Word Splash

Name:

Circle two or more words, and explain how each is connected to stewardship on the lines below.

caretaker

future

manager

environment

responsible

conservation

commit

LAND

wildlife

use

WYOMING STEWARDSHIP PROJECT

Stewardship
Bumper Sticker Template

Name: _____

Exit Tickets

Name:_____ Date:_____

Give an example of ***stewardship***:

Name:_____ Date:_____

Give an example of ***stewardship***:

Name:_____ Date:_____

Give an example of ***stewardship***:

Name:_____ Date:_____

Give an example of ***stewardship***:

Name:_____ Date:_____

Give an example of ***stewardship***:

Name:_____ Date:_____

Give an example of ***stewardship***:

WYOMING STEWARDSHIP PROJECT

Minerals & Energy in Wyoming

My alarm went off at 6:00 this morning. I checked my cell phone, turned on the light, and took a shower. How many of you started your day like this? How many of these things do you think are a result of Wyoming products?

Wyoming Resources

Oil, gas, and mining have been important in Wyoming for over 130 years! In 1884, the first oil well was drilled near Lander, and oil drilling continues throughout the state today. Historically, the Wyoming mineral and energy industries have been a major contributor to employment and state money (revenue). These include the oil and gas industry, minerals, and power production.

Wyoming Oil and Gas

Oil and gas products include crude oil, natural gas, and helium. These are used for reliable heating and power for things like our homes, schools, and businesses. Natural gas produces approximately 34% of the nation's electricity, much of which comes from Wyoming.

Oil rig in Wyoming
Wyoming State Historic Preservation Office

Wyoming produces 6% of the nation's natural gas. We are ranked number 4 in production, with Texas ranked number 1 at 26%.

This industry pays the largest amount of taxes to the state to fund infrastructures, like schools and roads.

Wyoming Minerals

The minerals mined in Wyoming include coal, uranium, trona, bentonite, and rare earth minerals.

Coal truck in the mine at Hanna, Wyoming
Wyoming State Historic Preservation Office

Wyoming has an abundant supply of coal with a total resource 6,681 million short tons. Coal produced in Wyoming goes to U.S. electricity production with 32 states obtaining coal from Wyoming. Wyoming produced 42% of all coal mined in the United States in 2015. Coal is an important source of income for Wyoming and is the second largest source of tax revenue for state and local governments. Coal mining companies pay taxes, royalties, and fees to all branches of government, federal, state, and local. Coal's estimated contribution to Wyoming in 2015 was almost $1.2 billion.

Trona, which comes out of Sweetwater County, is the number one export for Wyoming producing 90% of the nation's soda ash. Wyoming trona is used to create soda ash that is used in a variety of products like glass, baking soda, cosmetics, toothpaste, and soaps.

According to the Wyoming Mining Association, Wyoming produces 70% of the world's supply of bentonite. This mineral is used for a variety of products including drilling fluids, compounds needed for absorption, cat litter, and lipstick.

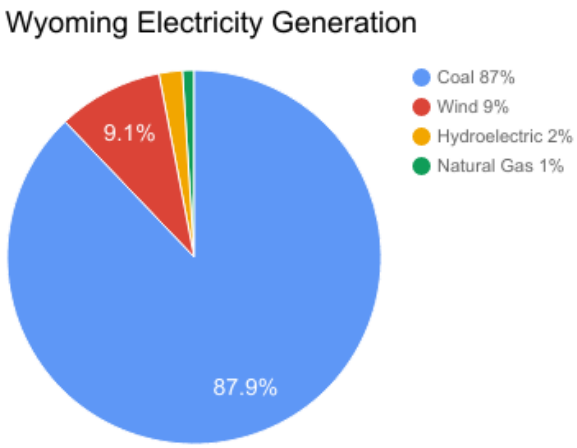
Minerals & Energy in Wyoming

Wyoming Power

Power Production includes coal and natural gas power plants, hydroelectric, and wind energy.

The energy produced through these resources is transmitted throughout the entire country from Wyoming!

The combination of all these resources contribute to the economy of Wyoming but also gives you the personal resources to wake up to an alarm, have a cell phone, turn on your lights, and take a warm shower!



Source: U.S. Energy Information Administration State Energy Profiles. (24 March 2016). Wyoming Electricity Generation. Retrieved June 22, 2017 from http://www.eia.gov/electricity/state/wyoming/

Minerals & Energy in Wyoming

Word Sort

trona	helium	state's largest amount of generated taxes
hydro	rare earth minerals	bentonite
crude oil	wind	solar energy
power plants	gas	uranium
carbon dioxide	coal	

Oil & Gas	Minerals	Power Production

Wyoming Energy Resources

Coal at a Power Plant

Coal Mining

Source: Wyoming Mining Association

Coal Mining

Source: Wyoming Mining Association

Coal Mining

Source: Wyoming Mining Association

Uranium

Source: United States Geological Survey

Uranium

Source: Wyoming Mining Association

Uranium

Source: Wyoming Mining Association

Uranium Mining

Source: Wyoming Mining Association

Oil Drilling

Source: Bureau of Land Management

Oil Refinery

Oil Rig

Source: Wyoming Petroleum Association

Oil/Gasoline

Wyoming Energy Resources

Natural Gas Pipeline

Natural Gas

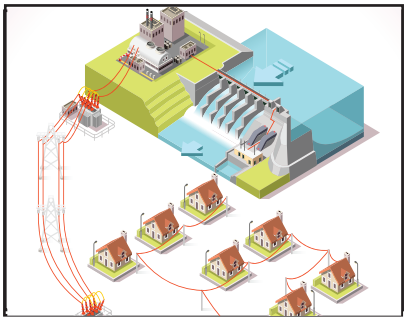
Natural Gas Fueling Station

Natural Gas Fueling Pipeline

Hydropower

Hydroelectric Dam

Hydropower



Hydroelectric

Wind Power

Wind Power

Wind Power

Wind Power

Wyoming Energy Resources

Name:

	Description	Location
Oil		
Natural Gas		
Hydroelectric		
Wind		
Coal		
Uranium		

Wyoming Energy Resources

Hydropower Plants

KEY

Hydroelectric Power Plant

Wyoming has a long history of using water to generate electricity, dating back to the early 1900s. While hydropower generation is considered small and seasonal, it represents a consistent and established electricity source. There are 15 hydropower plants on 10 reservoirs. Thirteen of these are operated by the Bureau of Reclamation and two by private companies. The total hydropower generation capacity in Wyoming is 299.6 MW.

Stafford, J. (2012, February). Wyoming's Electrical Generation (Rep.). Retrieved June 22, 2017, from Wyoming State Geological Survey website: http://www.wsgs.wyo.gov/products/wsgs-2012-electricalgeneration-summary.pdf

Development & Use of Energy Resources

Stops on the tour for our Virtual Field Trip.
Record key information about how the resource is developed, used, and cared for.

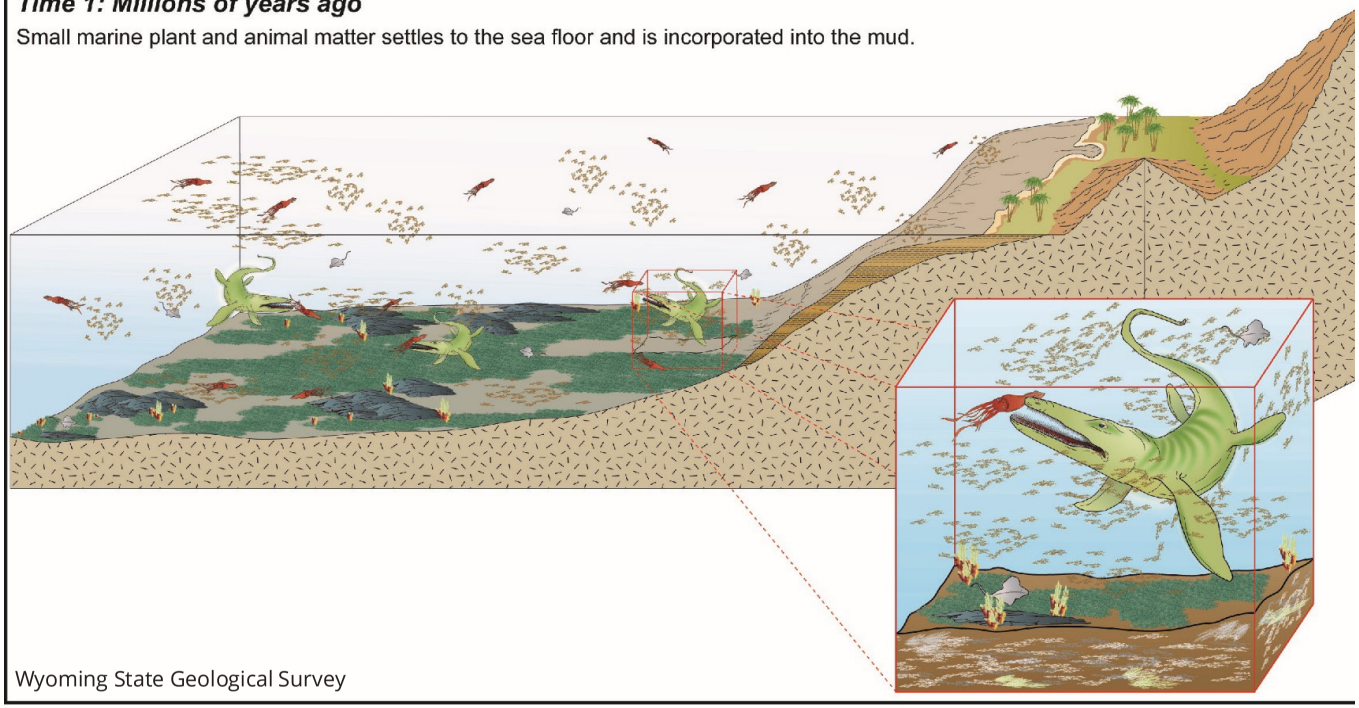
Group Members' Names: _____

Topic: _____

Developed
By who?
Facts:
Used
By Who:
Facts:
Cared For
By Who:
Facts:

Time 1: Millions of years ago

Small marine plant and animal matter settles to the sea floor and is incorporated into the mud.

