What's Included?

Unit Planning

- NGSS and APES Standards document
- Unit Pacing Guide for 50 min classes
- Differentiation ideas for honors students and virtual students ***Digital links for virtual learning found here**
- Honors assignment list

Notes

- Unit 3 PowerPoint (17 slides)
  - Energy
  - Fossil Fuels
- Cornell Notes Pages (2 pgs)
- Doodle Notes Pages (1 pgs)
  - Guide to Using Doodle Notes
  - Doodle Note Keys & Examples
- Web-quest (3 pgs) (Can be used as an alternative to notes)

Student Pages

- This folder contains duplicate copies of every student page. They are in order according to the pacing guide for QUICK PHOTOCOPYING if you are using the pacing guide as is.

Activities

- Electricity Generation STEAM Lab (8 pgs)
- Energy Speed Dating (4 pgs)
- Energy Source Battle (2 pgs)
- Energy Impacts Google Mapping Activity (3 pgs)
- Answer Keys for all activities

Extensions

- Energy Efficiency in Lighting (1 pg)
- Math Extension: Light Bulb Efficiency* (2 pgs)
- Data Analysis: Global Energy Usage* (1 pg)
- Digging Deeper: Distribution of Resources* (1 pg)
- Digging Deeper: Energy Conservation Strategies (1 pg)
- Answer Keys for all extensions

*Honors Options

Review and Assessment

- Fossil Fuels & Renewable Energy Quiz (paper) - with answer sheets

Unit Planning

What's Included? Geosphere: Unit 3

Included Resources by Folder:

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- Web-quest (3 pgs) *Can be used as an alternative to notes
- Cornell Notes Pages (2 pgs)
  - Editable Cornell Notes version
- Doodle Notes Pages (1 pg)
  - Guide to Using Doodle notes
  - Doodle Notes Key & Example

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Not included:

Supplementary Resources
- Lots of data and maps on EIA.gov
- Crash Course Video: Future of Clean Energy

Materials Needed
- General classroom use: computers, calculators, rulers, colored pencils, paper, scissors

Electricity Generation Lab: Computers with internet access, 4 - 1x2x5cm ceramic bar magnet from EI Ceramic Magnets, 1 - #30 Magnet wire 200ft from Amazon TEMCo Magnet Wire, 1 - Miniature Lamp, 1.5V 25mA from All Electronics 1.5V Lamp, cardboard, 8cm x 30.4cm, large nails (8cm+), sandpaper to strip the wires, voltmeter or multimeter, water source attached to long hose or tube, bucket, tape, scissors, rulers, recycled materials, wooden or metal skewers, index cards or cardboard, house fan, X-acto knife or box cutter

Unit Overview Page
plus
Supplementary Resource Ideas
and **Materials Lists**

NGSS and APES Standards Document

If you have specific state standards, contact me by email (support@suburbanscience.com) and I'll help you figure out which ones are covered!

Standards:

Choosing Standards:
Although many states use NGSS, there are some states that do not. I would be glad to help you determine which of your state standards are covered in this unit. You can send me an email at support@suburbanscience.com to find out. Thank you!

The NGSS standards included in this unit are addressed multiple times throughout this course, rather than just once. As the course builds upon itself, the standards will be met with greater depth and detail further into the course.

Geosphere Unit 3 Guide

Topic	NGSS Standard	Description	APES Topics
Energy Sources	HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).	6.1: Renewable and Nonrenewable Resources 6.5: Fossil Fuels 6.6: Nuclear Power 6.7: Energy from Biomass 6.8: Solar Energy 6.9: Hydroelectric Power 6.10: Geothermal Energy 6.11: Hydrogen Fuel Cell 6.12: Wind Energy
	HS-PS3-3	Design, build and refine a device that works within given constraints to covert one form of energy into another form of energy.	
	HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.	
Energy Use & Conservation	HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.	6.2: Global Energy Consumption 6.4: Distribution of Natural Energy Resources 6.13: Energy Conservation
	HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	
	HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	
	HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	
	HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	
	HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.	

*Note: NGSS is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards were involve in the production of this product, and do not endorse it.

Editable Pacing Guides

50 min classes

	Day	Instruct	Assess	Homework
Review	11	• Wrap up assignments not yet finished • Students summarize energy concepts from this unit by filling in details on **Energy Doodle Notes**.	• Informal check of student understanding based on answers from homework • Informal assessment of student participation and progress during research	<u>All:</u> Study for Test
	12	• Use **Task Cards** to review unit concepts (also copy **Task Card Answer**	• Go over answers to task cards when students are	All:
Assess	13	• Take **Unit 3 Test**		

50 min classes

	Day	Instruct	Assess	Homework
Energy Sources	6	• <u>Honors</u>: Check homework answers for accuracy. • Students research one energy source and complete the **Speed Dating Profile** page.	• Informal check of student understanding based on answers from homework • Informal assessment of student participation and progress during research	
	7	• Students cycle through the speed dating process. While learning about each energy source, they complete the **Energy Speed Dating** charts.	• Formal or informal assessment of student understanding and participation by checking/grading answers on Energy Speed Dating charts	
	8	• Students complete the **Energy Battle** debate as a class using information Speed Dating Profile.	• Informal check of student understanding based	
Energy Use & Conservation	*	• This is an extra day for complete some assignm depth. If you teach reg skip this day. • <u>Honors</u>: Complete **Data Usage**. • <u>Honors</u>: Complete **Digg of Resources**		
	9	• Students begin work or		
	10	• Students finish work or • Students complete **Digg Conservation Strategie** discuss answers as a cla		

Coincide with NGSS document in Unit Planning Folder

***Bold items** mu photocopied.

Geosphere Unit 3 Pacing Guide

© Suburban Science

50 min classes

	Day	Instruct	Assess	Homework
Energy Sources	1	• Intro: Students read and complete **Energy Efficiency in Lighting** • Unit 3 PPT (Section 1) • **Cornell Notes** (Energy) (Option 2: Use Energy web-quest instead of PPT & Cornell Notes. Find web-quest links in "Differentiation Guide" within the "Unit Planning" folder or use PDF from Notes folder. Students will likely need to continue working on this during the next day.)	• Informal discussion of answers on Energy Efficiency page • Informal questioning during PPT • Cornell notes summary	
	2	• Unit 3 PPT (Section 2) • **Cornell Notes** (Fossil Fuels) • Collect items for **Electricity Generation Lab**. Divide students into groups and begin the cardboard cutting instructions. Materials: See teacher instructions on lab- very specific materials are required for this activity.	• Informal questioning during PPT • Cornell notes summary • Check of progress and participation while students work on lab	
	3	• Students finish Part 1 of the Electricity Generation Lab and answer associated questions. • Students work on **Energy Generation Diagrams**	• Informal check of student progress and understanding during lab work • Informal check of understanding based on accuracy of Energy Generation Diagrams	
	4	• Work on Part 2 of the Electricity Generation Lab. Materials: computers or devices with internet access, colored pencils or markers	• Informal check of student progress and understanding during lab work • Informal check of understanding based on accuracy of Energy Generation Diagrams	<u>All</u>: Finish Energy Generation Diagrams, if necessary.
	5	• Finish Part 2 of the Electricity Generation Lab. • Class discussion of answers to the discussion questions at the end of Part 2. • <u>Honors</u>: Complete **Light Bulb Efficiency**	• Informal check of student progress and understanding during lab work and discussion	<u>Honors</u>: Finish Light Bulb Efficiency, if necessary

