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Name _____

Date _____

Episode 12 (Part 2): ELECTRICITY SOURCES

Part I. Vocabulary Words: Review the given definitions. Define the remaining vocabulary words as you watch [Cog's Episode 12](https://youtu.be/hX1WAt0I1Ks): <https://youtu.be/hX1WAt0I1Ks>

- **Fossil fuels** [0:05] like coal, oil, and gas are made of ancient dead things. When we burn them, we're releasing ancient carbon into the atmosphere.
- **Intermittently** [1:00] means irregularly, not continuously.
- **Turbines** [3:25] are machines that spin when wind, steam or water move the blades, a bit like a pinwheel. They are used to spin generators.
- **Generators** [3:25] are made of copper coils and magnets. When they spin, they create electricity.
- **Nuclear energy power plants** [4:20]
- **Hydro power** [4:30]
- **Geothermal energy** [4:45] produces electricity using underground heat from the Earth's mantle. That heat makes steam that spins a turbine to make electricity.
- **Fracking** [4:45] is the process of injecting liquids, sand and/or chemicals into a well to break up deep underground bedrock. (See Fracking demonstration in Cog's Episode 6 on Natural Gas and Methane.)
- **Biomass** [5:00]
- **Green hydrogen** [5:20] is made during the process of electrolysis, which uses electricity to separate out hydrogen fuel (and oxygen) from water.

Part II. Answer after viewing the video.

What are at least 3 ways we can store extra energy? 1. 2. 3.	Why is it important to store electricity?
Why are small actions important to combat climate change?	Who are the Solar Mamas?

Part III. Think

Draw at least five resources that *your* community could use to generate alternative electricity. (<https://thenounproject.com> can help you envision icons.)

Solar	Do you have sunny weather? Rooftops that aren't shaded by tall buildings or trees where PV panels can be installed? Open spaces for a solar farm?	
Wind	Do you have wind (but not too much?) Good roads to transport giant blades to the wind turbine location? Easy access to electric power lines to transmit the electricity?	
Hydro Power (Water)	A source of water that could spin a turbine? A river? The ocean?	
Nuclear	Do you have land with access to ample cooling water? Are you earthquake free? Are you located near to a facility that could store nuclear waste?	
Geothermal	Do you live near tectonic boundaries or volcanic areas? Are there empty spaces in your state available to drill, frack (create cracks in bedrock) and inject water to make steam?	
Biomass	Do you live near farmlands where agricultural waste is produced? Do you live in a city with lots of food waste that can be burned? A city with lots of sewage?	
Green Hydrogen	Do you live in a place with lots of renewable electricity that can be used to make green hydrogen?	

Part IV. Think-Pair-Share

Pair up with a partner to share the icons that you drew. Discuss your ideas about what the best alternative energy for your area might be.



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- **Generators** [3:25] are made of copper coils and magnets. When they spin, they create electricity.
- **Nuclear energy power plants** [4:20] rely on a fission reaction to create heat that makes steam that spins a turbine that turns a generator to make electricity.
- **Hydro power** [4:30] harness the power of water. Electricity can be generated at a dam, on a running river, or by using ocean tides or waves to turn a turbine.
- **Geothermal energy** [4:45] produces electricity using underground heat from the Earth's mantle. That heat makes steam that spins a turbine to make electricity.
- **Fracking** [4:45] is the process of injecting liquids, sand and/or chemicals into a well to break up deep underground bedrock. (See Fracking demonstration in Cog's Episode 6 on Natural Gas and Methane.)
- **Biomass** [5:00] is made of agricultural waste, garbage from a city, industry residuals, sewage and animal residue. It can be burned or turned into fuels that run vehicles, produce heat, or produce electricity. (Biochar stores carbon very efficiently.)
- **Green hydrogen** [5:20] is made during the process of electrolysis, which uses electricity to separate out hydrogen fuel (and oxygen) from water.

Part II. Answer after viewing the video.

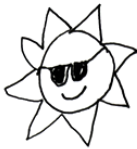
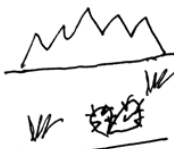
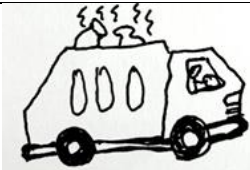
What are at least 3 ways we can store extra energy? 1. Iron phosphate batteries, sodium batteries, closed loop hydro, sand 2. batteries, flow batteries, green hydrogen 3.	Why is it important to store electricity? We have to store electricity that is made using intermittent energy sources, like wind and solar. That way we can keep the lights on when the wind doesn't blow or the sun doesn't shine.
Why are small actions important to combat climate change? They inspire hope, which inspires, more action, which inspires more hope, etc.	Who are the Solar Mamas? They are mothers and grandmothers trained by the Barefoot College to install and repair solar panels in their small villages.

