

Name _____

Date _____



<https://www.stemwithcog.org>

NATURAL GAS and METHANE

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch [Cog's Episode 6: Natural Gas and Methane](#).

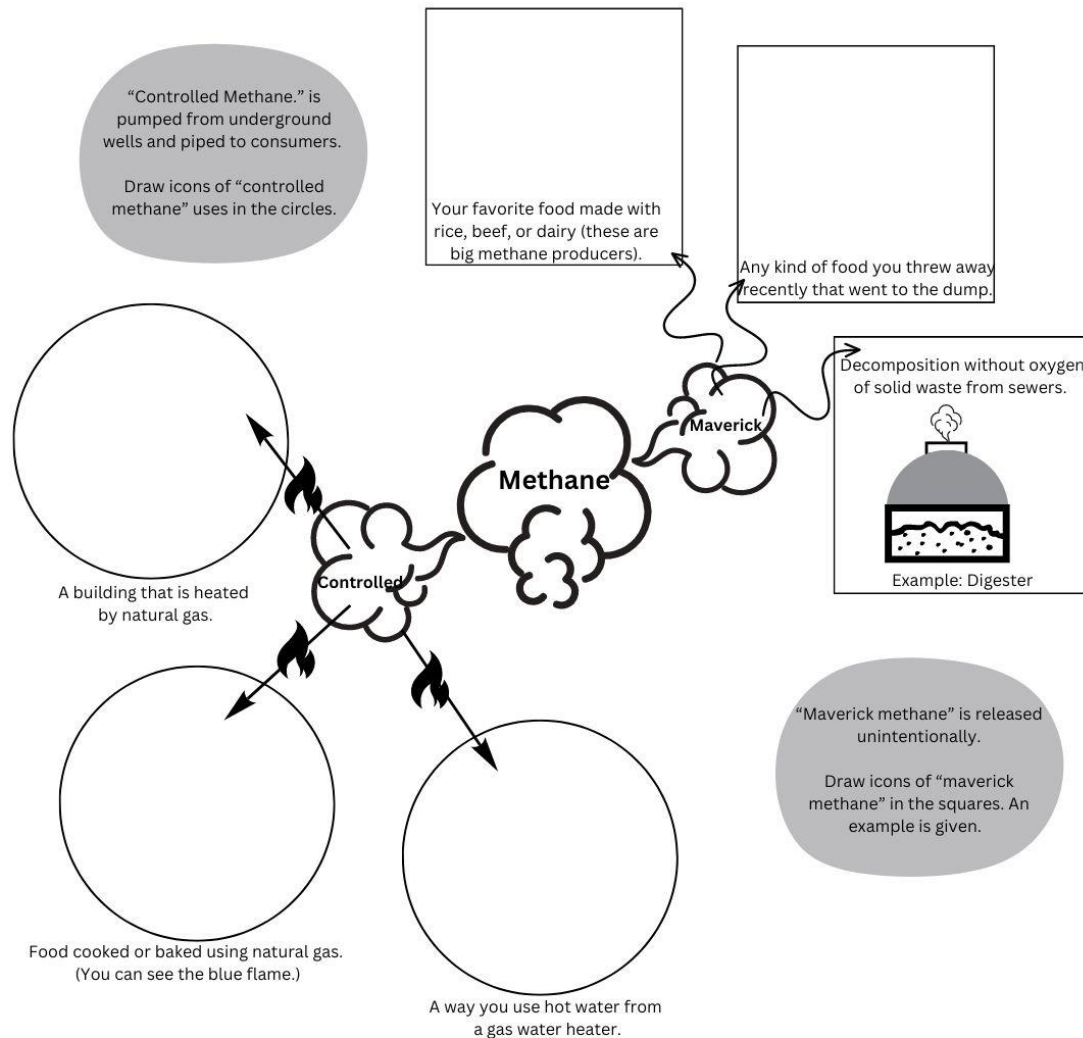
- **Plankton** [0:08] are minute organisms that float or swim weakly near the surface of bodies of water. Phytoplankton can photosynthesize. Zooplankton are consumers.
- **Methane** [0:17] is the simplest hydrocarbon, CH₄. Odorless, invisible, and highly flammable, methane is a powerful greenhouse gas. Methane is about 85-95% of natural gas.
- **Porous rock** [0:56] contains empty spaces between the grains that can hold liquid or gas. Permeable rock has connected spaces through which liquid or gas can flow.
- **Fracking** [1:30] injects fluid into shale beds at high pressure causing the rock to crack and opening up pathways for oil or gas to flow, making them easier to extract.
- **Maverick methane** [5:10]
- **Methanogens** [6:25]
- **Anthropogenic methane** [6:48]

Part II. Answer after viewing the video.