Coincide with NGSS document in Unit Planning Folder

***Bold items** must be photocopied.

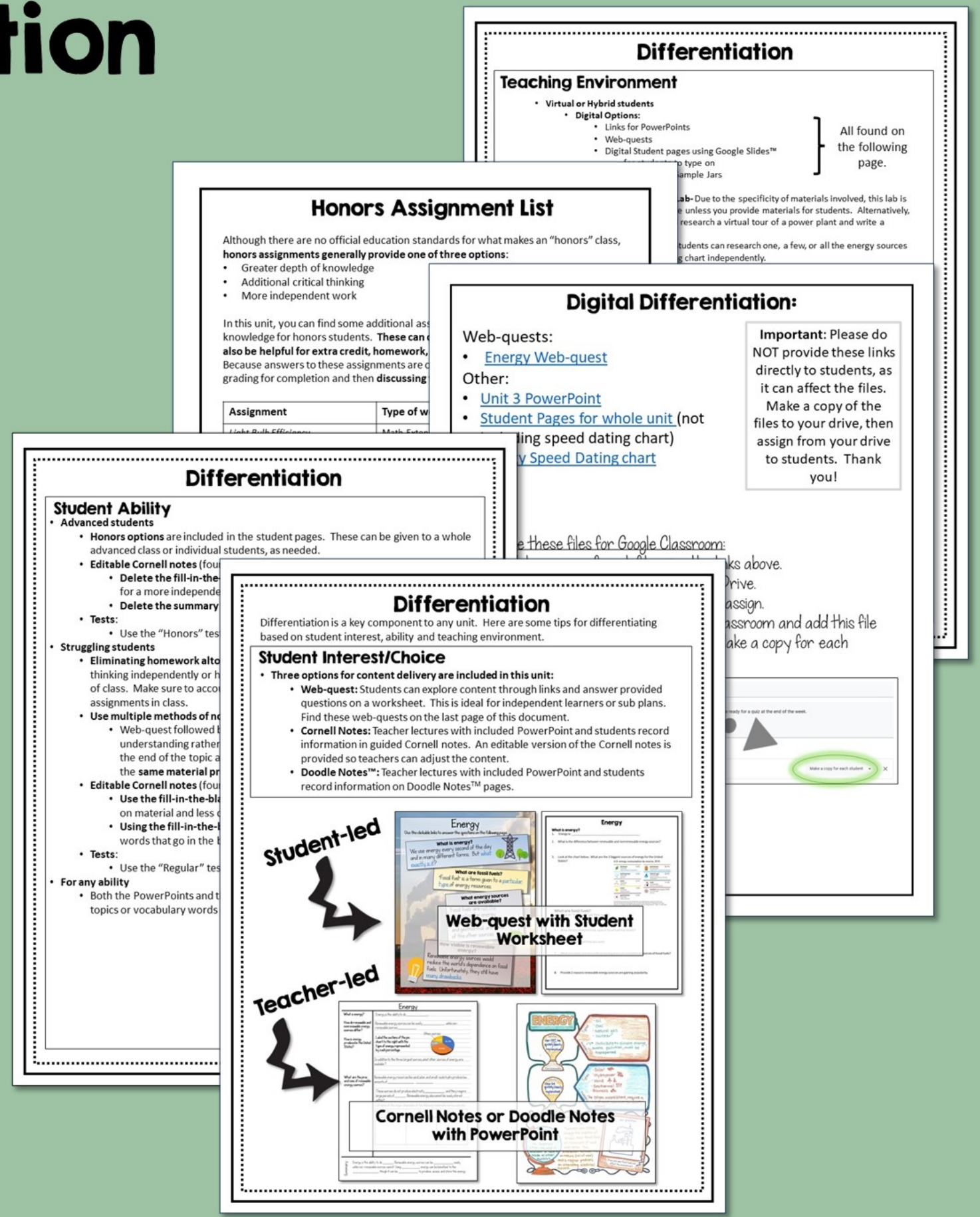
This icon is found on the top right corner of Honors pages for easy identification.

The daily topics coincide with the previous standards document.

Lesson planning is now quick and easy!

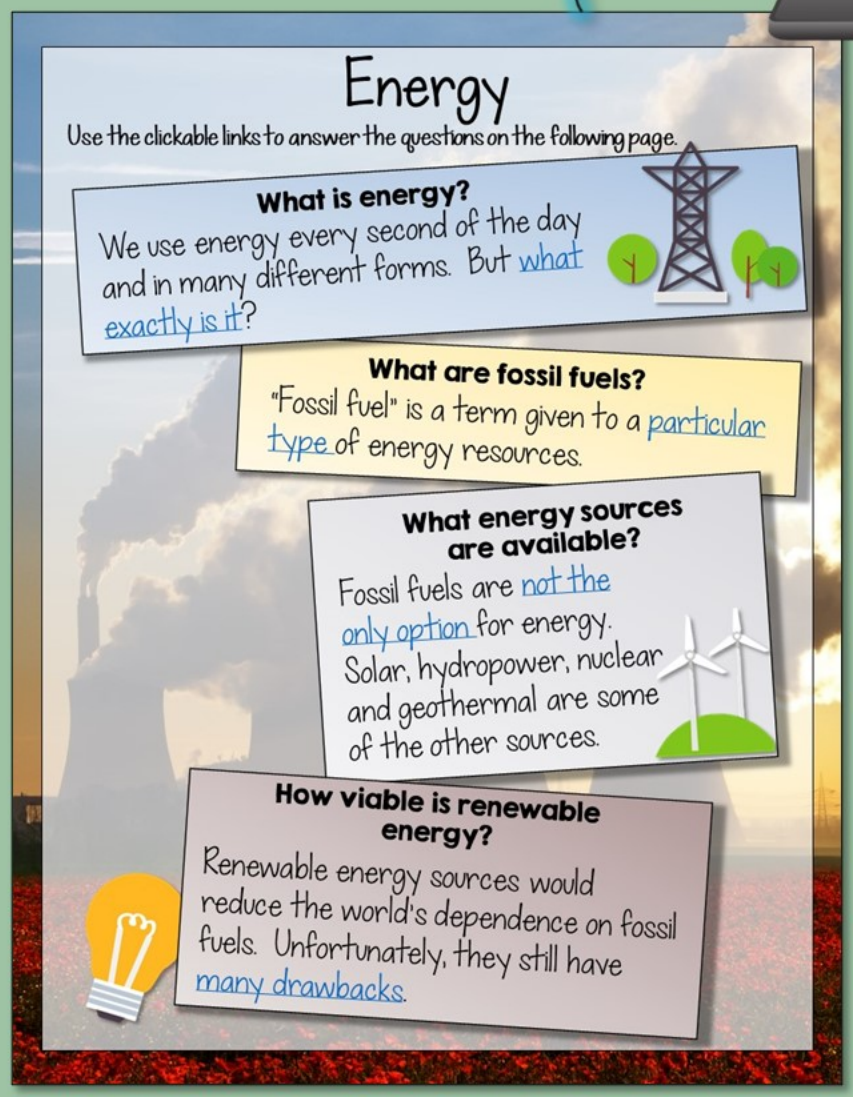
Differentiation Ideas for:

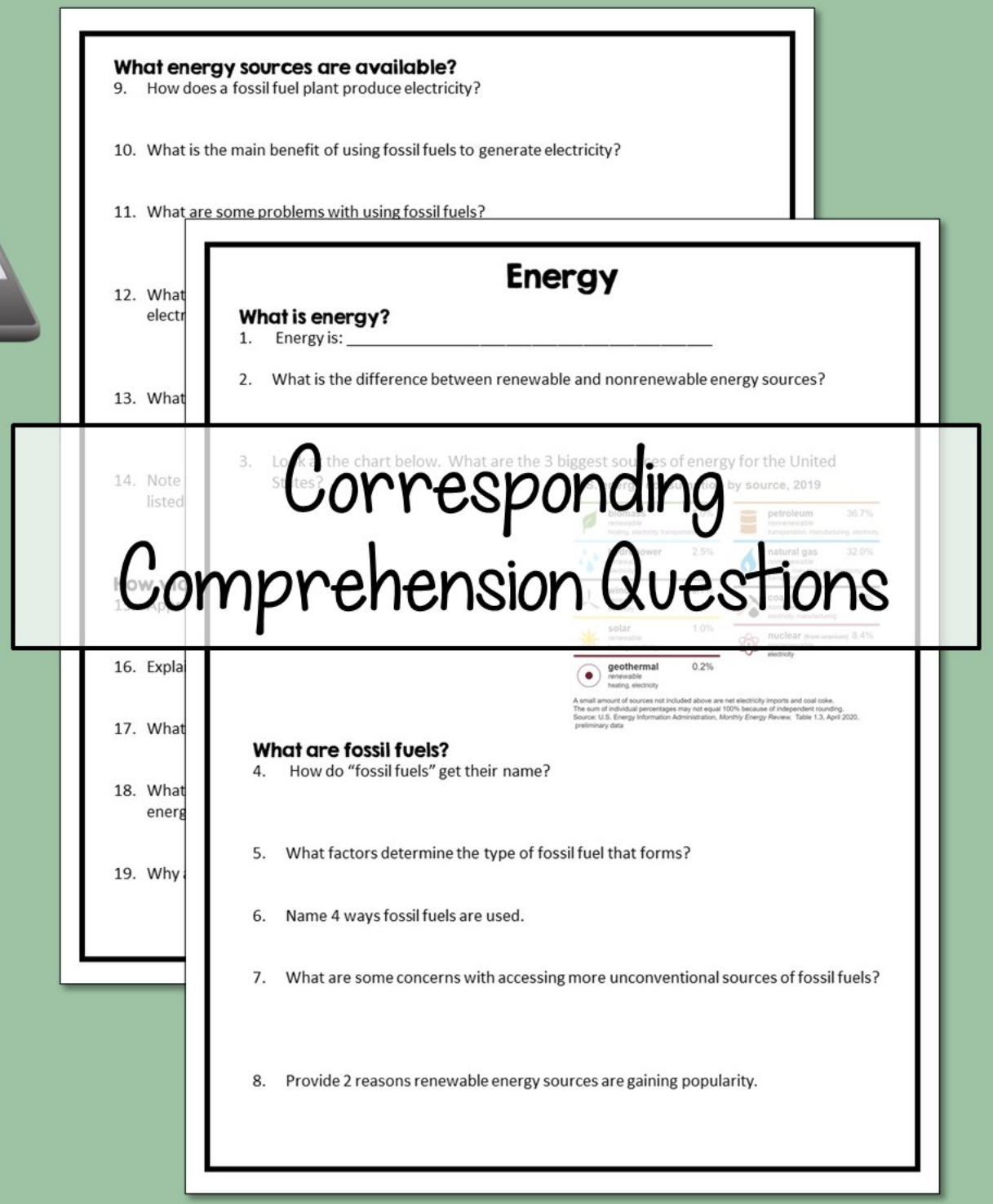
- Student Interest
- Student Ability
- Teaching Pace
- Teaching Environment (Virtual, in-class, or hybrid)



Content Delivery Option I: Student Webquest

Live video links for independent learning on any device!