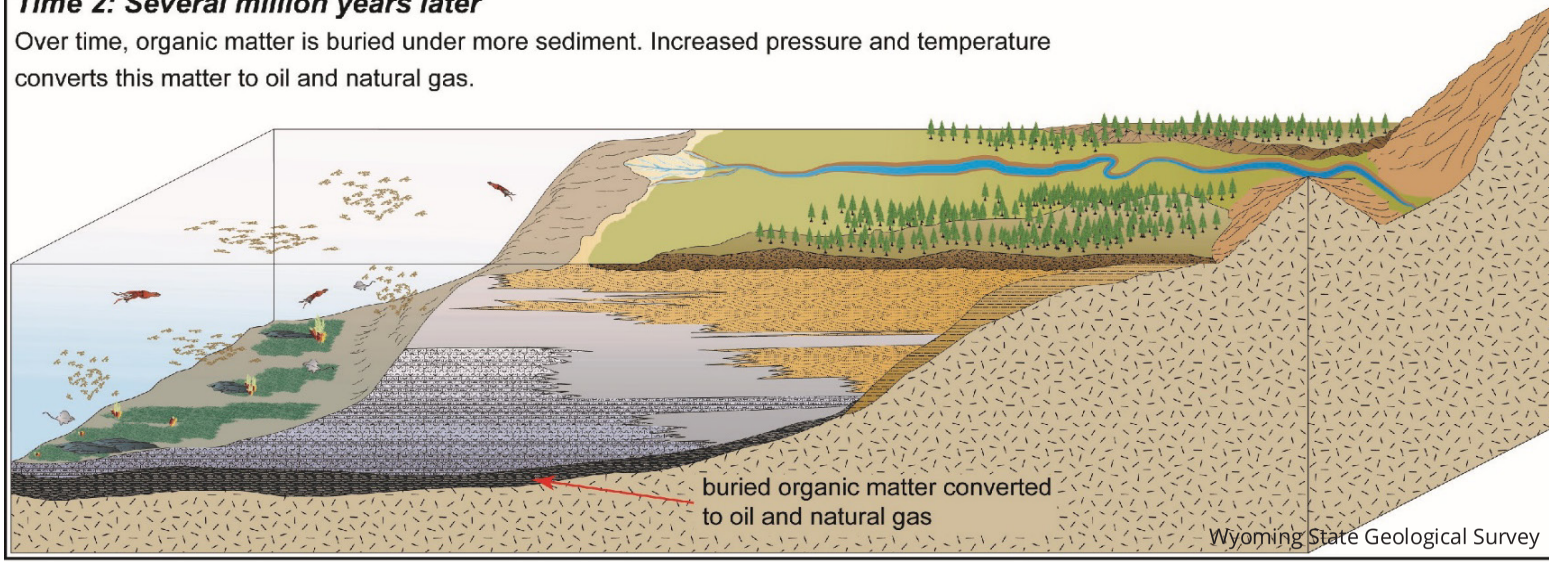


Wyoming State Geological Survey

Millions of years ago, oil was formed from the remains of tiny sea plants and animals.

Time 2: Several million years later

Over time, organic matter is buried under more sediment. Increased pressure and temperature converts this matter to oil and natural gas.



Wyoming State Geological Survey

Oil is buried underground in tiny pockets in rocks. Oil wells are drilled to pump out the oil. Some oil rigs are out in the ocean and some are on land. People involved include geologists, engineers, and rig workers.

Oil is transported by railway, ship, or pipeline to refineries. People involved include transportation workers.

Charles Willgren - Creative Commons

At the refinery, oil is separated into different components, and made into fuels. People involved include refinery workers.

Fuel is transported to gas stations. People involved include truck drivers and rail workers.


Tony Webster - Creative Commons

Buhler013 - Creative Commons

We use gasoline to power our cars. Petroleum is also used to make other fuels; lots of materials such as plastics, paints, and many other items. People involved include consumers.

Once drilling is completed, the companies work to reclaim the land. People involved include environmental engineers.

Energy Consumption in the U.S.

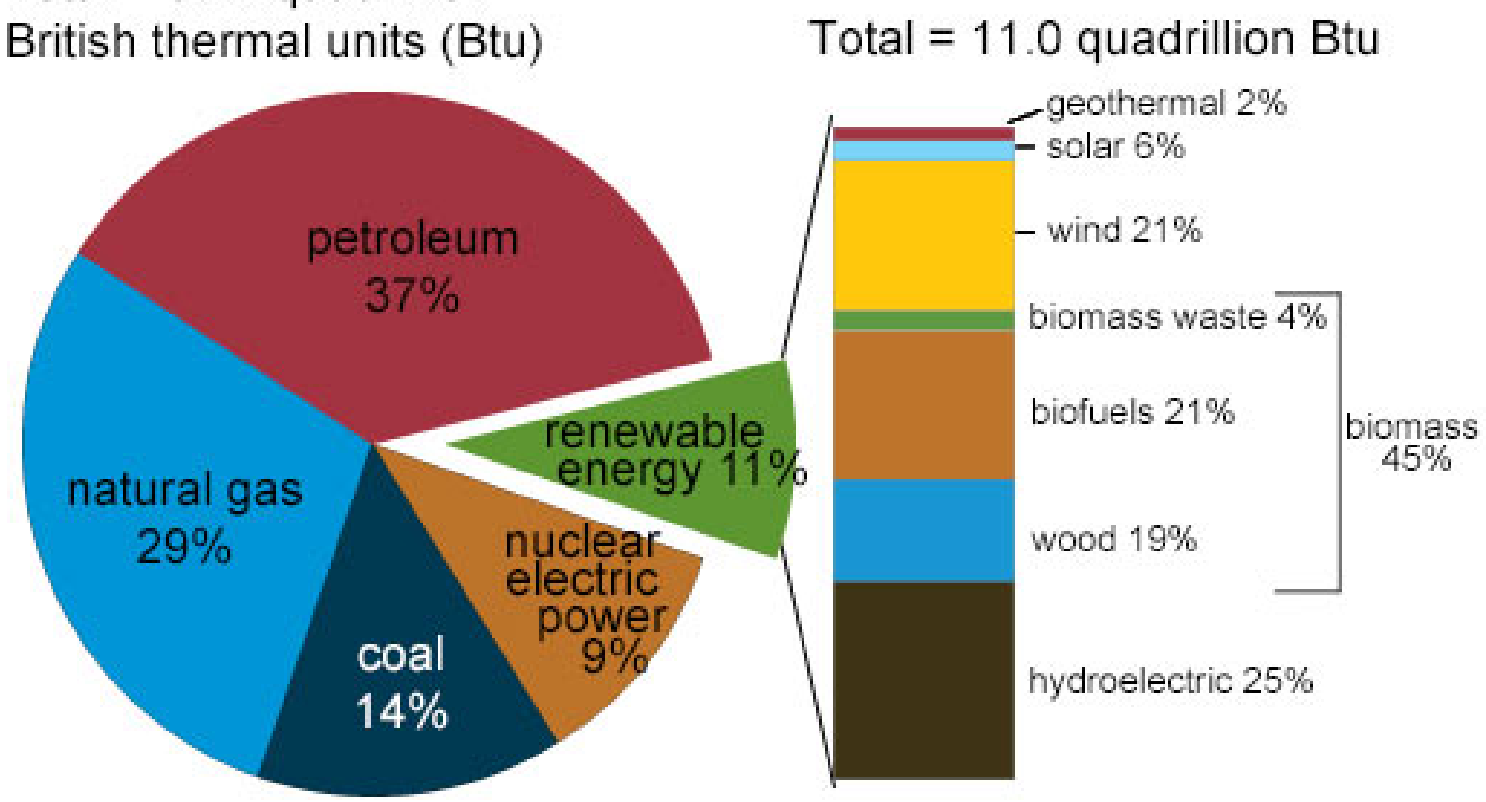
Energy can be categorized into nonrenewable and renewable resources. Looking at the chart below, write your thoughts and observations about the types of energy consumed.

