carbon cycle:

- Episode 2: Cellular Respiration & the Fast Carbon Cycle (Food becomes CO_2 and H_2O.)
- Episode 3: Campfires (How plants burn, releasing CO_2 and water.)
- Episode 8: Photosynthesis (How plants turn CO_2 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 CO_2)
- Episode 10: The Slow Carbon Cycle (How CO_2 is absorbed into oceans from atmosphere, incorporated into shells, falls as sediment, lithifies into rock, which can release CO_2 when heated (volcanoes or cement production) or chemically eroded.

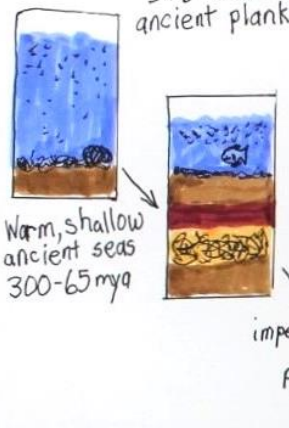
Moving fossil fuels from slow carbon cycle into fast carbon cycle:

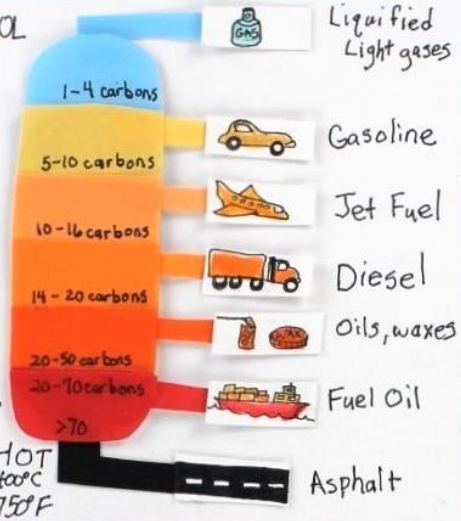
- Episode 1: Carbon Dioxide: A Greenhouse Gas (Intro to climate change.)
- Episode 4: Coal-Fired Power Plants (How coal forms and is burned as a CO_2-generating heat source to create steam that turns a turbine and generator to produce electricity.)
- Episode 5: Crude Oil Fuels (How crude oils (petroleum) form, are refined, and burned as transportation fuels that release excess CO_2 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 CO_2. Includes fracking info.)

Crude Oil

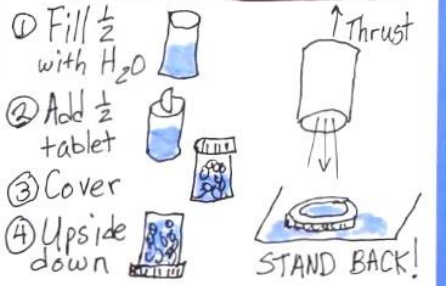
It's made of ancient plankton



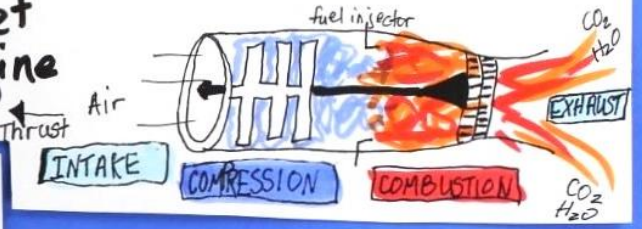


Powerful Gas

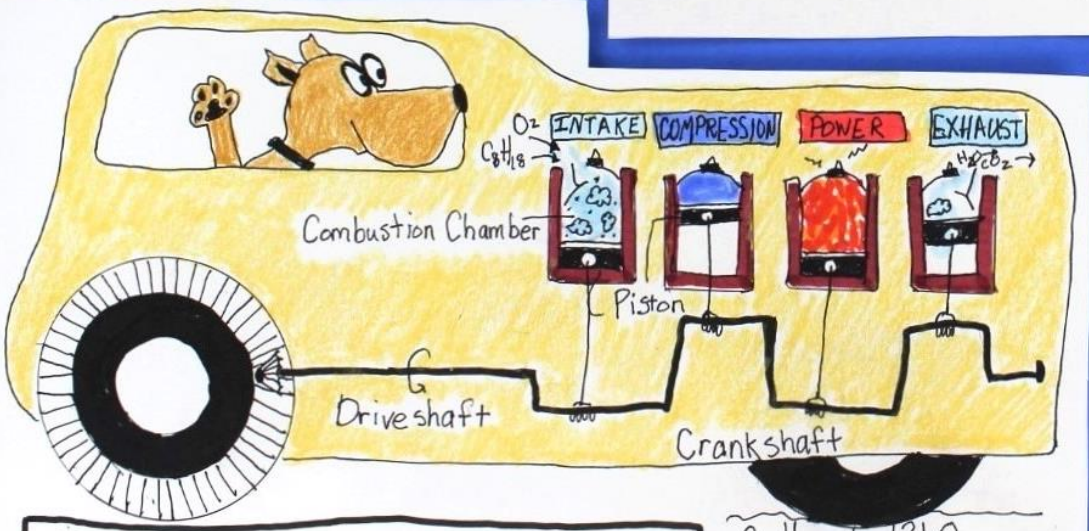
- Safety goggles or glasses
- Open outdoor area
- No innocent bystanders



Jet Engine



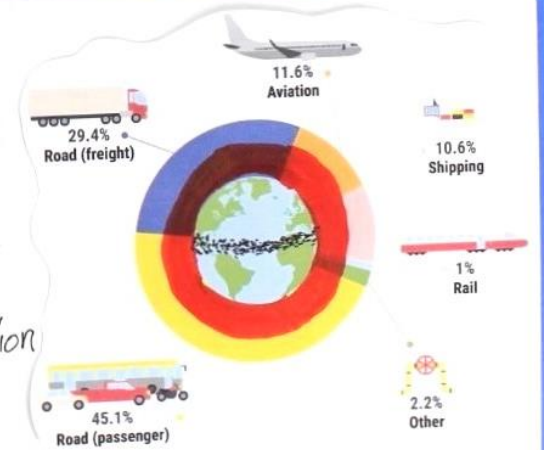
CO_2 comes from CRUDE OIL FUELS



Internal Combustion Engine

$$C_8H_{18} + 12\tfrac{1}{2}O_2 \xrightarrow{\text{heat}} 8CO_2 + 9H_2O + \text{Heat Light}$$

In 2021 we produced 7.6 billion tons of CO_2 globally for transportation



A beachball 3 stories high is 1 ton of CO_2!

Global CO_2 from Transport