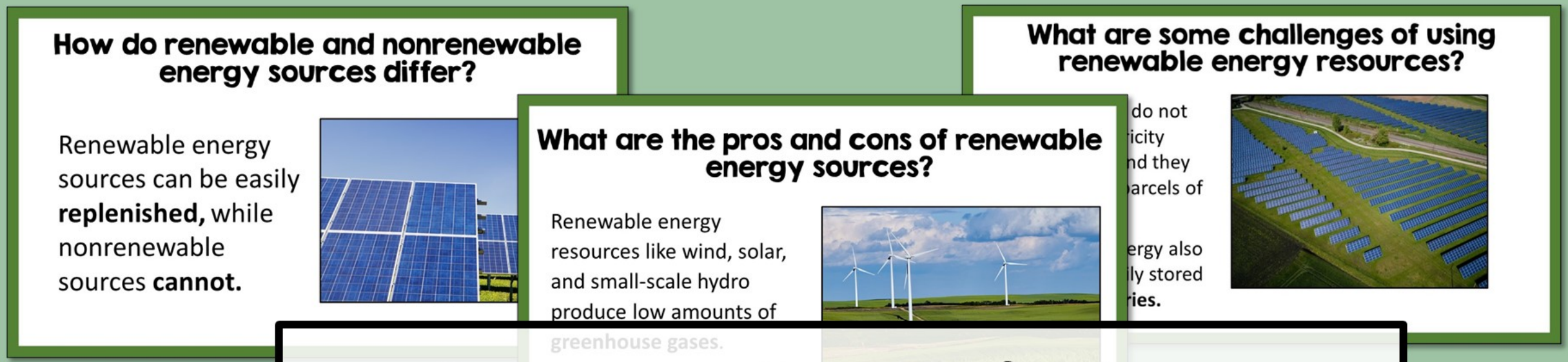




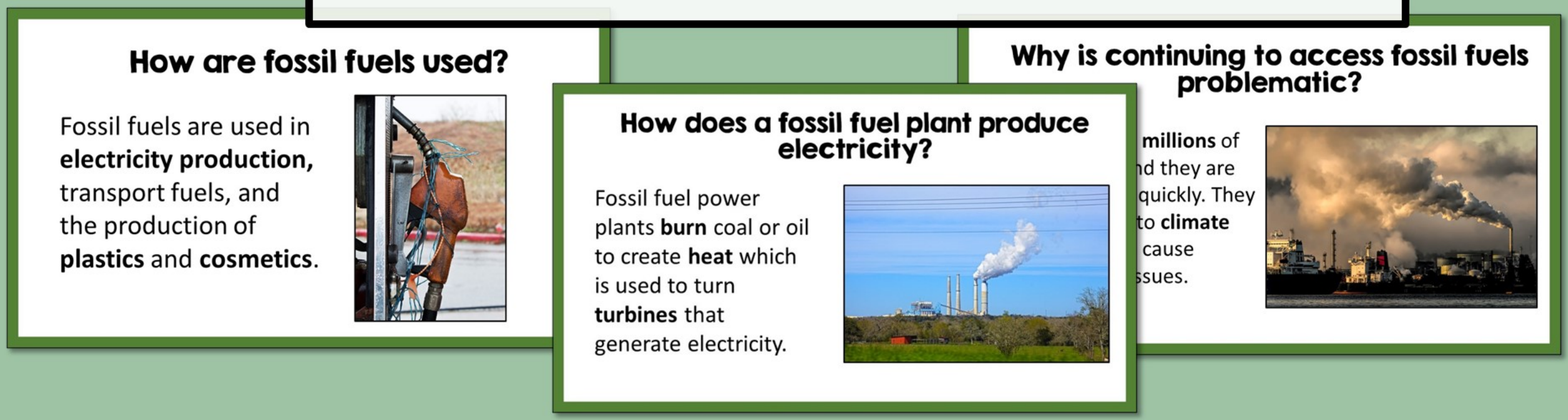
Corresponding Comprehension Questions

Content Delivery Option 2: PowerPoint Presentation

17 **editable**, fully-animated slides



Sample Slides



2 pages of Cornell Notes

Big concept questions

Fossil Fuels

What are fossil fuels?

Fossil fuels are formed from ancient plants and animals that died, were buried, and decomposed. The combination of organic matter, temperature, time, and pressure during decomposition determines the type of fossil fuel formed.

How are fossil fuels used?

Fossil fuels are used in electricity production, transport fuels, and the production of plastics and cosmetics.

How does a fossil fuel plant produce electricity?

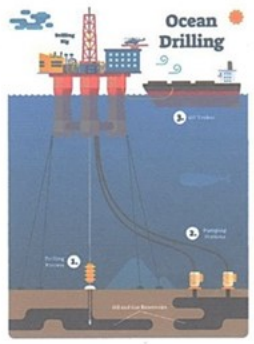
Fossil fuel power plants burn coal or oil to create heat which is used to turn turbines that generate electricity.

Pros of Fossil Fuel Electricity Production	Cons of Fossil Fuel Electricity Production
· Reliable source of fuel · Cheap to produce	· Produce large amounts of CO_2, contributing to climate change · Create pollutants & must be transported

Why is continuing to access fossil fuels problematic?

Fossil fuels take millions of years to form and they are being depleted quickly. They also contribute to climate change and can cause human health issues.

As easily reachable fossil fuel reserves are depleted, extraction from unconventional reserves is required. This type of extraction costs more, causes safety issues, and has significant environmental impact.



Summary: Fossil fuels are formed from once-living organisms that have decomposed. Fossil fuels are used to fuel transportation, to produce electricity, and to make many common items. Fossil fuels are a reliable source of electricity but using them produces pollution and drives climate change. Fossil fuels are being depleted quickly. Continuing to access them has financial, safety, and environmental impacts.

Content summary for each page

Energy

What is energy?

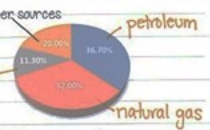
Energy is the ability to do work.

How do renewable and nonrenewable energy sources differ?

Renewable energy sources can be easily replenished, while non-renewable sources cannot.

How is energy produced in the United States?

Label the sections of the pie chart to the right with the type of energy represented by each percentage.



In addition to the three largest sources, what other sources of energy are available? biomass, hydropower, wind, solar, geothermal, nuclear

What are the pros and cons of renewable energy sources?

Renewable energy resources like wind, solar, and small-scale hydro produce low amounts of greenhouse gases.

These sources do not produce electricity consistently and they require large parcels of land. Renewable energy also cannot be easily stored without batteries.

List some of the major downsides of the following renewable energy sources:

Solar	Wind	Hydro
Must be in areas with lots of land & high sun year-round. Often not near consumers.	Inconsistent Kill migrating birds	Can adversely affect aquatic ecosystems

Summary: Energy is the ability to do work. Renewable energy sources can be replenished easily, while non-renewable sources cannot. Using renewable energy can be beneficial to the environment, though it can be challenging to produce, access and store this energy.

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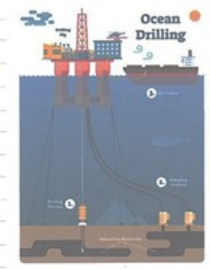

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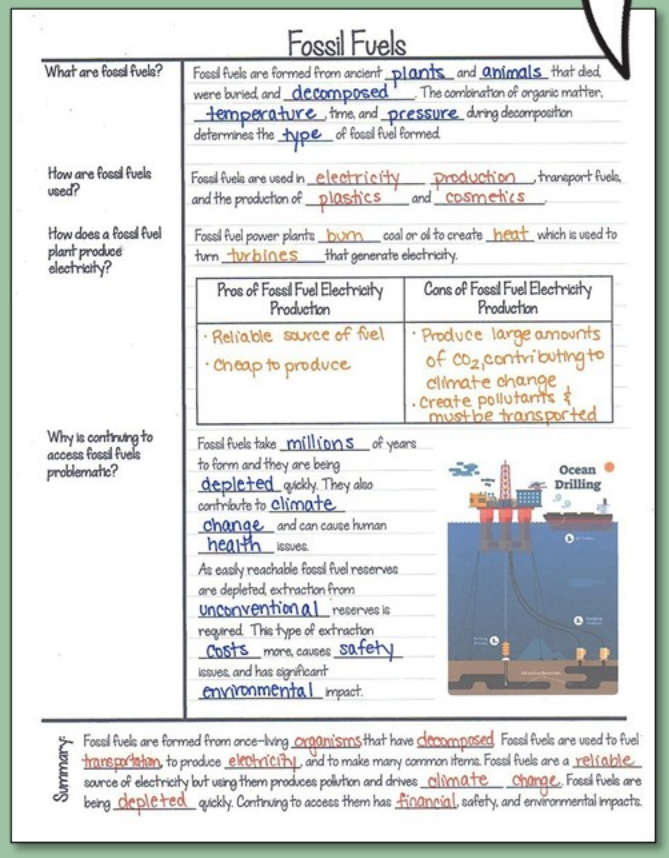
Each page is **editable**.

Add and delete text, questions, and summaries to meet the needs of your students.