Name _____

Part III. Think Big

Draw at least five resources that *your* community could use to generate alternative electricity.
(<https://thenounproject.com> can help you envision icons.)

Answers will vary. Here's how I'd fill this out for my home lands.

Solar	Do you have sunny weather? Rooftops that aren't shaded by tall buildings or trees where PV panels can be installed? Open spaces for a solar farm?	 Sunny Climate	 Open dessert lands
Wind	Do you have wind (but not too much?) Good roads to transport giant blades to the wind turbine location? Easy access to electric power lines to transmit the electricity?	 Lots of wind	
Hydro Power (Water)	A source of water that could spin a turbine? A river? The ocean?		
Nuclear	Do you have land with access to ample cooling water? Are you earthquake free? Are you located near to a facility that could store nuclear waste?		
Geothermal	Do you live near tectonic boundaries or volcanic areas? Are there empty spaces in your state available to drill, frack (create cracks in bedrock) and inject water to make steam?	 Dormant volcanoes	
Biomass	Do you live near farmlands where agricultural waste is produced? Do you live in a city with lots of food waste that can be burned? A city with lots of sewage?		Our city has LOTS of food waste.
Green Hydrogen	Do you live in a place with lots of renewable electricity that can be used to make green hydrogen?		

Part IV. Think-Pair-Share Pair up with a partner to share the icons that you drew. Discuss your ideas about what the best alternative energy for your area might be.

TEACHER RESOURCES

NGSS Standards

Middle School NGSS Standards:

[MS-ESS3.C](#): Human activities have altered the biosphere. Human populations and per-capita consumption increases negative impacts unless activities and technologies are engineered otherwise.

[MS-ESS3.D](#): Human activities (releasing greenhouse gases from fossil fuels) are major factors in Earth's temperature rising. Science, engineering, and other kinds of knowledge can help us act wisely to reduce human vulnerability.

[MS-PS2.B](#): Electric and magnetic forces can be attractive or repulsive.

High School NGSS Standards:

[PS3-3](#): Devices that convert one form of energy into another form.

[ESS3.C](#): Scientists and engineers can develop technologies that preclude ecosystem degradation.

Description: Episode 12 has 2 parts that can be viewed on the same day or on separate days. They stand alone, so you could even choose to watch just Part 1 or just Part 2. If you choose to watch Parts 1 and 2 on the same day, you could do vocabulary from both worksheets and then choose activities from the worksheets to fill out your class period.

Part 2 Worksheet: This worksheet supplements [Cog's Episode 12 \(Part 2\) : Electrify – Climate Solutions \[8:10\]](#). (<https://youtu.be/hX1WAt0I1Ks>) It can be used by teachers or their substitutes (given the answer key) to guide learning, check for understanding, and interpret the significance of the information in students' lives.

The first page asks questions that can help students recall and 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.

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 vocabulary words can be defined as you watch the video. The timestamp next to each word indicates 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. These questions come directly from the video. If students need help remembering, show them the Sketchnote from the video (page 8 of this document) to help them remember.

Part III. Think Big

Ask students to think about the resources available in their region that could be used to make fossil-fuel-free electricity. Give them 5-8 minutes to draw at least 5 icons in the spaces provided. The answer sheet shows drawings that I would use for the region where I live. If students need help envisioning icons to represent their resources, and they have access to computers, they can visit <https://thenounproject.com> to see examples of simple icons they could draw. If students are resistant to drawing, they can just use words.

Part V. Think-Pair-Share

Assign each student someone to work with as a pair. Each pair should share the icons they drew (or just tell each other what they drew if they don't want to share drawings). Ask them to decide which fossil-fuel-energy or energies they would like to see developed in your area. What do they think might be some problems with any of the possible projects. If time allows bring the class back together and discuss what your community can do to combat climate change.

Extra Credit: Ask students to make and fill in a Venn diagram with 3 circles, like the one in the video.

- What am I good at?
- What do I love?
- What is needed?
- What can I do?

WATCH RELATED COG VIDEOS

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 and CO₂](#) (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.)