U.S. Energy Consumption by Source 2017

Nonrenewable Energy		Renewable Energy	
Petroleum uses: transportation, manufacturing	28%	**Biomass** uses: heating, electricity, transportation	5.06%
Natural Gas uses: heating, manufacturing, electricity	31.8%	**Hydropower** uses: electricity	2.81%
Coal uses: electricity, manufacturing	17.8%	**Wind** uses: electricity	2.36%
Uranium uses: electricity	9.6%	**Solar** uses: heating, electricity	0.67%
		Geothermal uses: heating, electricity	0.22%

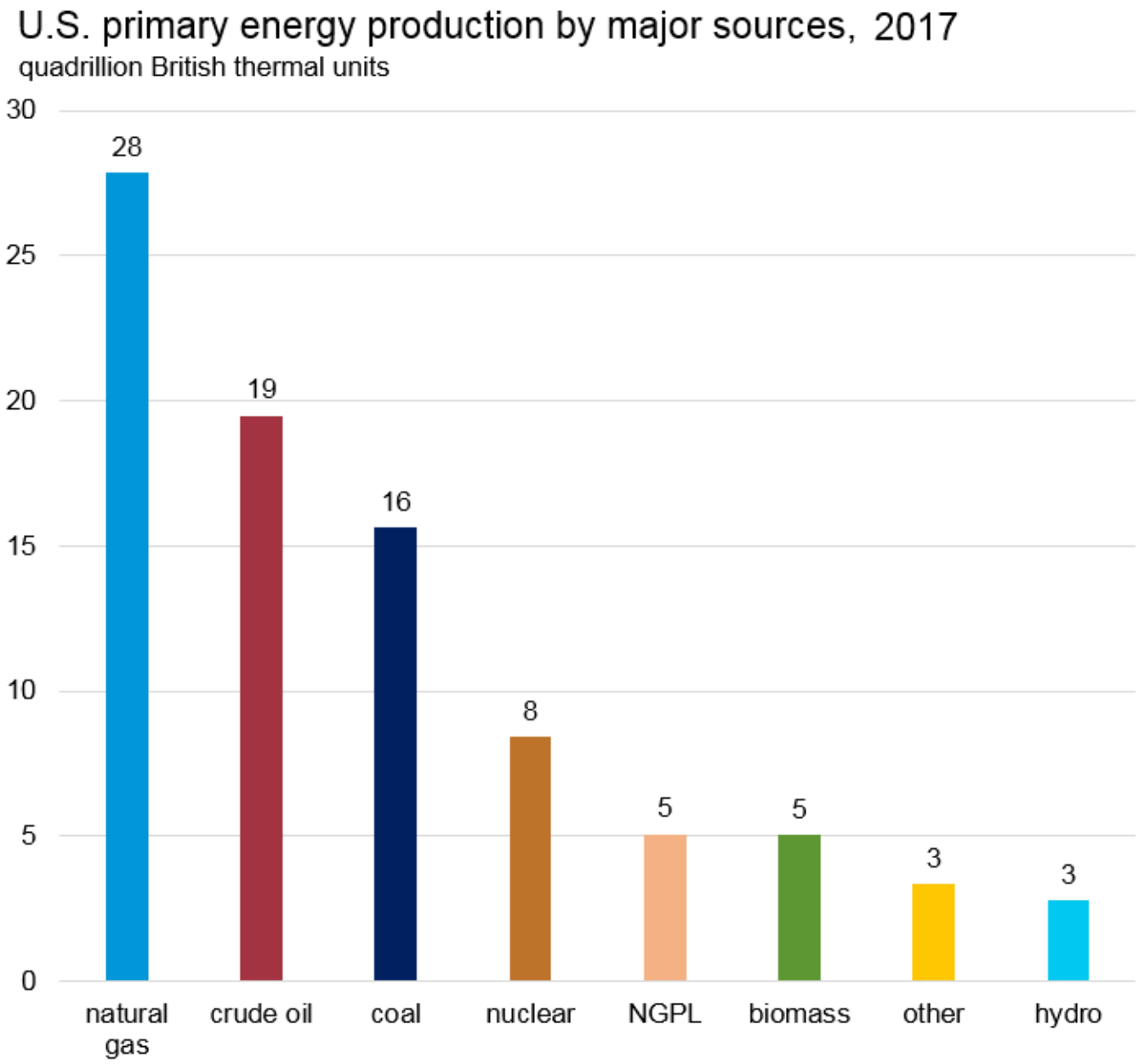
Thoughts and observations about the chart:

U.S. energy consumption by energy source, 2017



Note: Sum of components may not equal 100% because of independent rounding.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, April 2018, preliminary data

eia



Note: NGPL is natural gas plant liquids; other is geothermal, solar, and wind; hydro is conventional hydroelectric.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, April 2018, preliminary data

Energy Sort

Using the pictures from the previous lesson, sort the energy source according to renewable and nonrenewable energy.

Renewable	Nonrenewable

WYOMING STEWARDSHIP PROJECT

Renewable or Nonrenewable?

	Renewable or Nonrenewable (circle one)	Uses	Conservation Ideas
Coal	Renewable Nonrenewable		
Oil	Renewable Nonrenewable		
Wind	Renewable Nonrenewable		
Uranium	Renewable Nonrenewable		
Natural Gas	Renewable Nonrenewable		
Hydropower	Renewable Nonrenewable		

Renewable & Nonrenewable Resources

Exit Ticket

Name: _____ Date: _____

Give an example of two energy sources that are renewable:
1.

2.

Give an example of two energy sources that are nonrenewable:
1.

2.

What is the difference between renewable and nonrenewable?

Renewable & Nonrenewable Resources

Exit Ticket

Name: _____ Date: _____

Give an example of two energy sources that are renewable:
1.

2.

Give an example of two energy sources that are nonrenewable:
1.

2.

What is the difference between renewable and nonrenewable?

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Powering Up Wyoming's Economy
CLOZE Activity

As we play the Kahoot game, fill in the correct answers for each fact.

Coal

Wyoming ranks _____ in the nation for coal production.

The amount of coal available in the U.S. could provide energy for over ____ years.

Coal contributes over 1 billion dollars in taxes to Wyoming each year. This money is used to: _____.

_____ pound of coal supplies enough electricity to light ten 100-watt light bulbs for one hour.

The average _____ uses the equivalent of 20 lbs. of coal each day.

In 2016, _____ people were employed by Wyoming coal mines.

Oil

Nationally, Wyoming ranked _____ in production of crude oil in 2015.

Petroleum pipelines are located in all of the state's _____ counties.

In 2015, oil and gas production contributed _____ billion dollars to state and local governments.

In 2015, over _____ people were employed by the oil and gas industry.

Natural Gas

Wyoming ranked _____ in the nation in the production of natural gas in 2015.

Natural gas has many different uses. The most common are _____ _____.

Sublette and Campbell counties have experienced _____ growth due to oil, gas, and coal extraction.

Powering Up Wyoming's Economy
CLOZE Activity

As we play the Kahoot game, fill in the correct answers for each fact.

Wind

Generating wind power creates no _____ and uses virtually no _____.

One _____ turbine doesn't make much electricity.

Most wind farms have many wind turbines. That land can still be used to

_____.

Hydro

Hydropower is the world's largest contributor of all _____ resources.

Wyoming has _____ hydro-electric power plants capable of producing over 280 megawatts.

Reservoirs created by hydro plants can be used for _____

_____.

Uranium

Wyoming has the _____ uranium reserves in the country.

About one pound of uranium can produce the same amount of energy as

_____ pounds of coal.

Uranium is a _____ found in rocks in the _____.

Powering Up Wyoming's Economy Quiz
(Teacher Copy)

Teacher Directions: The question number noted on the teacher copy corresponds to the question number of the Kahoot game. Teacher will need to stop and discuss each question/statement, so students can successfully complete the cloze activity.

Coal

Question 1 - Wyoming ranks **1st** in the nation for coal production.

Question 2 - The amount of coal available in the U.S. could provide energy for over **250** years.

Question 3 - Coal contributes over 1 billion dollars in taxes to Wyoming each year. This money is used to: **fund the state government**, **pay teachers**, and **build new schools**.

Question 4 - One pound of coal supplies enough electricity to light ten 100-watt light bulbs for one hour.

Question 5 - The average **person** uses the equivalent of 20 lbs. of coal each day.

Question 6 - In 2016, **5,682** people were employed by Wyoming coal mines.

Oil

Question 7 - Nationally, Wyoming ranked **8th** in production of crude oil in 2015.

Question 8 - Petroleum pipelines are located in all of the state's **23** counties.

Question 9 - In 2015, oil and gas production contributed **2.1** billion dollars to state and local governments.

Question 10 - In 2015, over **20,402** people were employed by the oil and gas industry.

Natural Gas

Question 11 - Wyoming ranked **5th** in the nation in the production of natural gas in 2015.

Question 12 - Natural gas has many different uses. The most common are **heating**, **manufacturing,** and **electricity**.

Question 13 - Sublette and Campbell counties have experienced **rapid** growth due to oil, gas, and coal extraction.

Wind

Question 14 - Generating wind power creates no **emissions** and uses virtually no **water**.

Question 15 - One **wind** turbine doesn't make much electricity.

Question 16 - Most wind farms have many wind turbines. That land can still be used to **farm** or **graze animals**.

Hydro

Question 17 - Hydropower is the world's largest contributor of all **renewable** resources.

Question 18 - Wyoming has **11** hydro-electric power plants capable of producing over 280 megawatts.

Question 19 - Reservoirs created by hydro plants can be used for **swimming, fishing, boating,** and **other sports**.

Uranium

Question 20 - Wyoming has the **largest** uranium reserves in the country.

Question 21 - About one pound of uranium can produce the same amount of energy as **20,000** pounds of coal.

Question 22 - Uranium is a **mineral** found in rocks in the **ground**.

Panel Discussion

Role: _____

What are some of the benefits of this energy resource?

What are some challenges of this energy resource?

Which energy resource has the biggest impact on your life? Why?

Which energy resource could you live without? Why?

How would your life change if the most important resource was no longer available?

How would your life change if the price of that resource doubled?

How would you steward natural resources to benefit all Wyoming's citizens?