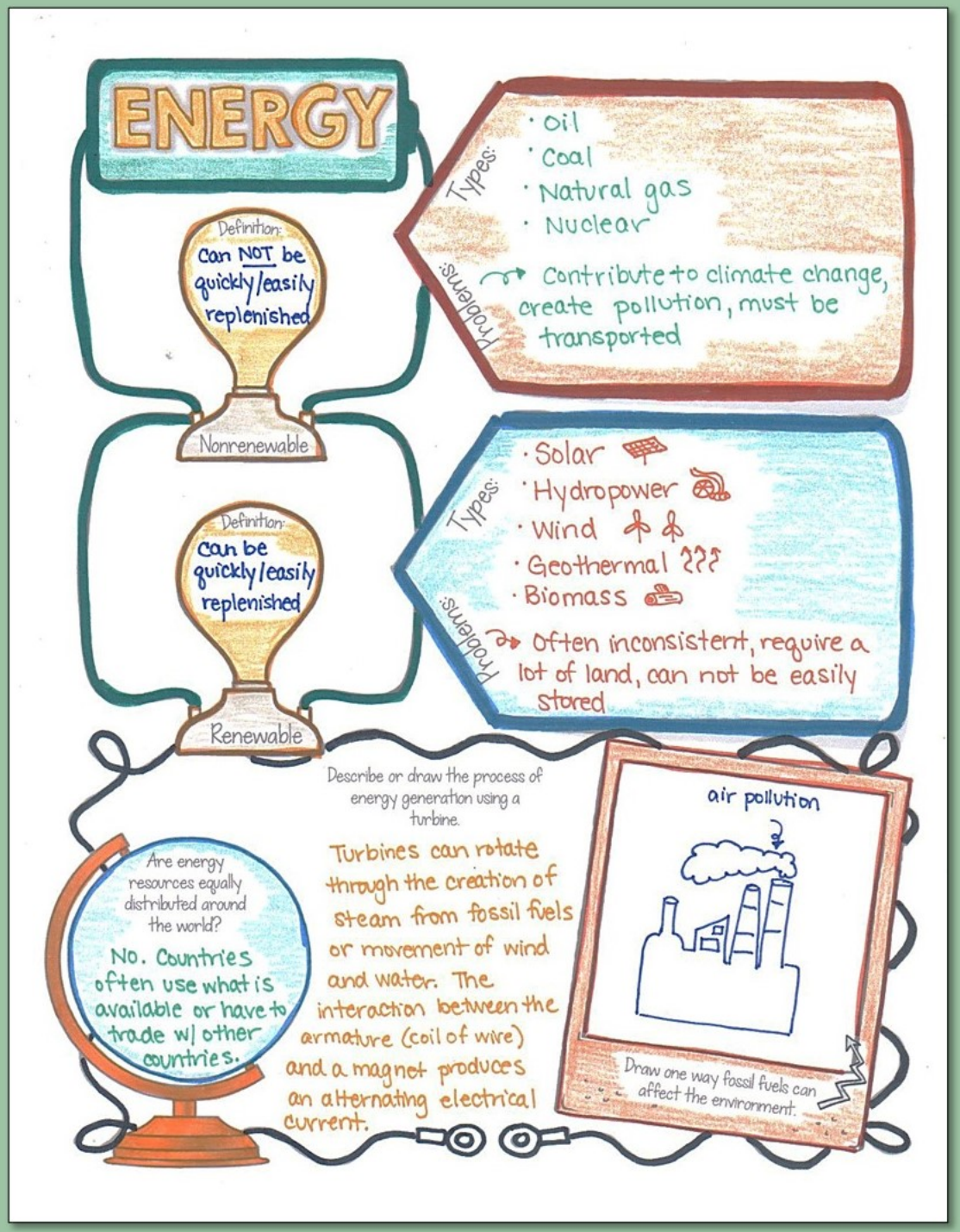
Every student page also comes in a digital version on Google Slides

Virtual, hybrid, or absent students can stay right on track!



Can be used in Google Classroom, Microsoft OneDrive or many other platforms!

1 page of Doodle Notes for Summarizing & Review



Doodle Notes™ increase student focus and memory- and they're great fun!

A guide for using them in your classroom is included.

Includes 4 Activities

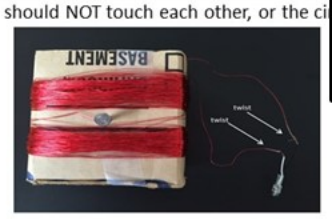
- Electricity Generation STEAM Lab
- Energy Source Speed Dating
- Energy Source Battle
- Energy Impacts Google Mapping Activity

Electricity Generation STEAM Lab
Sample Pages

At this point you should let your four magnets clamp themselves around the nail (2 on each side) and give it a spin. This guarantees the box is large enough. The nail and magnets should spin freely. The corners of the magnets should NOT bump the inside of the box as they spin. Using tiny pieces of cardboard in between the magnets helps to keep them stable. You can also tape them together.

Use the red wire (#30-thinnest) from the wir
of the box, leaving a 10 cm overhang. Wrap
box (not over the open ends), evenly on both
block the nail hole. When you reach the end
end and tape the wire coils onto the box so t

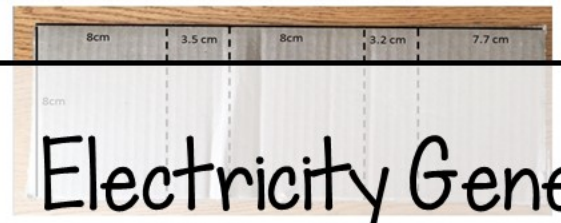
Rub the colored insulation off the ends of the
copper wire. Then, twist the ends of the wire
wires. This will complete the circuit to the lig
should NOT touch each other, or the circuit w



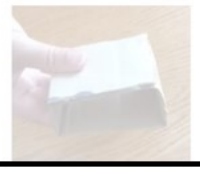
Electricity Generation: Part 1 Student Instructions

Part 1: Building a Simple Electric Generator

Cut around the perimeter of the cardboard 30.4 cm x 8 cm. Mark the lines as follows on the cardboard and fold on the dotted lines.



Fold the cardboard so that the 3.2 cm and 7.7 cm edges are on the inside as follows:



Use the nail to poke a hole through all three layers of cardboard. You can draw a large X on the side of the box to determine where the middle is located, if necessary.

Electricity Generation: Part 2 Student Instructions

During this activity, you will be working with a team to construct a structure that turns your electric turbine using wind or water. Your teacher will supply you with materials that you can use to build your structure. You will then attach your structure to the electric
rator you made in Part 1 and meas

ind turbine

ucture of your wind t

estions:

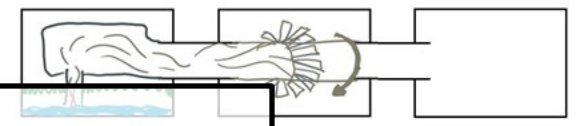
Why did you design it this way?

Were there characteristics of turbi
than yours? Why or why not?

Energy Generation Diagrams

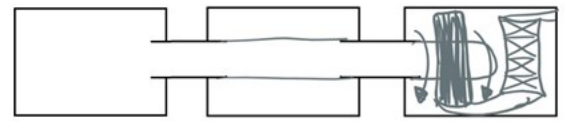
In real life, generators are attached to something other than man-power to make them spin. Finish the pictures on the following pages to show how electricity is generated by various energy sources.