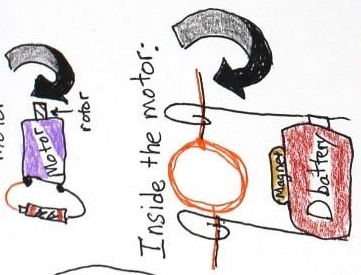
Climate Solutions:

- [Episode 11: A Climate Call to Action](#) (Shows how much CO₂ we're actually producing, why that causes climate change, how climate change will affect us, and what we can do about it.)
- [Episode 12 \(Part 1\): Electrify – EVs, Motors, Generators, and Turbines](#) (Builds a model of an EV and a model of an electric motor. Shows that EVs already produce CO₂ than gas-powered cars, but will be better when we recharge with CO₂-free electricity.)
- [Episode 12 \(Part 2\): Electrify - Solutions](#) (Addresses battery storage and other back up systems we can use to supplement intermittent electricity generated by wind and solar, as well as listing constant energy sources we can use. Gives ideas for how students can help combat climate change.

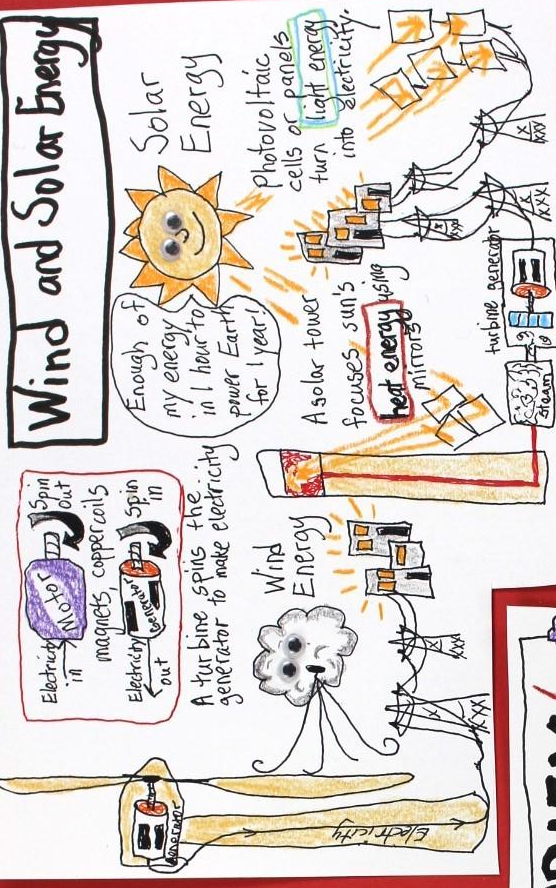
Electric Vehicles (EVs)



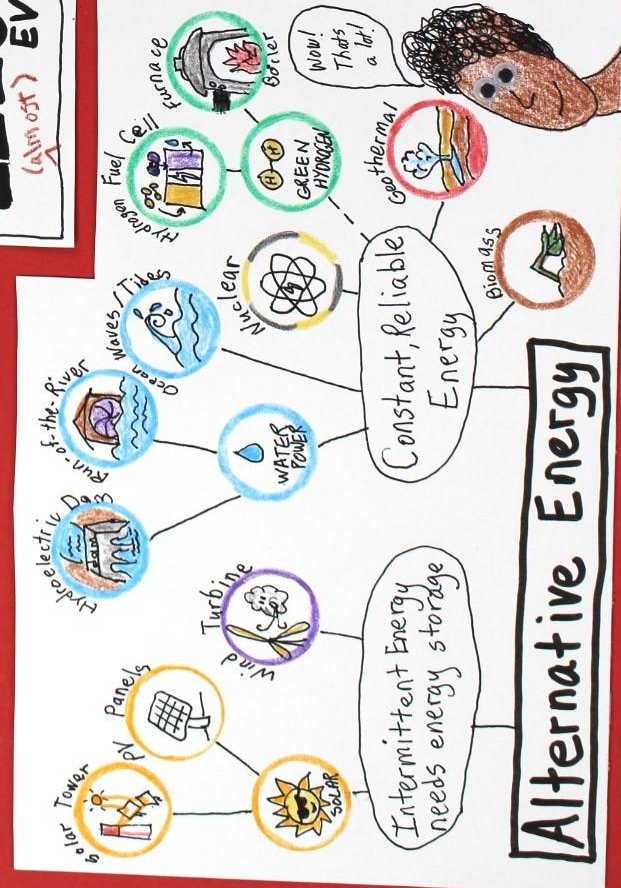
Electrical energy is transformed into mechanical energy of a spin in the motor



Wind and Solar Energy



ELECTRIFY EVERYTHING!



Alternative Energy