Wyoming Stewardship Project

Roles

FARMER

STUDENT

TEACHER

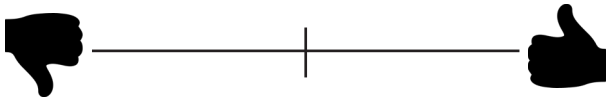
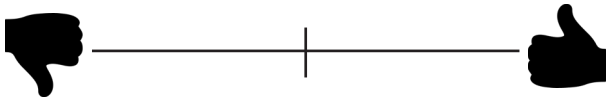
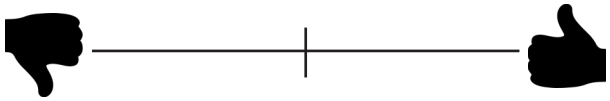
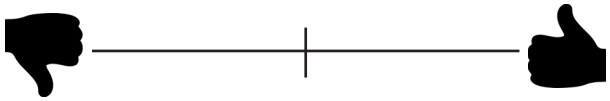
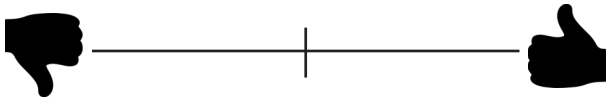
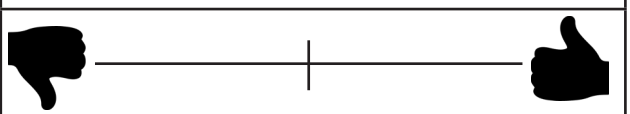
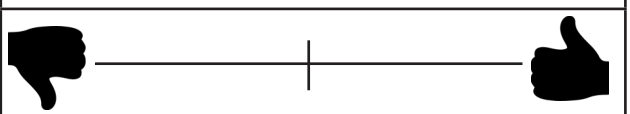
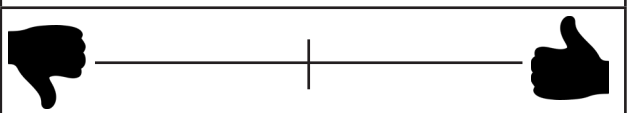
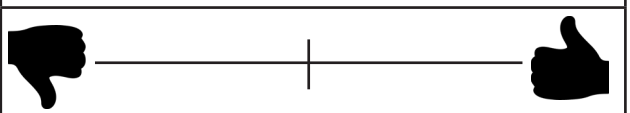
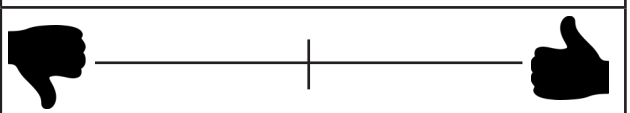
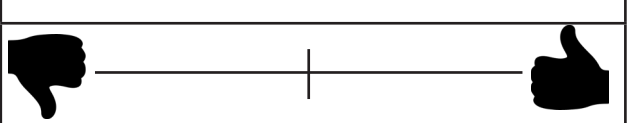
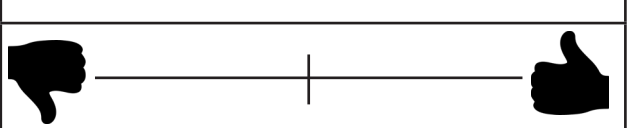
BUSINESS PERSON

MINER

Wyoming Stewardship Project

Energy Pro & Con

COAL

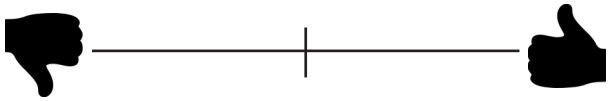
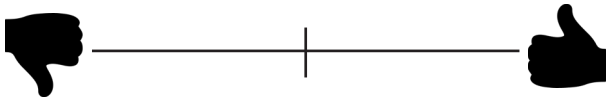
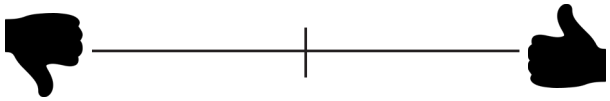
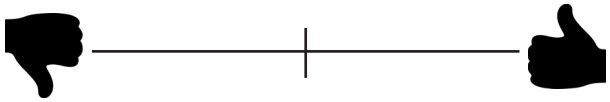
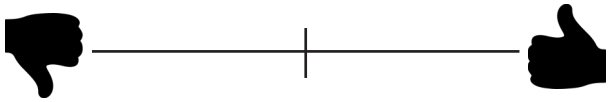
Energy produced from coal is inexpensive.	
The amount of coal available to be mined in Wyoming could provide energy for the next 150 years.	
Coal is a nonrenewable resource.	
Wyoming is the nation's top coal producer. [1]	
Coal contributes over $1 billion in taxes to the state. [1] Royalties for coal supports the building of new schools. [4]	
Wyoming coal is low-sulfur and more environmentally friendly than other forms of coal. [4]	
Coal contributes 31% of CO_2, more that any other source. [EPA]	
Coal is a dispatchable energy source that can be turned on and off to meet demand. [18]	
Coal can be accessed through underground mining or surface mining. [3]	
After coal is mined, they put back the dirt and rock, and plant trees and grass. This is called reclamation.[3]	
In 2015, 6,646 people were employed by Wyoming coal mines. [4]	
A pound of coal supplied enough electricity to light ten, 100-watt light bulbs for one hour. [4]	

Overall view of this energy resource:

Negative ——————|—————— Positive

Energy Pro & Con

OIL

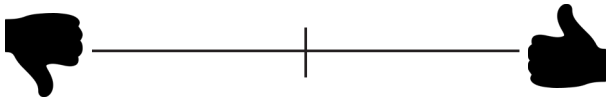
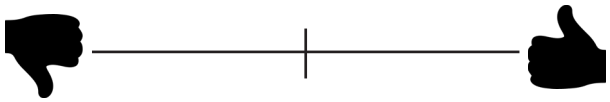
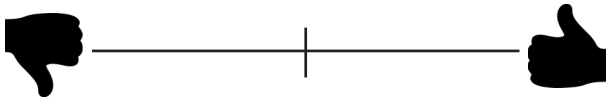
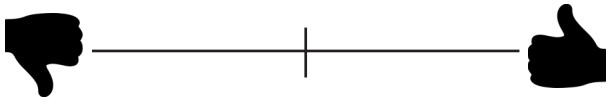
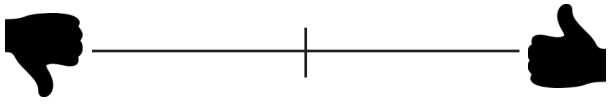
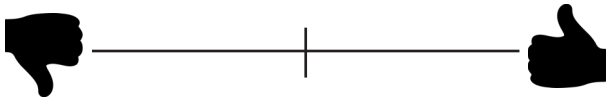
In 2015, Wyoming's petroleum industry directly employed over 20,400 people. [2]	
In 2015, oil and gas production contributed $2.1 billion to state and local governments. [2]	
In 2015, 751 wells were drilled and completed. Of that number, 38% found oil, 53% found gas, and 9% were dry holes. [2]	
Nationally, Wyoming ranked 8th in production of crude oil in 2015. [2]	
Petroleum pipelines are located in all of the state's 23 counties. [2]	
It costs about $4.5 million to $5.5 million to drill a well. (Wyoming Tribune Eagle)	
Oil is a nonrenewable resource.	
Drilling can lead to spills.	
Oil companies create environmental plans.	

Overall view of this energy resource:

Negative ——————|—————— Positive

Energy Pro & Con

NATURAL GAS

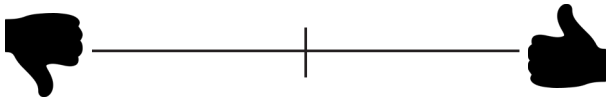
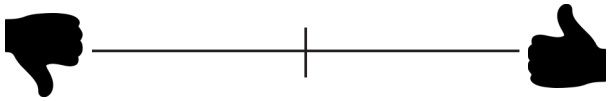
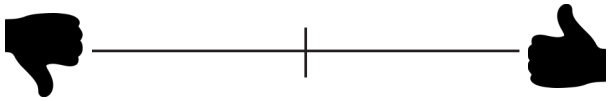
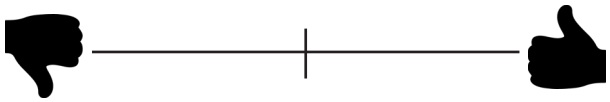
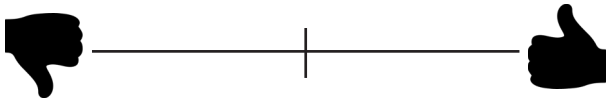
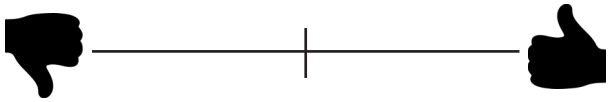
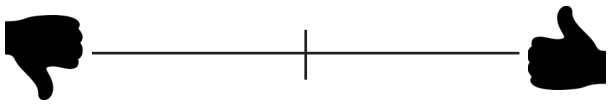
Wyoming ranked 5th in the nation in the production of natural gas in 2015. [2]	
In 2015, Wyoming had 41 operating gas plants processing nearly 87% of the state's gas production. [2]	
The extraction of natural gas releases methane into the air.	
When used to generate electricity, natural gas emits less than half of the carbon dioxide that coal does. [8]	
Natural gas is a mixture of gases you can't see, smell, or taste. [3]	
Natural gas is a nonrenewable resource.	
Natural gas has many different uses. The most common are heating, manufacturing, and electricity. [3]	