Geothermal Power: Steam from heat below the earth's surface can turn a turbine to generate

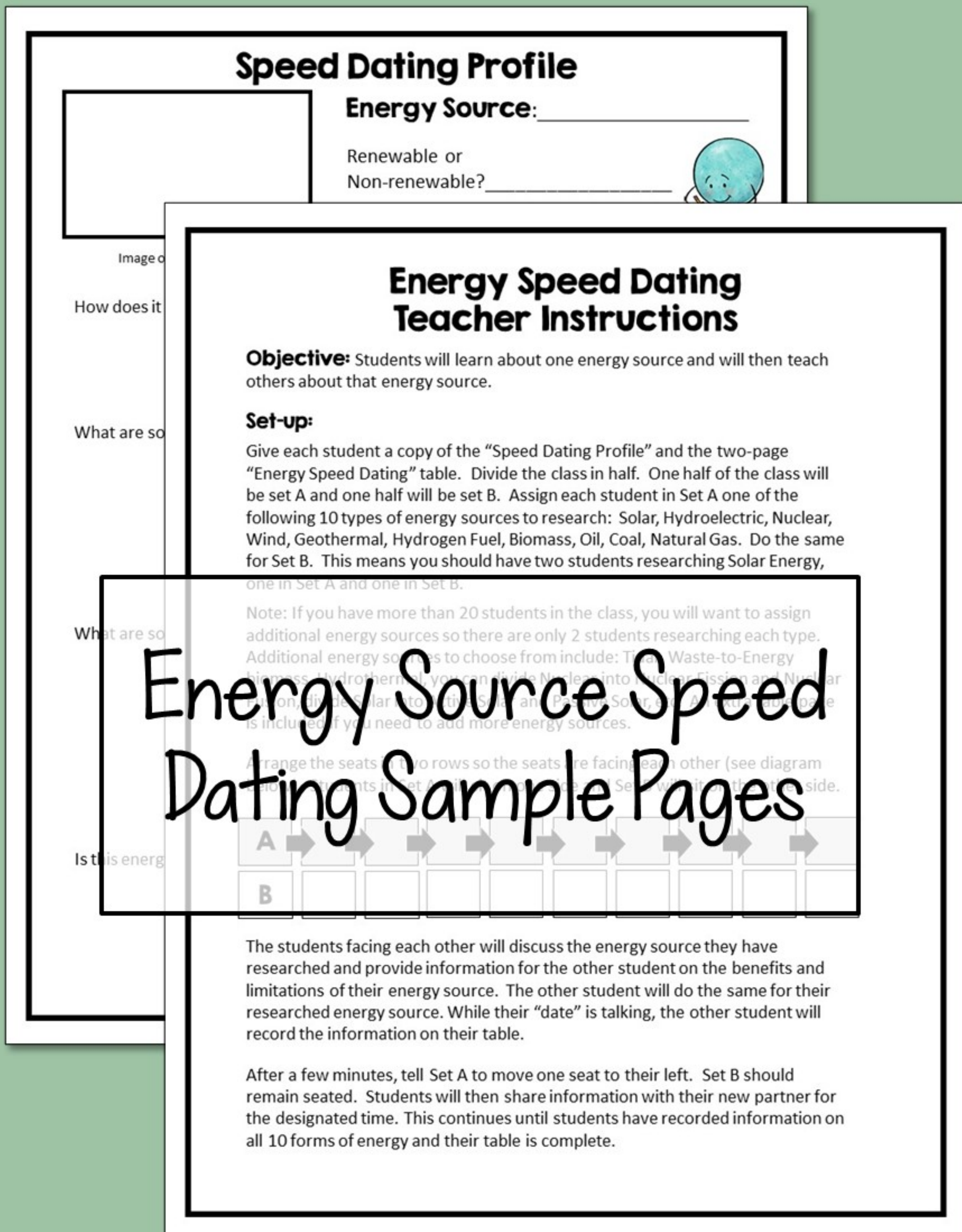


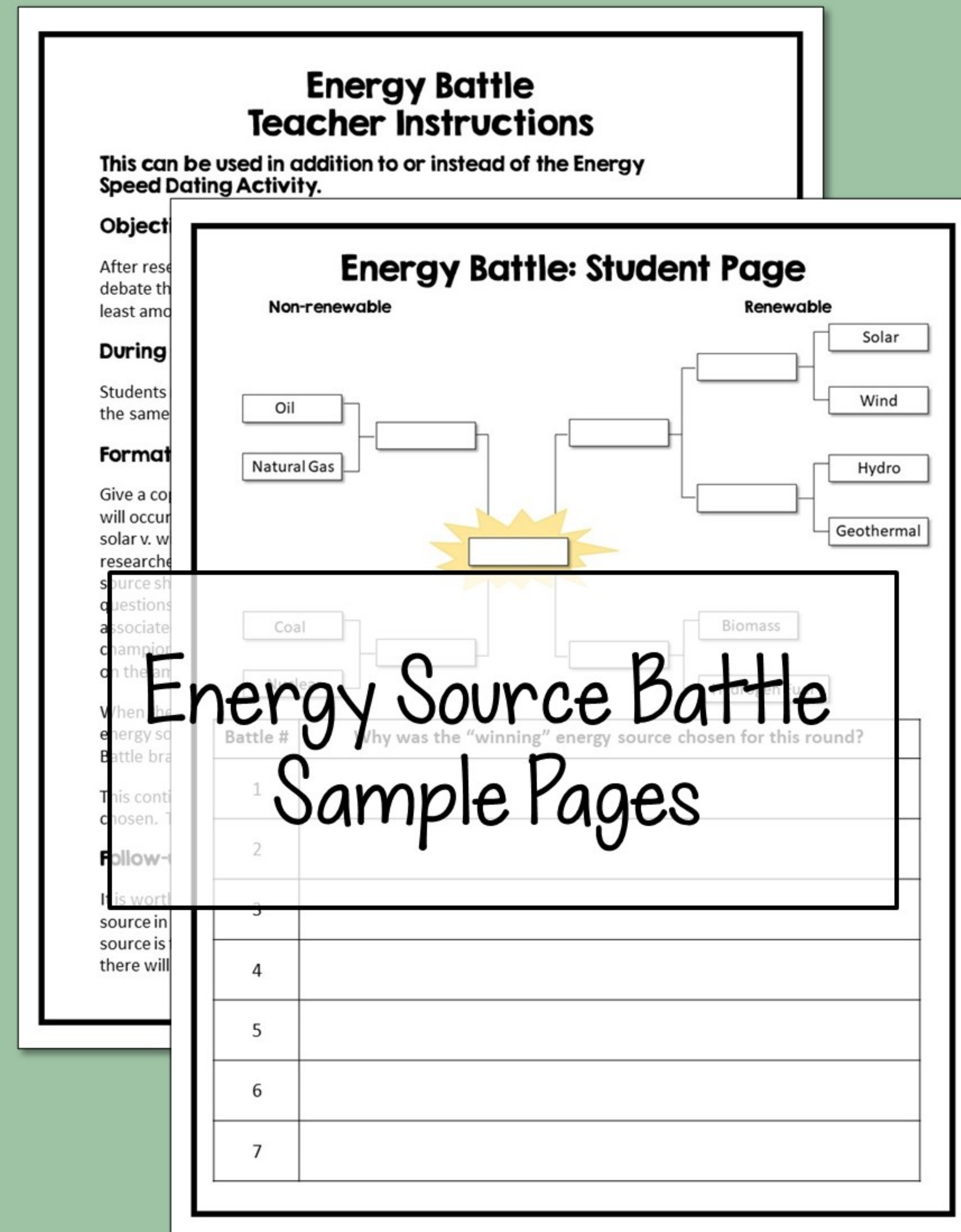
Hydroelectric Power: Water from dams can turn a turbine to generate electricity.

Wind Power: Wind can turn roto blades which are attached to a shaft within a turbine that generates electricity.



Nuclear Power: Uranium atoms split, releasing energy, heating water that creates steam. This steam turns a turbine that generates electricity.


Speed Dating Profile
Energy Source:
Renewable or Non-renewable?
Energy Speed Dating Teacher Instructions
Objective: Students will learn about one energy source and will then teach others about that energy source.
Set-up:
Give each student a copy of the "Speed Dating Profile" and the two-page "Energy Speed Dating" table. Divide the class in half. One half of the class will be set A and one half will be set B. Assign each student in Set A one of the following 10 types of energy sources to research: Solar, Hydroelectric, Nuclear, Wind, Geothermal, Hydrogen Fuel, Biomass, Oil, Coal, Natural Gas. Do the same for Set B. This means you should have two students researching Solar Energy,
Energy Source Speed Dating Sample Pages
The students facing each other will discuss the energy source they have researched and provide information for the other student on the benefits and limitations of their energy source. The other student will do the same for their researched energy source. While their "date" is talking, the other student will record the information on their table.
After a few minutes, tell Set A to move one seat to their left. Set B should remain seated. Students will then share information with their new partner for the designated time. This continues until students have recorded information on all 10 forms of energy and their table is complete.


Energy Battle Teacher Instructions
This can be used in addition to or instead of the Energy Speed Dating Activity.
Energy Battle: Student Page
Non-renewable
Renewable
Oil
Natural Gas
Solar
Wind
Hydro
Geothermal
Energy Source Battle Sample Pages
4
5
6
7

Energy Impacts Teacher Instructions

The extraction and use of resources for
environment and human safety. In this ac
locations that house a power plant or ene

For each location, students will determin
-Where it is in the world?
-What type of energy is used/created ther
-Is there an important date associated wit
-How has this location impacted the envir

Set-up:
- Students will be using "My Maps" thro
explanation of each energy location.
- If your students have experienc us
list of locations and the questions they
- In addition to the questions given abo
attention to the way in which governm
cover ups, clean ups, misinformation,
etc.). This will give students a good se
plays in energy resource use and how

Locations for research:
- Chernobyl, Ukraine
- Kamuthi Solar Power Project, India
- Centralia, Pennsylvania
- Banqiao Reservoir, China
- Altamont Pass, California
- Pohang Geothermal Plant, South Kore
- Talmadge Creek, Michigan

Assessment:
Students will share their completed maps
rubric is included to assess student produ
A sample of a completed map can be foun

Energy Impacts Map Student Instructions

The extraction and use of resources for energy can have impacts to the environment and human safety. In this activity, you will research several locations that house a power plant or energy-related resources. For each location, you will determine:

-Where it is in the world?
-What type of energy is used/created there?
-Is there an important date associated with this location?
-How has this location impacted the environment and human lives?

You will be using Google Maps™ to create your finished product to demonstrate your knowledge.

Directions:
1. Go to www.google.com/maps and choose the Menu icon on the top left corner.
2. Sign in to your account if prompted. From the options that appear, select "Maps".
3. At the bottom of the tab, select "Create Map".
4. Give your map a title (i.e. My Energy Resource Map).
5. This map will be your finished product to demonstrate your knowledge about the locations given. For each location, place a marker on the map in the correct location and then describe the location by providing answers to the questions above.
6. When you have located and described each location, select "Share" from the map menu to share this map with your teacher for assessment.

Locations:
- Chernobyl, Ukraine
- Kamuthi Solar Power Project, India
- Centralia, Pennsylvania
- Banqiao Reservoir, China
- Altamont Pass, California
- Pohang Geothermal Plant, South Korea
- Talmadge Creek, Michigan

Energy Impacts Google Mapping Activity Sample Pages

5 Extension Pages

Math skills check!
(great for standardized test prep)

Energy Efficiency in Lighting

The **Law of the Conservation of Energy** states that energy can neither be created nor destroyed, it can only be transformed from one form into another. Lightbulbs are a visible illustration of this scientific law.

Lightbulbs have come a long way in the past 20 years. Thomas A. Edison received a patent for the **incandescent light bulb** in 1879. The incandescent bulb emits light as a tungsten filament inside it is heated. The bulb itself is filled with an inert gas- likely argon. Incandescent bulbs are widely used but have several drawbacks- they are inefficient (almost 90% of the energy used is released as heat) and the tungsten filaments don't last very long. **Compact Florescent Lights** (CFLs) and **halogen bulbs** used different gases to fill the bulbs and were an improvement on the incandescent bulb in that they used less energy and lasted longer. However, these bulbs were not loved by consumers because they didn't have the warm glow of an incandescent bulb and their shapes were less attractive.

Thankfully, a new bulb came on the market. **Light emitting diodes** (LEDs) were originally used in electronic parts but began to gain popularity as a lighting solution in the early 2000s. They are far more efficient than incandescent bulbs using 75% less energy to produce the same amount of light. LEDs don't use filaments; in fact, they're not really bulbs at all. LEDs are tiny semiconductors that emit light when a current passes through them. They can now be produced in a huge variety of colors and arrangements, which make them much more accepted by consumers. Unfortunately, the upfront costs of LEDs are still slightly higher than other bulbs.

Incandescent

CFL

Digging Deeper: Distribution of Resources

The distribution of energy resources is not even throughout the world. The middle east has large shares of oil and natural gas, Canada and Australia have high amounts of uranium, and Russia and the United States have large quantities of coal.

Today you'll look at the distribution of different energy sources within the United States.

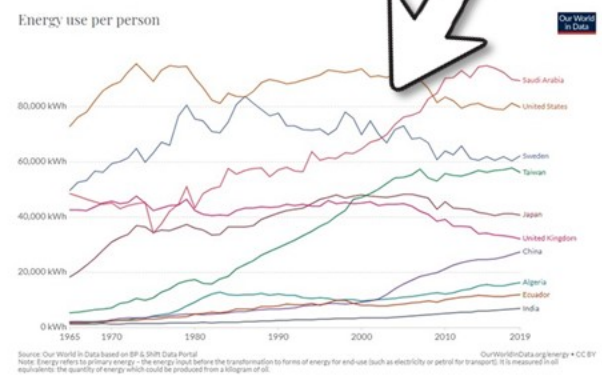
Directions:

1. Go to the following site: https://www.eia.gov/state/maps.php
2. Click on the "Layers/Legend" button and then choose "Remove All". This will turn off all the layers and icons on the map.
3. Click on the boxes as necessary to help you answer the following questions.

1. Where are most of the coal mines found in the United States?

2. What portion of the United States has the most geothermal power plants? Why do you think this is?

Data Analysis: Global Energy Usage



1. What trends do you notice for some of the highly developed nations like United Kingdom, United States, and Japan from the last decade?

2. What trends do you notice for the developing countries like China, Taiwan, and Saudi Arabia?

3. What possible explanations can you give for these two trends?

4. In 2019, the energy usage per person in India was 6,924 kWh and the energy usage per person in the United States was 79,897 kWh. How many times greater is the energy usage per person in the United States than in India?

Math Extension: Light Bulb Efficiency

Show your work for each of the following questions.

1. You have the choice between an LED bulb that uses 5.5 watts of energy and an incandescent bulb that uses 15 watts of energy. Both produce the same amount of light (500 lumens). How many lumens does each watt of energy produce for the
   a. LED bulb?

   b. Incandescent bulb?

   c. How much more efficient is the LED bulb than the incandescent bulb?

2. For the following questions, use the information below.
   kW= kilowatt or 1000 watts
   kWh= kW x hours

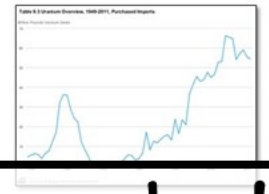
   a. You have a 60 watt incandescent bulb that you leave on every hour for a year. How many kWh of energy does your bulb use during the year?

   b. If energy in your area costs $0.13/kWh, what is the energy cost of this bulb for the year?

   c. A 16 watt LED bulb emits the same amount of light as your incandescent bulb. How many kWh of energy are used by this bulb during the year?

   d. What is the energy cost for the LED bulb for the year?

3. An average incandescent bulb lasts 1,000 hours before burning out. An average LED bulb lasts 40,000 hours. During your year of use, how many incandescent bulbs would you need? How many LED bulbs?



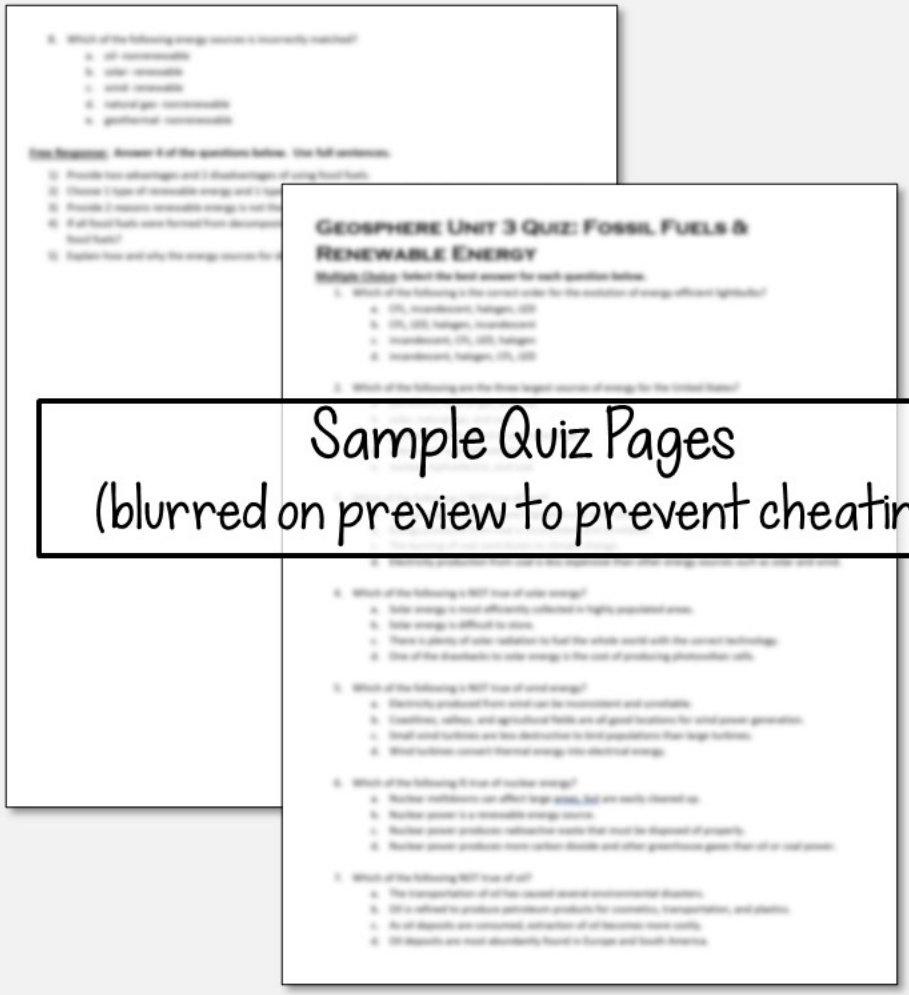
Area of house	Energy conservation methods

Greater depth of knowledge, scientific literacy, & critical thinking

Assessment

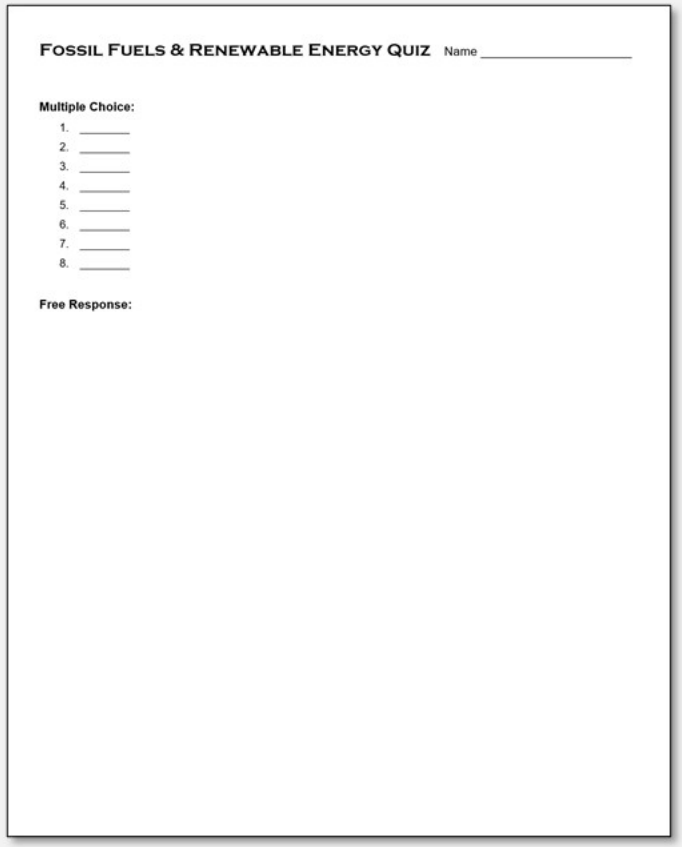
Editable Unit Quiz

- 8 multiple choice questions
- 5 free response questions



Sample Quiz Pages
(blurred on preview to prevent cheating)

Student answer sheet &
answer keys included
(both fully editable)



Fossil Fuels & Renewable Energy Quiz Name _____

Multiple Choice:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Free Response:

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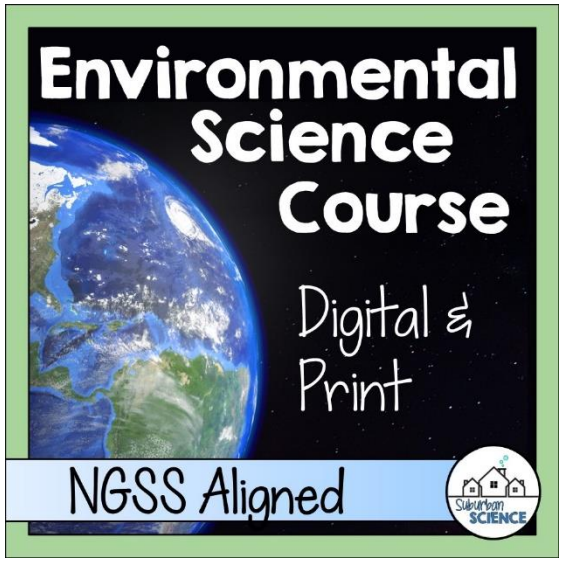

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Want to connect?

I sincerely hope this resource will make your school year easier and more fun.

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Sincerely,
Anne from Suburban Science