Why have we started fracking to extract oil and gas?	What are three settings where we burn natural gas to produce heat? 1. 2. 3.
What is one reason it's preferable to burn natural gas than coal or gasoline?	What are three categories of human activities that produce maverick methane? 1. 2. 3.

Take a deeper dive after viewing the video:

Part III. In the circles draw icons showing uses of methane in natural gas. In the squares draw icons showing sources of maverick methane. <https://thenounproject.com> can help you visualize icons.



Part IV. Think Big: We can minimize the anthropogenic methane we release by minimizing food waste, cow burps, leaky mines/wells, and leaky gas pipes. Design a program that could limit one of these methane sources.

Circle the source you'll fix: **Food Waste/Cow Burps/Leaky Mines or Wells/Leaky Pipes**

1. What is the change you want to see?
2. What steps will be needed to make this change?
3. How will you entice people to adopt this change?



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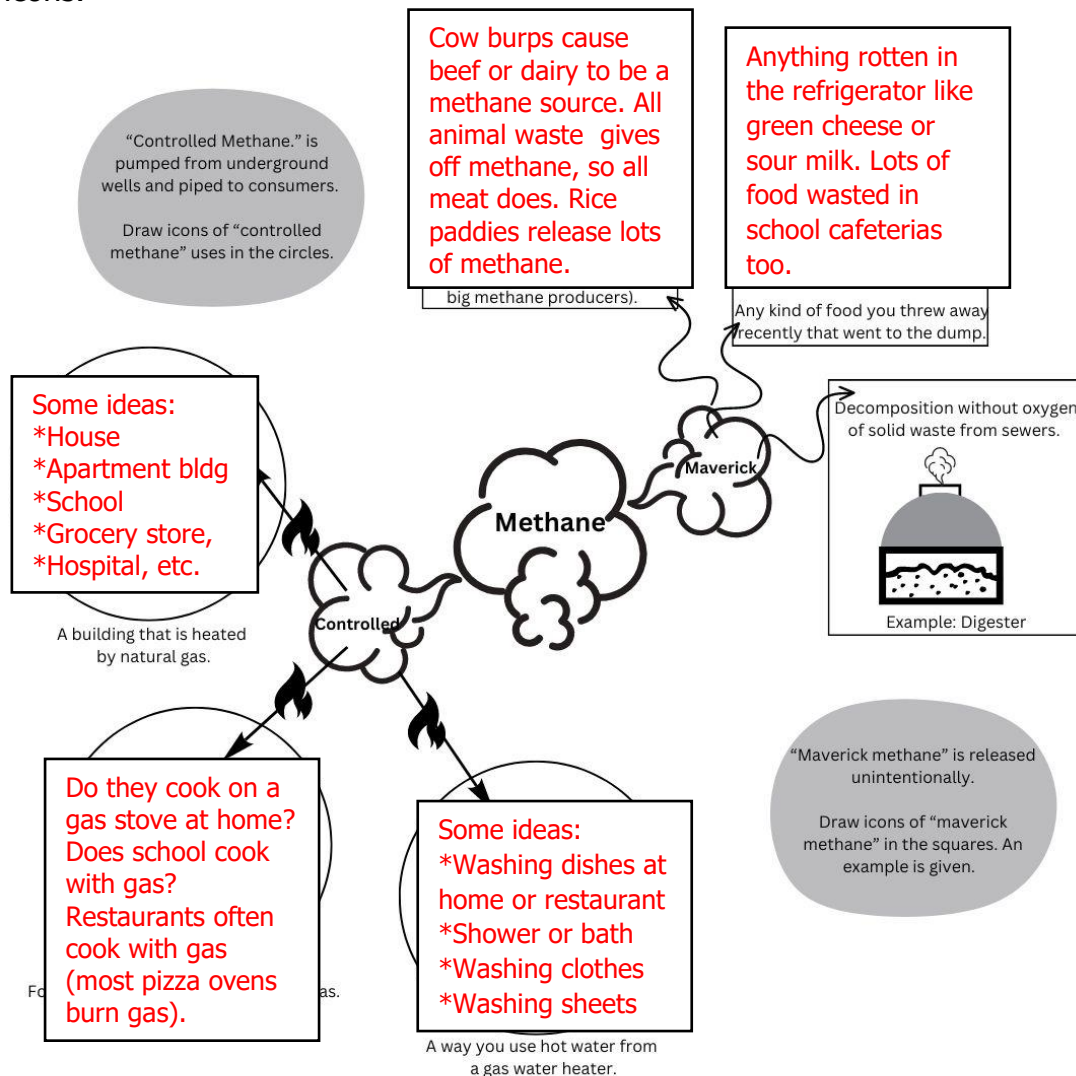
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- **Fracking** [1:30] injects fluid into shale beds at high pressure causing the rock to crack and opening up pathways for oil or gas to flow, making them easier to extract.
- **Maverick methane** [5:10] *all of the methane released into the atmosphere. [Teacher note: Maverick methane is a made-up term you will not find in other sources, but it describes the *on the loose* characteristic of the methane.*
- **Methanogens** [6:25] *are microbes that break down waste in conditions where little oxygen is available, releasing methane in the process.*
- **Anthropogenic methane** [7:03] *is methane released into the atmosphere from human activities.*

Part II. Answer after viewing the video.

Why have we started fracking to extract oil and gas? <i>The easy-to-get natural gas has already been extracted.</i>	What are three settings where we burn natural gas to produce heat? 1. <i>In our homes (heaters, water heaters, washers, stoves).</i> 2. <i>Industry (furnaces and kilns).</i> 3. <i>Electricity generation at power plants.</i>
What is one reason it's preferable to burn natural gas than coal or gasoline? <i>Methane burns much cleaner. Methane produces less CO₂ per unit of heat, than coal or gasoline. (Either answer works.)</i>	What are three categories of human activities that produce maverick methane? 1. <i>Agriculture</i> 2. <i>Fossil fuels (methane leakage at mines, from pipes or machinery).</i> 3. <i>Waste</i>

Take a deeper dive after viewing the video:

Part III. In the circles draw icons showing uses of methane in natural gas. In the squares draw icons showing sources of maverick methane. <https://thenounproject.com> can help you visualize icons.



Part IV. Think Big: We can minimize the anthropogenic methane we release by minimizing food waste, cow burps, leaky mines or wells, and leaky gas pipes. Design a program that could limit one of these methane sources.

Answers will vary. Here is one example.

Circle the source you will fix: **Food Waste/Cow Burps/Leaky Mines or Wells/Leaky Pipes**

1. What is the change you want to see? Fewer cow burps or less methane per burp.
2. What steps will be needed to make this change? Scientists get funding to do research to develop feed supplements for cattle that reduce methane burps. Ranchers feed it to cattle.
3. How will you entice people to adopt this change? Ranchers can get certified as "eco meat producers" which will make people prefer to buy their beef products.

TEACHER RESOURCES

NGSS Standards:

[MS-PS1-1](#) Models of simple molecules like methane, CH₄.

[MS-PS1-2](#) Substances before and after reaction, CH₄ + 2 O₂ -> CO₂ + 2 H₂O.

[MS-ESS2-1](#) Energy flow from ancient plankton to methane that we burn for heat.

[MS-ESS3-3](#) Methane Satellite will monitor unintended methane release. Students can design methods for minimizing food waste, cow burps, orphan wells, or leaky pipes.

[MS-ESS3-4](#) Increased human population burns more natural gas and releases more anthropogenic methane.

Experiment resources:

Find directions for the fracking demonstration at [Make-a-Fracking-Model-Activity.pdf \(insideenergy.org\)](#) .

Description: This worksheet goes along with the Cog's Episode 6 video about Natural Gas and Methane [10:14]. 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 6: Carbon from Natural Gas and Methane](#)
<https://youtu.be/sAeSm-7KTII>

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 print front-to-back to use both pages.

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 [9:47] 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. Warm up by brainstorming sources of maverick methane. An example is given. Ask for a few ideas about food that released methane at the farm or ranch. Foods related to cows are good because of cow burps, so burgers or beef tacos work. Rice paddies release a lot of methane from the mud because the soil is underwater, limiting oxygen needed for aerobic decomposition of the stalks etc. *If* you decide to ask what food they've thrown away, be prepared to be grossed out or just don't ask. Give students 1-2 minutes to draw the two icons.

Now move onto burning methane for heat. Some students won't know if they use gas to heat at home. It would be great if the school used gas water heaters and heated their buildings

with gas and the school's food service used gas stoves. But if not, or if you don't know, ask students to think about a hypothetical hospital that uses natural gas to heat and clean. What icons might describe ways they use heat? Now give students 2-3 minutes to draw those 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. If time allows, ask students to share their ideas.

Part IV. Think Big: Each student or group will choose one of the four anthropogenic methane sources they'd like to control: food waste, cow burps, leaky coal mines, leaky oil/gas wells, or leaky pipes. Share the Teacher Answer Key solution if they need help. Give them 3 minutes to **Think** of a solution and write it down. If students are still having trouble, ask them to think of a way to reduce food waste by changing the cafeteria menu. If time allows, assign each student to a **Pair**. Ask the pair to **Share** their ideas. Remind students to listen respectfully and ask questions if they have any. If time allows bring the class back together to share ideas.

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.)

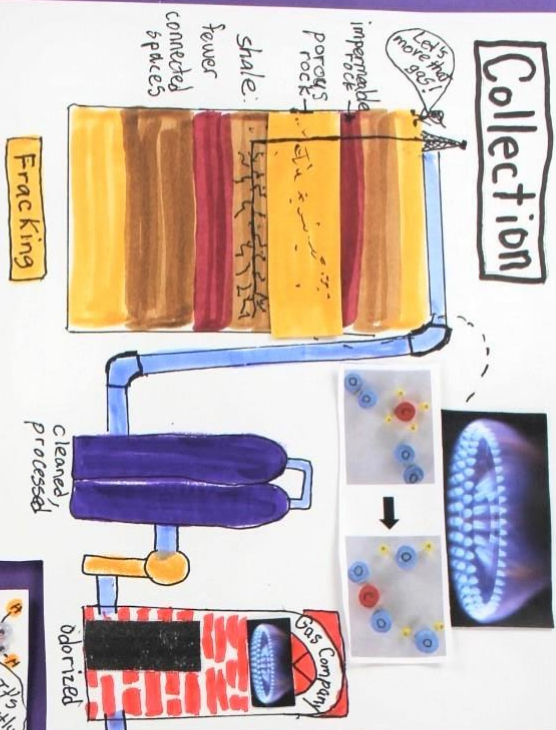
The slow carbon cycle:

- [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](#) (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.)

Collection

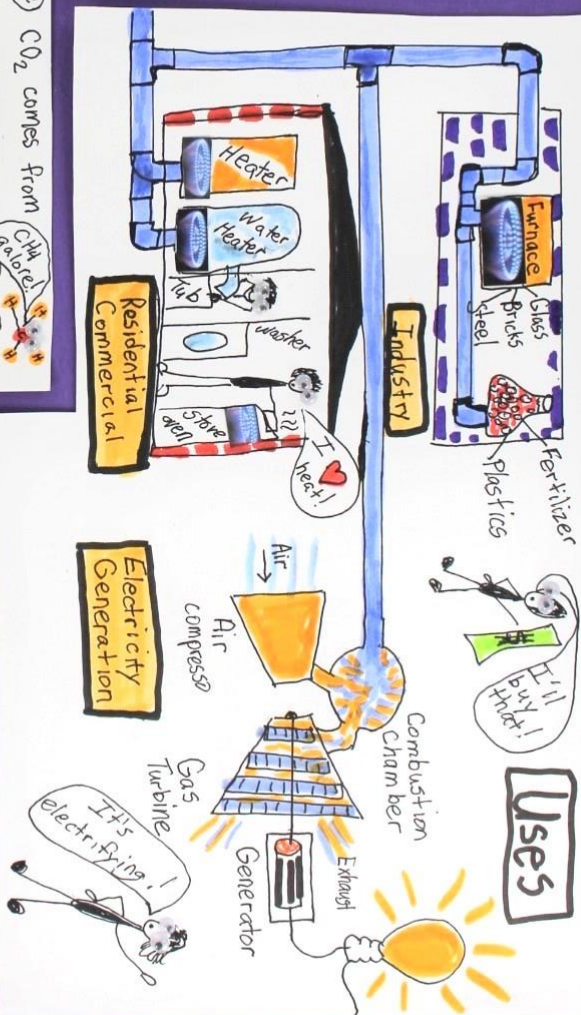


NATURAL GAS

It's mostly methane

CO_2 comes from

Uses

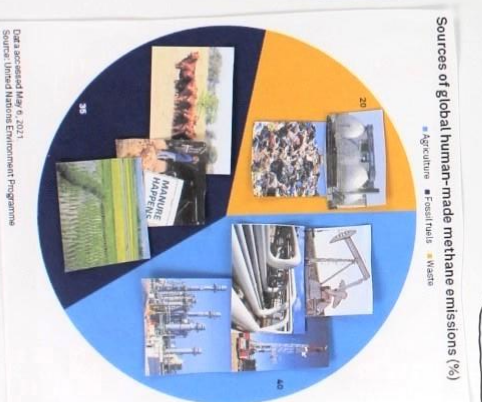
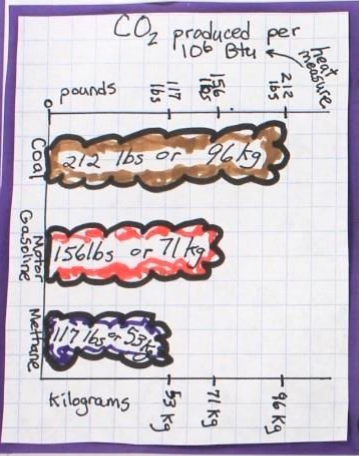


CO₂ Produced



This shows CO_2 per unit of heat.

2021:
8 billion
tons of
CO₂ from
burning
natural gas



You are such a wim CO₂!

Yeah,
but I'll
be here when
you're CO₂ and
H₂O

Anthropogenic

over 100 years
Sure, but
I'll trap
25x more
heat!

over 100 years

Maverick CH₄