Overall view of this energy resource:

Negative ——————————— Positive

Energy Pro & Con

WIND

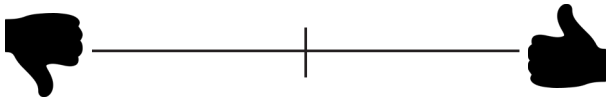
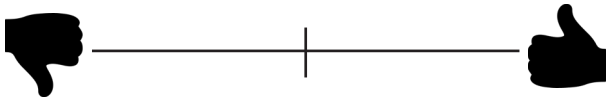
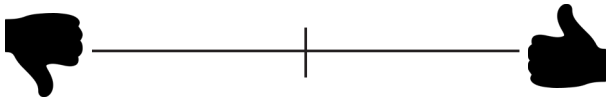
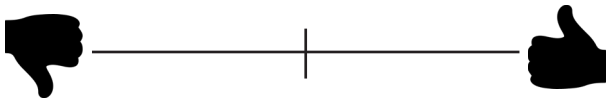
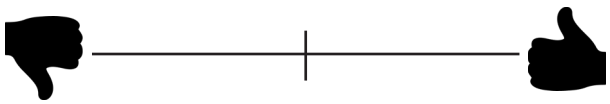
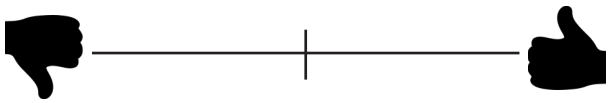
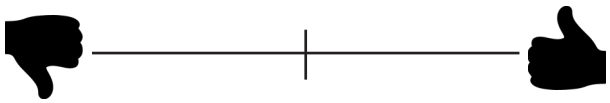
Wyoming is ranked 15th in the country for the number of wind turbines it has installed. [13]	
Generating wind power creates no emissions and uses virtually no water. [14]	
Wind is a renewable energy source that can be used to make electricity. [3]	
One wind turbine doesn't make much electricity. Most wind farms have many wind turbines and can take up a lot of land. [3]	
The land that wind farms are on can still be used to farm or graze animals. [3]	
Wind power is accessible for homeowners and businesses to set up their own power grids and even sell electricity to the power company. [6]	
Wind provides intermittent power because the amount of electricity produced varies due to factors that cannot be controlled. [18]	
The wind turbines don't run all the time. Sometimes the wind doesn't blow at all, and sometimes the wind blows too hard. Most wind turbines run between 65-90% of the time. [3]	
Wind electricity makes up about 5.6% of the nation's electricity. [10]	
Some types of wind turbines and wind projects cause bird and bat deaths. [6]	
Electricity from wind energy must be stored (i.e. in batteries). [6]	

Overall view of this energy resource:

Negative ——————|—————— Positive

Energy Pro & Con

HYDROPOWER

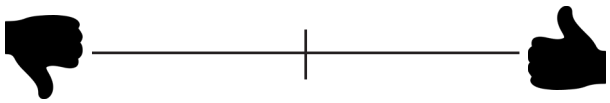
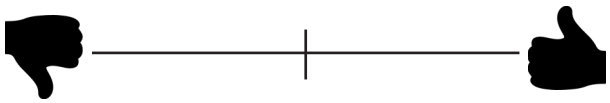
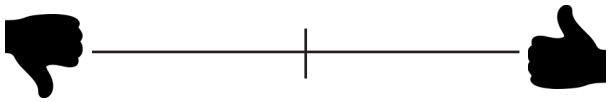
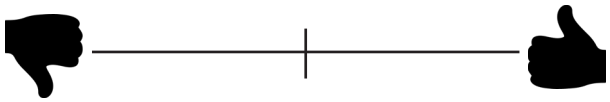
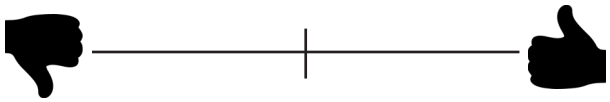
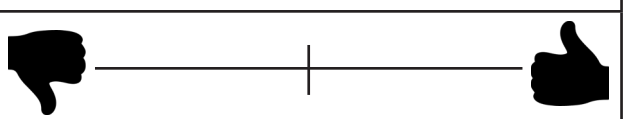
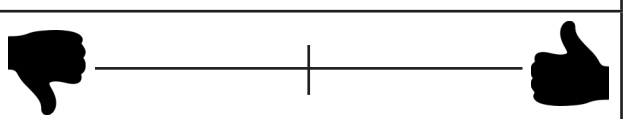
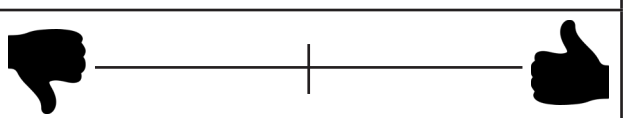
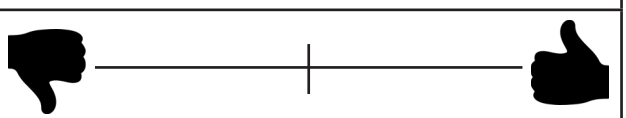
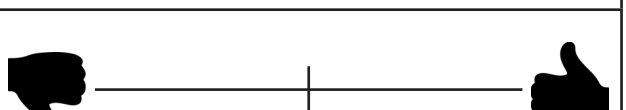
Hydropower is a clean source of energy. [3]	
When dams are built, they flood a lot of land. [3]	
Sometimes, when the flow of rivers change, fish can't swim upriver to lay their eggs, so dams have fish ladders and other devices to help fish move up the river. [3]	
Yellowstone National Park generates $^1/_3$ of its electricity from a hydroelectric plant. [9]	
Hydropower is the world's largest contributor of all renewable resources, making up 6.7% of electricity production worldwide. [7]	
Damming a river to produce hydropower can disrupt the local ecosystem causing flooding, changing fish passages, and impacting wildlife habitats. [7]	
Hydropower is a renewable source of energy.	
Hydropower relies on the water cycle. [3]	
Reservoirs can be used for irrigation, swimming, fishing, boating, and other sports. [3]	

Overall view of this energy resource:

Negative ——————|—————— Positive

Energy Pro & Con

URANIUM

Wyoming has the largest uranium reserves in the country. [1]	
Nuclear energy is the cleanest energy. [1]	
Disasters in nuclear energy plants rarely occur, but when they do, they are devastating. [5]	
Nuclear fission can release one million times more energy than fossil fuels. [7]	
Nuclear fission generations radioactive waste that can remain hazardous to both human health and the environment for thousands of years. [7]	
Uranium is a nonrenewable energy source.	
After uranium is used, it is still radioactive. [3]	
Radiation is dangerous and has to be dealt with carefully. [3]	
About one pound of uranium can produce the same amount of power as 20,000 pounds of coal. [4]	
Presently, the uranium produced in Wyoming is mined in-situ (meaning “in place”), an environmentally friendly process involving minimal surface disturbance.	

Overall view of this energy resource:

Negative  Positive

Energy Resource Labels

Coal

Energy Resource Labels

Oil

Natural Gas

Nuclear

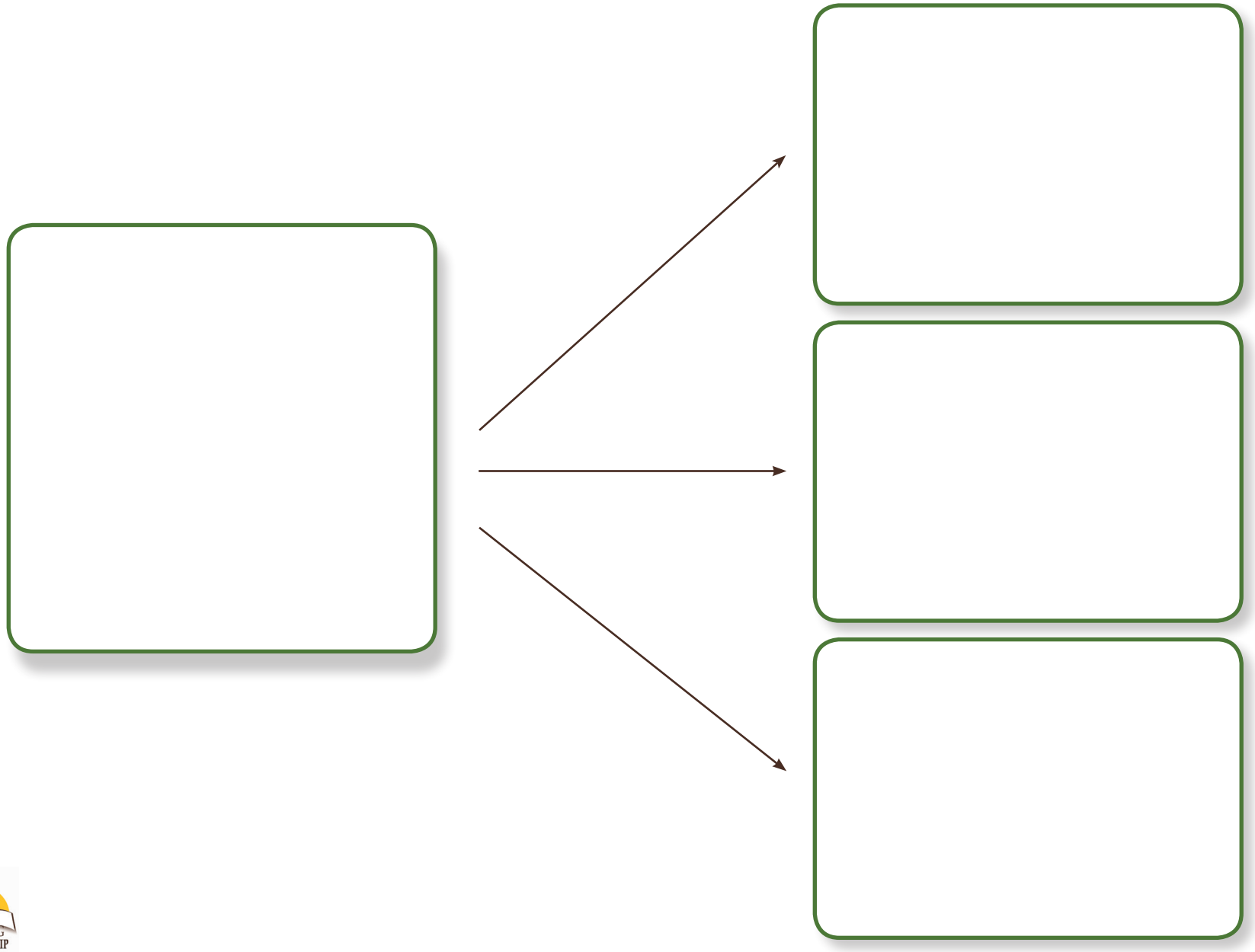
Energy Resource Labels

Wind

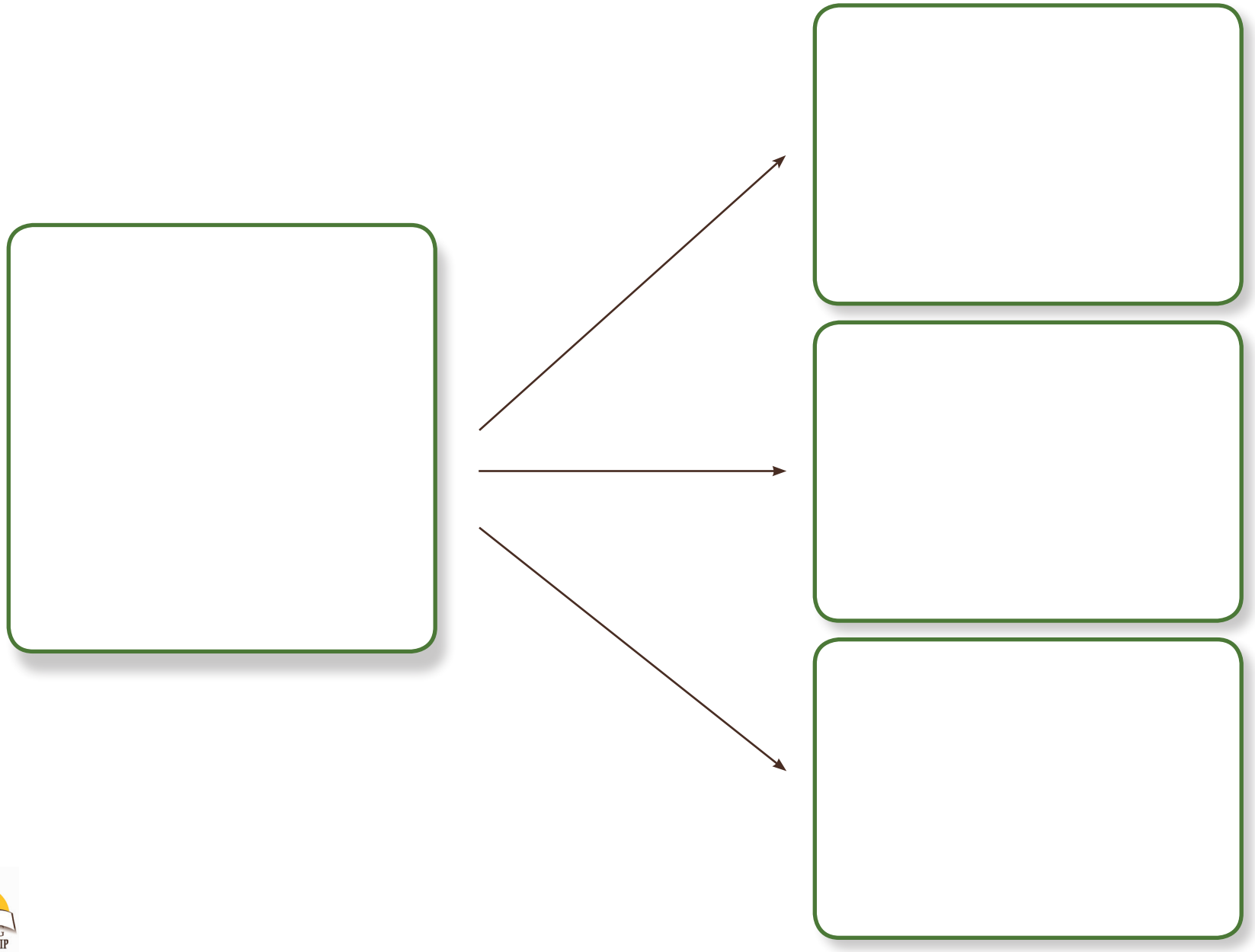
Energy Resource Labels

Hydro

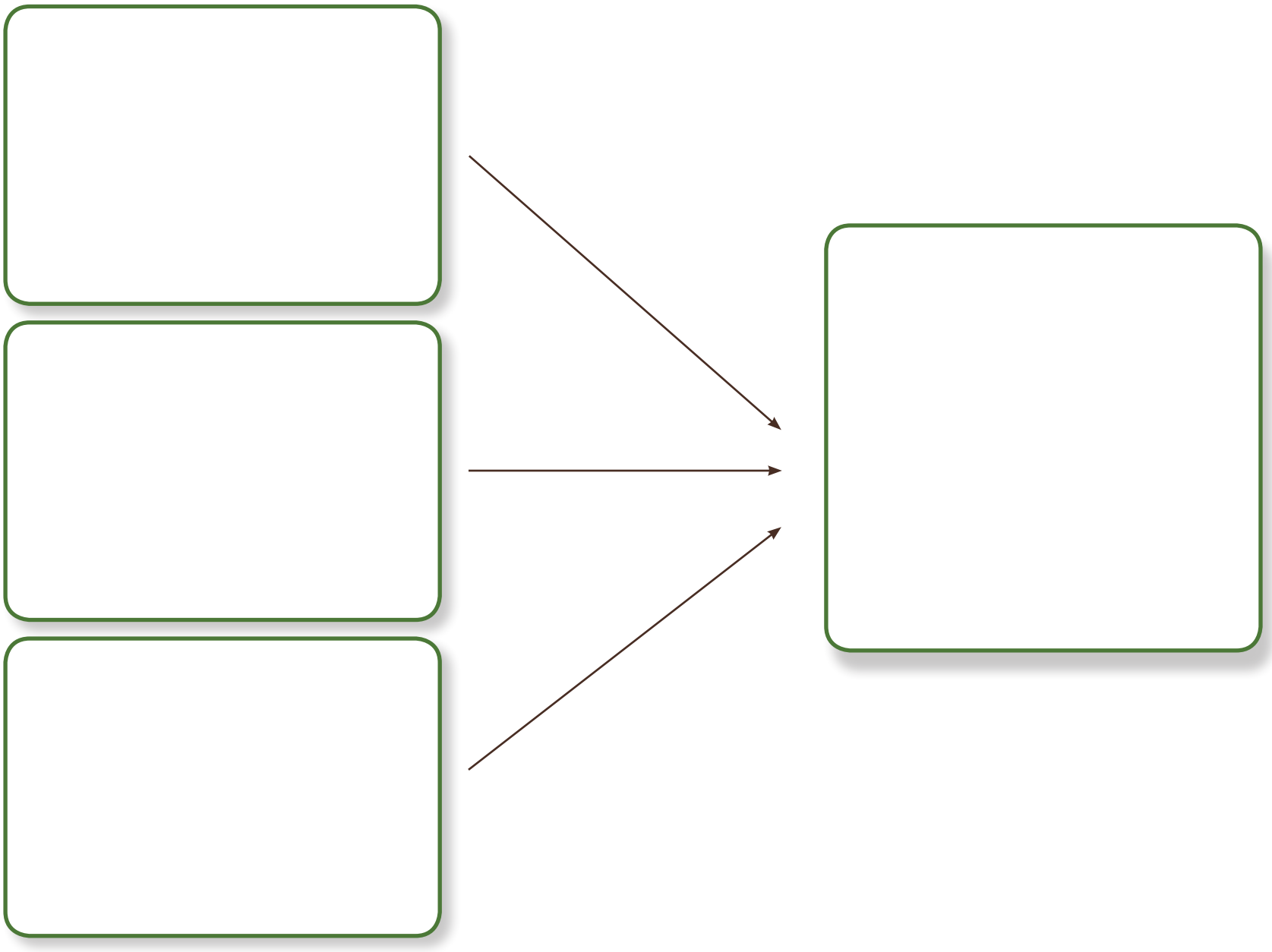
Cause and Effect Relationships



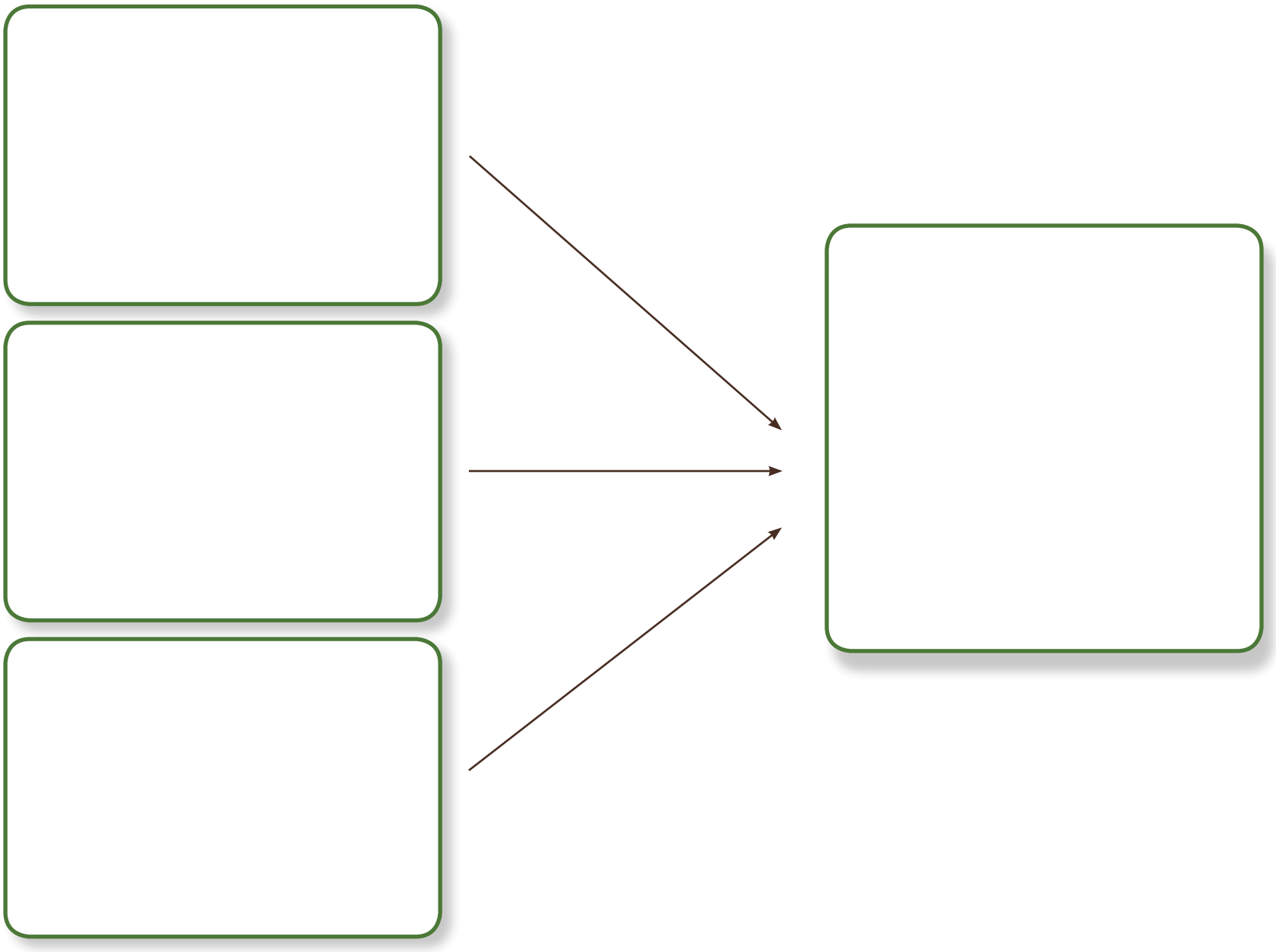
Cause and Effect Relationships



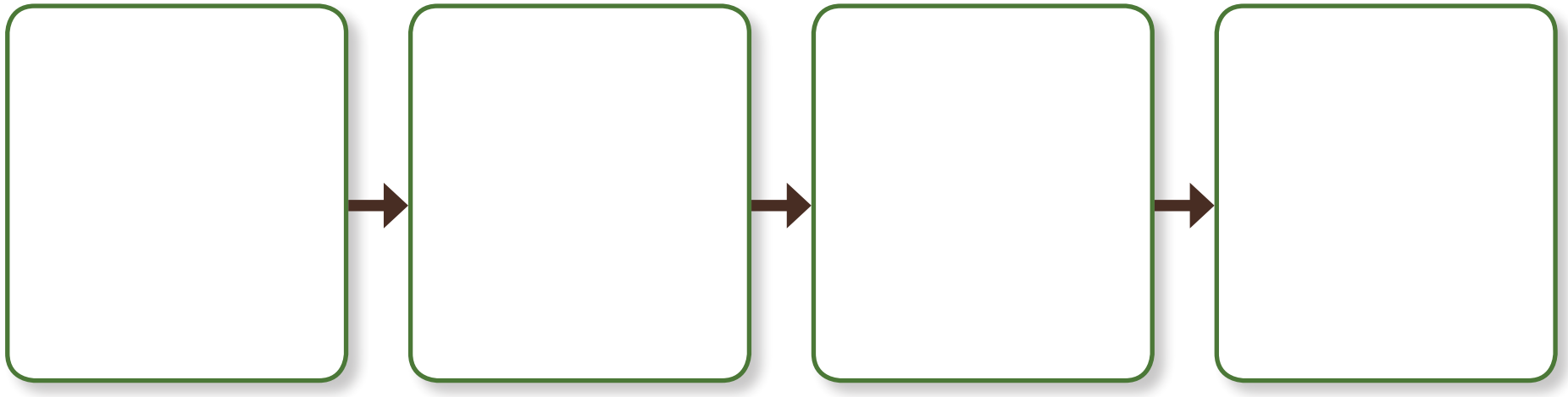
Cause and Effect Relationships



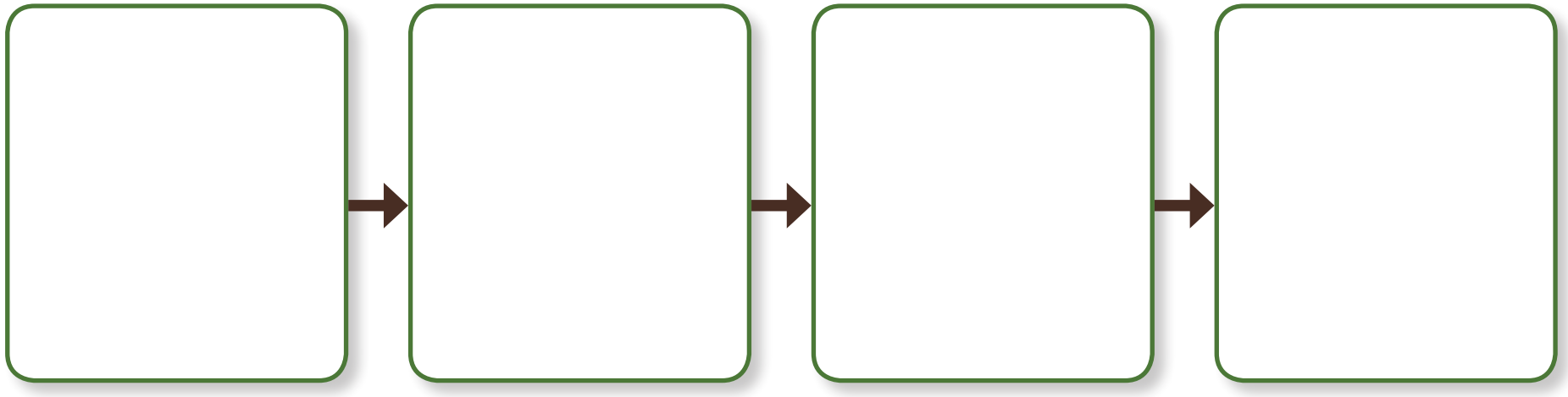
Cause and Effect Relationships



Cause and Effect Relationships



Cause and Effect Relationships



Energy Cause & Effect Relationships

Predicting Effects

Name: _____

Choose one of the graphic organizers that you completed showing cause and effect relationships. Imagine that one of the parts of the system changed. Write about your predictions for how that would change other aspects of the system.

What change I am considering: _____

_____

_____

My predictions for how that would affect the other parts of the system: _____

_____

_____

_____

_____

_____

_____

_____

Please staple your graphic organizer to this page.

Oil Production

Oil is used for:

If you have ridden in a car today, you have used several oil based products. Gasoline, the fuel for most of our cars and trucks, is made from oil, and so are the tires. In addition to gasoline, oil and other hydrocarbons are used to make about 75% of the products we use each day. Just a few of these products include: heating oil, diesel fuel, jet fuel, propane, synthetic rubber, and plastics. It is also used to make many common household products, including crayons, dish washing liquids, deodorant, and eyeglasses.

What is an oil reservoir?:

If you could look down an oil well you wouldn't see a big underground lake. Oil doesn't exist in deep, black pools. In fact, an underground oil formation - an "oil reservoir" - looks very much like any other rock formation. Oil exists in this underground formation as tiny droplets trapped inside the open spaces inside rocks. The droplets cling to the rock, like drops of water cling to a window pane.

The first step to drilling for oil is knowing where to drill. Because it is expensive to drill an oil well, oil producers need to know a lot about an oil reservoir before they start drilling. Scientists learn as much as they can about an oil reservoir before they every drill a well.

Oil recovery can be done in multiple steps:

Crude oil development and production in U.S. oil reservoirs can include up to three distinct phases: primary, secondary, and enhanced recovery.

Primary recovery:

The natural pressure created by the rock layers over an oil reservoir drives oil into the well. Inside the well, pumps bring the oil to the surface where it can be collected and used. Only about 10 percent of a reservoir's original oil is typically produced during primary recovery.

Secondary recovery:

Secondary recovery techniques extend a field's productive life. Secondary recovery is typically done by injecting water or gas to push oil away from the rock holding it and driving it to an oil well. This results in the recovery of 20 to 40 percent of the original oil.

Enhanced Recovery:

Three major categories of enhanced recovery have been found to be commercially successful depending on characteristics of an oil reservoir:

Thermal recovery adds heat in the form of steam to an oil well. This helps the oil flow through the rock formation more easily.
Gas injection uses gases such as natural gas, nitrogen, or carbon dioxide (CO_2) to push additional oil to an oil well.
Chemical injection is used the least often, and uses special chemicals to help oil move more easily to an oil well.

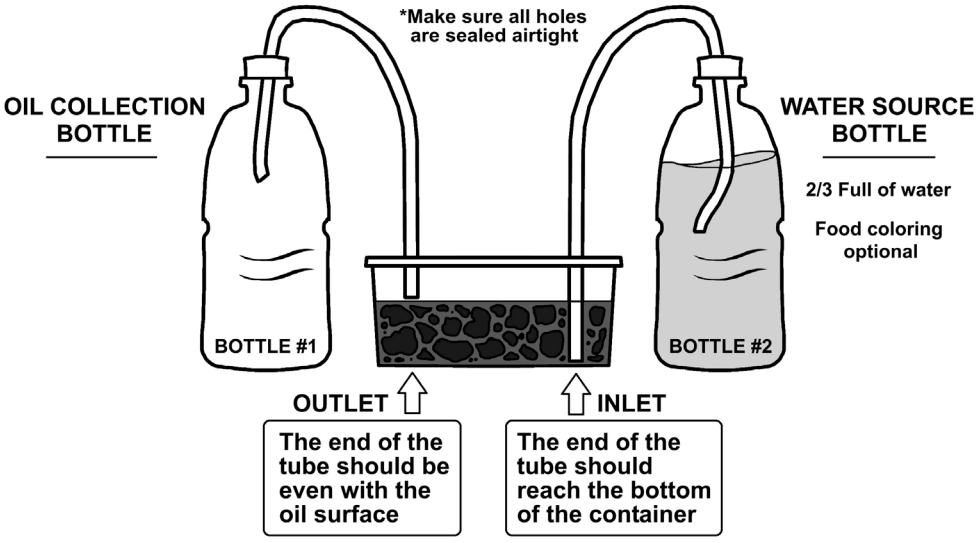
Oil Recovery Instruction Sheet

Required materials:

1. (1) Small disposable plastic container (1-2 cup) with tight-fitting lid
2. (2) Plastic water bottles for injection reservoir and oil collection (one for the "extracted" oil, and one for water. Additional bottles may be needed for alternate design methods.)
3. Rocks or gravel
4. Vegetable Oil
5. ¼ inch plastic tubing (two 30 cm pieces)
6. Material to make a watertight seal (ex: Goop, silicone caulk, hot glue)
7. Food coloring for the inlet water *optional
8. Bucket or container for disposal of liquids
9. Seal-able container for disposal of oil
10. Metric measuring cup or graduated cylinder for liquids
11. Water
12. Additional materials and liquids of your choice use for design challenge

Building the Model:

1. Make two holes in the plastic container lid, spacing them equally apart. They should be the same size as your tubing.

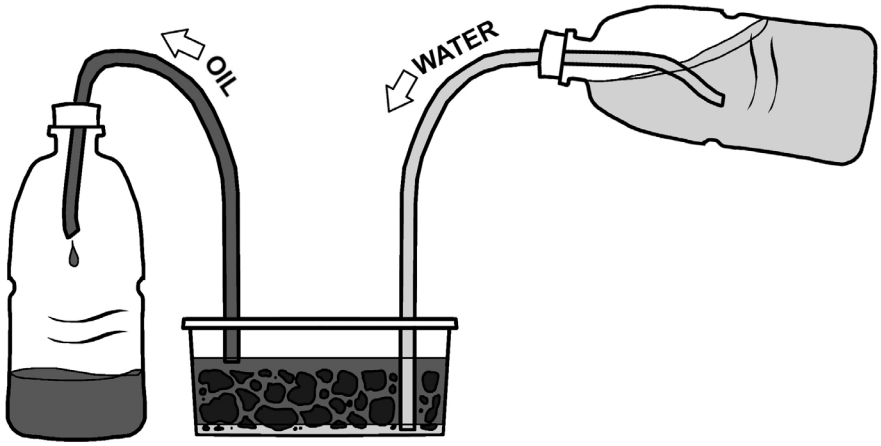


2. Slide one piece of tubing into each hole. Make sure that the first tube (outlet)protrudes at least 1-2 cm from the bottom of the lid. The second tube (inlet) should protrude about 4-5 cm in order to reach the bottom of the oil reservoir.
3. Seal the tubing hole with a type of watertight sealant.
4. Make a hole in the cap of each plastic water bottle. Slide the tubing so 5 cm extends below the lid. Make a watertight seal between the tubing and the lid. Repeat with the second lid.

Oil Recovery Instruction Sheet

5. Fill the plastic container $^{2}/_{3}$ full of rock or gravel to represent bedrock. Place the inlet tubing so it reaches the bottom of the container (manipulate the rocks and tubing accordingly).
6. Pour vegetable oil into the reservoir, enough to cover the rocks in the container.
7. When placing the sealed lid onto the container, the outlet (1-2 cm) tubing should rest at the surface of the oil. (trim it accordingly). Fit the lid onto the first water bottle to serve as the oil collection vessel. This will hold the oil as it is removed from the rocks in the oil reservoir.

Demonstrating Water Flooding



1. Fill the second bottle $^{2}/_{3}$ full of water. You might want to add food coloring to help observe water as it moves through the process to differentiate the water and oil.
2. Place the cap on the water bottle (inlet) tightening the lid.
3. Manipulate the water bottle so the water flows into the oil reservoir. This should cause the oil to flow out of the reservoir into the oil collection bottle.

Oil Recovery Design Challenge

Name:_____

Initial method: Water flooding

Procedure:

Results: _____ mL of oil were extracted.
Other Observations:

Success Criteria:
- We are able to extract more oil

Constraints:
- We can't build a whole new system (the well is already established).
- We can only use materials that we have access to.

Brainstorm modifications that we might make to the oil extraction process in order to increase the amount of oil that we can extract.

Oil Recovery Design Challenge

Method #2:

Procedure:

Results: _____ mL of oil were extracted.
Other Observations:

Method #3:

Procedure:

Results: _____ mL of oil were extracted.
Other Observations:

Speed Gallery Walk Take Aways

Type of Stewardship	Something I Could Do	Something the Community Could Do
Conservation		
Advocacy		
Education		
Innovation		

Graphic Organizer for Writing

TITLE: _____

Topic

We can be stewards of Wyoming's mineral and energy resources.

Supporting Reason 1

Proof-Evidence (facts/examples)

Supporting Reason 2

Proof-Evidence (facts/examples)

Supporting Reason 3

Proof-Evidence (facts/examples)

Conclusion

Stewardship Scroll

I pledge to be a steward of Wyoming's mineral and energy resources by...

Signed by:_____

Date:_____

Wyoming Mineral & Energy Fair
Success Criteria

Group Topic: _____

Group Members' Names: _____

	Specific comments that offer ways to improve project in each area	Success Criteria	Specific comments on how the project exceeds expectations	Final Scoring of Success Criteria. (Circle choice that applies.)
Stewardship		Students include a call to action. They provide specific examples of what people can do to help be stewards of this resource.		Project met this criteria: Yes No Partially
Knowledge of the Resource		Students provide information telling about what the resource is; whether it is renewable or nonrenewable; and how it is developed, used, and cared for.		Project met this criteria: Yes No Partially
Pros and Cons		Students describe pros and cons associated with the resource.		Project met this criteria: Yes No Partially

Wyoming Mineral & Energy Fair

Success Criteria

Role in Wyoming's Culture & Economy		Students describe how the resource affects Wyoming's culture and economy, and why it is important to our state.		Project met this criteria: Yes No Partially
Speaking and Listening		Students use appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly and at an understandable pace.		Project met this criteria: Yes No Partially
				Project met this criteria: Yes No Partially

Wyoming Mineral & Energy Fair

Project Checklist

As you are working on your project, make sure it answers the following questions:

- ☐ Is the resource renewable or nonrenewable?
- ☐ How is the resource developed, used, and cared for?
- ☐ Who is involved with the development, use, and care of this resource?
- ☐ How is the resource used?
- ☐ What are pros and cons of this resource?
- ☐ How does the resource relate to Wyoming's culture and economy?
- ☐ What are ways we can be stewards of this resource to benefit current and future generations?

Wyoming Mineral & Energy Fair
Peer/Self Evaluation

My Name: _____

My Group Members' Names: _____

Self Evaluation	Peer Evaluation
I would rank my effort on this project 1 2 3 4 No effort Exceeds	I would rank my group members' effort on this project 1 2 3 4 No effort Exceeds
The parts of this project that I was responsible for were:	The parts of this project that other group members were responsible for were:
If I could change anything about my project, I would...	Other Notes: