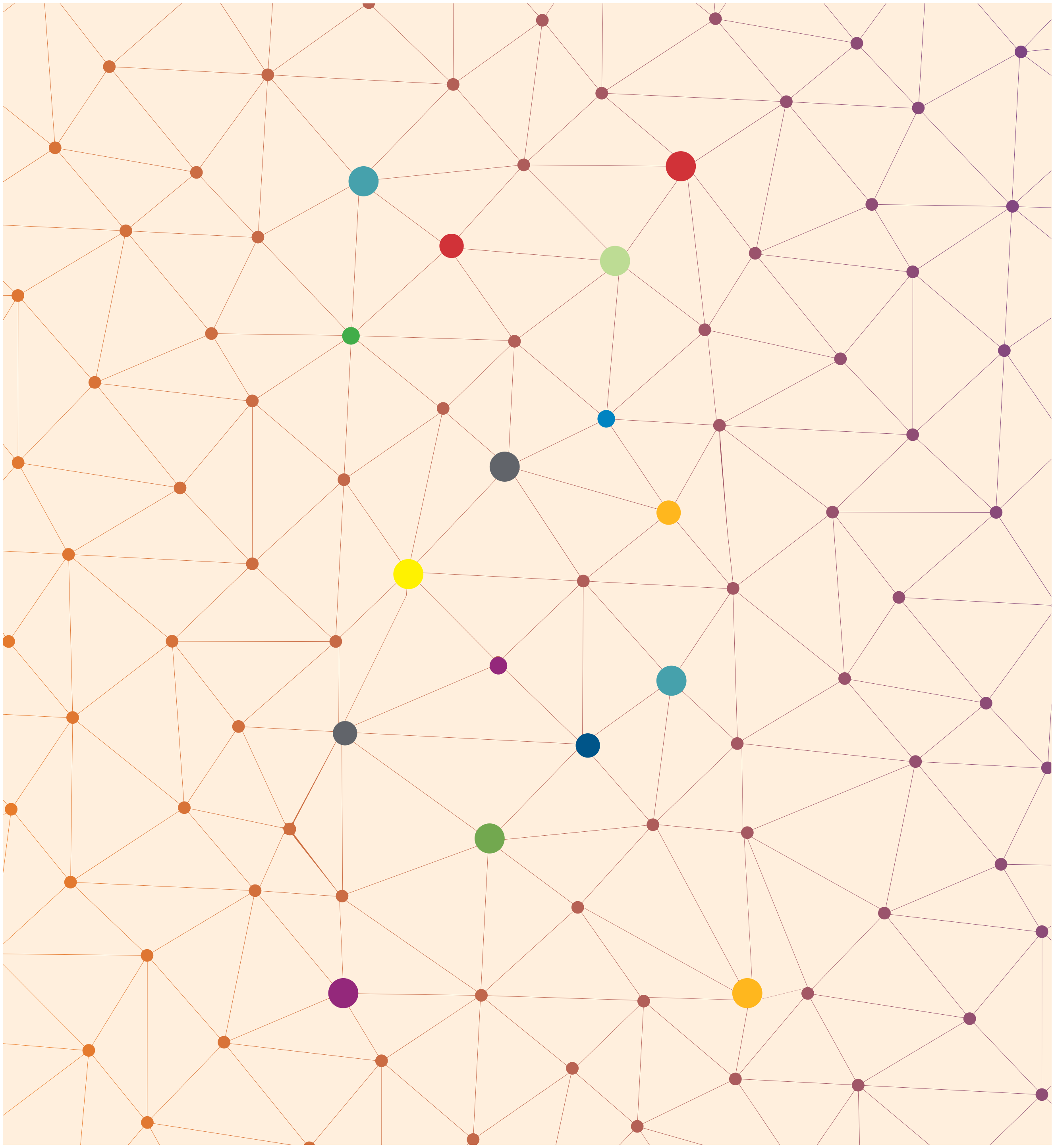


Electricity In Saskatchewan

An Educational Resource
for Grade 6 Science

Saskatchewan is growing and so is our need for power. With a population of 1,142,570 as of January 1, 2016, and industry and businesses popping up all the time, keeping up with the electrical demand is both challenging and providing some unique opportunities.

This resource provides ways for students to inquire and explore a variety of topics when it comes to producing power, delivering it, conserving it and the ethical, social and environmental considerations that go along with it. As students learn what goes into powering a province, it is hoped that they will also begin a journey of discovering the value of electricity in their lives and the role they can play to use less of it.

This resource was developed to provide teachers with the most up-to-date information on electricity in Saskatchewan. As the electrical industry is constantly evolving and regulations and innovations influence new directions, it's important that teachers have current information to share with students.

As much as possible, teachers are forwarded to the SaskPower website as that will have the most current content. Student handouts will be updated annually, but if there is a discrepancy between the printed copy and the website, please defer to the content on saskpower.com.

This resource was developed by SaskPower with input from the following educators who provided valuable ideas, feedback and expertise.

Thank you to:

Melissa Sullivan, Lesson Plan Developer

Sarah Anderson, Lesson Plan Developer

Maxine Koskie

Lisa Horsman

Tina Exner

Elizabeth Stephenson

Robert Brossart

Ryan Lee Carriere

Marguerite Allard

SaskPower
Powering the future®

To access the most up-to-date resource and additional resources visit saskpower.com/teacher

Section 1: Electricity comes to Saskatchewan

Section 1.0

Long after investigators in Ancient Greece discovered static electricity in 600 BC by rubbing amber against a fur cloth and seeing the amber attract feathers or pieces of straw, and a little bit after Benjamin Franklin's discovery of electricity in 1752 when he used a key attached to a kite to attract lightning, and shortly after Thomas Edison's public demonstration of his incandescent light bulb in 1879 did electricity find its way to Saskatchewan in the early 1900's.

In this section, students will discover how electricity made its way into our homes and neighborhoods and how this advancement was hampered or enhanced by world events.

OUTCOME:

EL6.1
Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

INDICATOR:

a) Provide examples of the types of energy sources used to provide heat and light to homes in the past and describe ways in which electricity-based technologies have changed the way people work, live, and interact with the environment in Saskatchewan.

TEACHER BACKGROUND

You will need to understand Instagram. It isn't necessary to have an account. However, if you as the teacher have an account you will receive updates as they become available.

1.1 Electricity comes to Saskatchewan

ACTIVITY

Students will complete an Instagram search (or this same search can be done via saskpower.com) to complete their activity. Working in groups, students will have a chance to research, write and present findings in front of the class, all while learning how electricity came to Saskatchewan.

SUGGESTED TIME

30 minutes to an hour.

APPROACH:

1. Log into Instagram (@the_saskpower_story), or saskpower.com

2. Briefly familiarize the students with the layout of the SaskPower timeline pointing out where new decades begin.

3. Break students into groups and assign them each a decade. (There's 10 full decades represented).

4. Instruct the students to work together to answer the questions on the worksheet based on what they discover from their decade.

5. Have groups present their decade summary to the class.

ASSESSMENT:

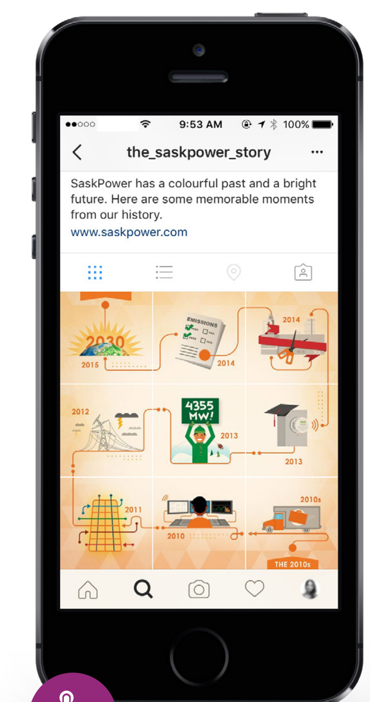
Expectations Checklist (pg. 54).

RESOURCES:

@the_saskpower_story (Instagram) or http://www.saskpower.com/about-us/our-company/our-history

Search saskpower.com for:

- Our History
- Grade 6



Instagram: @the_saskpower_story

IT'S 1929 AND THE SASKATCHEWAN POWER COMMISSION HAS JUST BEEN FORMED. THEIR GOAL? PROVIDE ELECTRICITY TO EVERYONE IN SASKATCHEWAN.

Lesson 1.1 The History of Electricity Teacher Answer Key

TEACHER ANSWER KEY

(Note, this key identifies the main points to look for. Some students may say other points that could also be true, so teachers may need to go back into the timeline to verify).

2) **Identify one world or local event or milestone in your decade.**

30's - Depression

40's - World War II

50's - Colour TV, rock and roll

60's - Beatles, Vietnam War, first person to step on the moon, President Kennedy's assassination

70's - The first Earth Day observed, energy crisis

80's - First space shuttle launch, computer use is growing

90's - Hubble space telescope, recession, Gulf War, end of Cold War

00's - Y2K happens uneventfully

10's - Saskatchewan population reaches all time high, Roughriders win the Grey Cup

3) **Name one SaskPower generating facility, or building, from your decade.**

30's - Humboldt Generating Station is opened, Island Falls Station is built

40's - The Commission purchases power plants from Canadian Utilities Limited

50's - Boundary Dam and Queen Elizabeth Power Stations

60's - Three Northern Plants are built, SaskPower Head Office opens in Regina, Coteau Creek Station

70's - Research and Development Centre is formed

80's - Poplar River Power Station is opened, SaskPower purchases Island Falls Power Station, SaskPower purchases three Northern Plants, Nipawin Hydro Station opens

90's - Shand Power Station is opened, SaskPower Shand Greenhouse is opened, Meridian cogeneration Power Station

00's - Cypress Wind Facility, Cory Cogeneration Station is opened, Centennial Wind Facility, Ermine

10's - Carbon Capture and Storage Facility

4) **Identify one transmission or power line fact from your decade.**

30's - 1939: 2,309 km of transmission lines

40's - 1946: 266 km of transmission lines
1949: 7,390 km of transmission lines

50's - 1958: 500 km of high voltage line between Saskatoon and Estevan linking north to south

60's - 90,000 km single line wire. More than enough to wrap all the way around the earth twice

70's - 1974: 145 km transmission line between Coteau Creek and Swift Current (also acceptable is Corporate acquires the uranium city electrical distribution system)

80's - SaskPower begins to run electric cables underground

90's - 1997: Condie to Queen Elizabeth power line delivering more electricity to Saskatoon and points north

00's - 2006: 76 km transmission line between Island Falls and Pelican narrows in northern Saskatchewan

10's - Major storms cause damage to 11 transmission lines in Saskatchewan

5) **What was the name of the power company in your decade?**

30's - Saskatchewan Power Commission

40's - Saskatchewan Power Commission / Saskatchewan Power Corporation (1949)

50's - Saskatchewan Power Corporation or SPC

60's - Saskatchewan Power Corporation or SPC

70's - Saskatchewan Power Corporation or SPC

80's - SaskPower

90's - SaskPower

00's - SaskPower

10's - SaskPower

6) **Look for accuracy, spelling, grammar, and punctuation.**

Lesson 1.1 The History of Electricity Student Worksheet

Answer the following questions using the Instagram account the_saskpower_story.

1) Indicate your decade. ______________________________

2) Identify one world or local event or milestone in your decade and what impact it might have had on the power industry.

____

____

3) Name one SaskPower generating facility, or building fact, from your decade.

____

____

4) Identify one transmission or power line fact from your decade.

____

____

5) What was the name of the power company in Saskatchewan in your decade?

____

6) Write a paragraph to summarize your decade including info you collected in 1-4 plus one other interesting fact you uncovered about electricity in your decade. Watch for grammar and spelling.

____

____

____

____

____

____

____

Section 2: Renewable and Non-renewable Resources

Section
2.0

All life on earth is sustained by energy from the sun. Plants and animals can store energy and some of this energy remains with them when they die. It is the remains of these ancient animals and plants that make up fossil fuels. Fossil fuels are non-renewable because they will run out one day. Burning fossil fuels generates greenhouse gases and relying on them for energy generation is unsustainable so the need to find more renewable, sustainable ways of generating energy is important. Renewable or infinite resources are sources of power that quickly replenish themselves and can be used again and again.

In this section, students will discover the differences between renewable and non-renewable resources to generate electricity and specifically how electricity is generated in Saskatchewan.

OUTCOME:

EL6.1 Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to redue those impacts. [CP, DM]

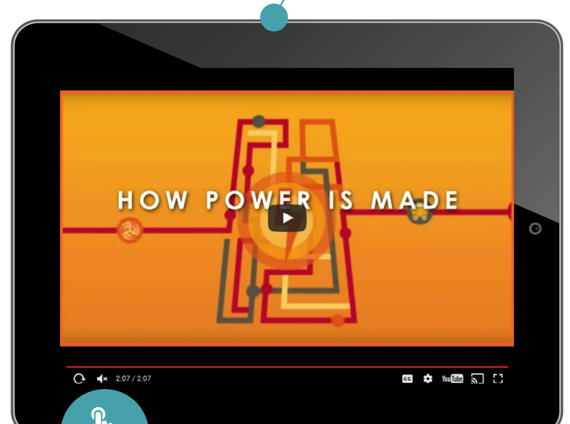
INDICATOR:

b) Describe how electrical energy is generated from hydroelectric, coal, natural gas, nuclear, geothermal, biomass, solar, and wind sources and categorize these resources as renewable or non-renewable.

SASKPOWER'S GOAL IS TO REDUCE EMISSIONS BY 40% BY 2030.

TEACHER BACKGROUND

Each power source includes an information sheet, activity, terms for a glossary and teacher answer key. After completing each source, students can keep track by filling in the All Sources chart on pg. 32.



Search saskpower.com for:
- How Our Power Stations Work

Lesson 2.1 Coal Information Sheet

WHAT IS COAL?

Coal is a black, rough rock that is dug out of the ground. It is a widely used resource --almost half of the world's energy comes from burning coal. Like all fossil fuels, coal is a non-renewable resource but our reserves in Saskatchewan should last at least the next hundred years.

HOW DOES IT PRODUCE ENERGY?

Coal is burned in large power plants to heat water and turn it into steam which then spins generators to create electricity. In Saskatchewan we have three coal power generation facilities: the Poplar River Power Station near Coronach, and Shand Power Station, and Boundary Dam Power Station in Estevan.

WHAT ARE THE BENEFITS OF USING COAL?

There are many benefits of using coal for the generation of power. First, there is an abundance of coal in the world, particularly in Saskatchewan. Coal is also relatively cheap to mine and use in the production of electricity. Although coal is underground and difficult to haul or move around, the fact that we have so much in Saskatchewan means the coal doesn't have to travel far.

WHAT ARE THE DISADVANTAGES OF USING COAL?

Coal is not a renewable resource, which means that someday it will run out and we will not be able to use it as a source of electrical energy. Coal also produces emissions that are harmful to the environment unless ways to lesson those emissions are put into play.

WHAT IS THE FUTURE OF COAL?

Saskatchewan is a world leader in creating and using new carbon capture and storage (CCS) technology. This means that carbon dioxide emissions from coal generation stations is captured and stored underground keeping it out of the atmosphere.

Visit saskpower.com/supplyoptions to learn more about coal

ALL COAL-FIRED POWER STATIONS IN SASKATCHEWAN THAT HAVE REACHED THE END OF THEIR LIFE (*ABOUT 50 YEARS OLD*) MUST CLOSE OR BE RETROFITTED TO CARBON CAPTURE AND STORAGE TECHNOLOGY.

Take a virtual tour of Boundary Dam Power Station and the Carbon Capture Test Facility

Search saskpower.com for:
- CCS Tour

Lesson 2.1 Coal Activity

2.1 Coal

ACTIVITY:

In addition to what is learned in the information sheet (pg. 9), students will watch a video to complete their worksheet on coal.

Make sure students watch for definitions of terms to add to their glossary and encourage them to keep track of this non-renewable source in the All Fuel Sources Chart (pg. 32).

SUGGESTED TIME:

30 minutes or one class period or work as a jigsaw activity with lessons 2.2-2.5.

APPROACH:

1) Make copies and distribute the information sheet to each student. Review the content to suit your classroom.

2) Watch the video on how coal fired power stations work and have students take notes on what they learn.

3) Allow students time to web search saskpower.com and other sources to complete their glossary, All Fuel Sources Chart (pg. 32), and their worksheet.

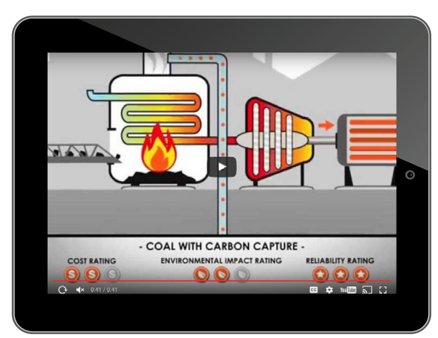
ASSESSMENT:

Expectations Checklist (pg. 54).

RESOURCES:

How power is made video:
https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/How-Our-Power-Stations-Work

source: http://www.coal.ca/coal-basics/



Search saskpower.com for:

- How Our Power Stations Work » Coal

Lesson 2.1 Coal Teacher Answer Key

(For worksheet on pg. 12)

WEB SEARCH QUESTIONS

1) Name two advantages of using coal to produce electricity in Saskatchewan.

1) Reliable *2) Relatively low cost* *3) Abundant in Saskatchewan*

2) Why would some people think using coal would be a bad idea?

Burning coal has a high environmental impact

3) What is Saskatchewan doing to help reduce the negative impacts of using coal for electricity?

Converting coal power stations to carbon capture and storage (CCS) technology to collect greenhouse gases from going into the atmosphere

4) Where are coal plants located?

Southern Saskatchewan - Coronach and Estevan

5) What is the future of all coal-fired power stations in Canada?

Unless they have CCS technology:

- *Units built before 1975 must close by 2020*
- *Units built between 1975-1985 must close by 2030*
- *Units built after 1985 must close after 50 years*

DEFINITIONS

See Glossary (pg.56)

Lesson 2.1 Coal Student Worksheet

Search for the answers to the following questions at saskpower.com

1) Name two advantages of using coal to produce electricity in Saskatchewan.

2) Why would some people think using coal would be a bad idea?

3) What is Saskatchewan doing to help reduce the negative impacts of using coal for electricity?

4) Where are coal plants located?

5) What is the future of all coal-fired power stations in Canada?

Add the following terms and their definitions to your personal glossary:

- Coal
- Turbine
- Carbon Capture and Storage
- Reclamation
- Emissions
- Baseload

Carbon Capture and Storage Facility
Estevan, SK

Lesson 2.2 Natural Gas Information Sheet

WHAT IS NATURAL GAS?

Natural gas is a non-renewable resource. It is a flammable gas made up of methane and is clear and odourless. Found underground, natural gas is carefully released from the ground by using drills to extract the gas and have it come up through pipes.

HOW DOES IT PRODUCE ELECTRICITY?

There are two ways:

1. Simple cycle gas turbines use heat from when the gas is burned to turn a turbine and generate electricity. This method is best when power use is at its peak, like hot summer days, or in the middle of winter.

2. Combined cycle gas turbines add another step and use hot air from the burning gas to create steam. The steam powers a turbine, which generates electricity and can be up to 15% more efficient than using simple cycle alone.

WHAT ARE THE BENEFITS

Compared to coal, natural gas produces 50% less greenhouse gases but it will have even stricter regulations in the near future. Canada has enough natural gas reserves to meet national energy demand for 300 years.

WHAT ARE THE DISADVANTAGES OF NATURAL GAS?

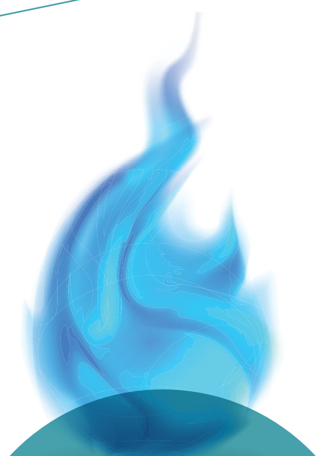
Natural gas is a non-renewable resource and will eventually run out. Natural gas can also be hard to find and the price can vary quite a bit. The exploring and drilling of land in order to find natural gas can upset the environment and the methane makes the gas very flammable which increases the chance of explosions and fire.

Visit saskpower.com/supplyoptions to learn more about natural gas

ELECTRICITY PRODUCED FROM NATURAL GAS (*EXCLUDING COGENERATION*) MAKES UP ABOUT 30% OF SASKPOWER'S TOTAL GENERATING CAPACITY.

2.2

Lesson 2.2 Natural Gas Activity



CANADA IS THE WORLD'S FIFTH–LARGEST NATURAL GAS PRODUCER AND HAS ENOUGH NATURAL GAS RESERVES TO MEET CURRENT NATIONAL ENERGY DEMAND FOR 300 YEARS.[1]

[1] Source: https://www.capp.ca/energy/canadas-energy-mix/

ACTIVITY

In addition to what is learned in the information sheet (pg. 13), students will watch a video to complete their worksheet on natural gas.

Make sure students watch for definitions of terms to add to their glossary and encourage them to keep track of this non-renewable source in the All Fuel Sources Chart (pg. 32).

SUGGESTED TIME:

30 minutes or one class period or work as a jigsaw activity with lessons 2.1-2.5.

APPROACH:

1) Make copies and distribute the information sheet to each student. Review the content to suit your classroom.

2) Watch the natural gas video and have students take notes on what they learn.

3) Allow students time to web search saskpower.com and other sources to complete their interactive timeline, glossary, All Fuel Sources Chart (pg. 32) and worksheet.

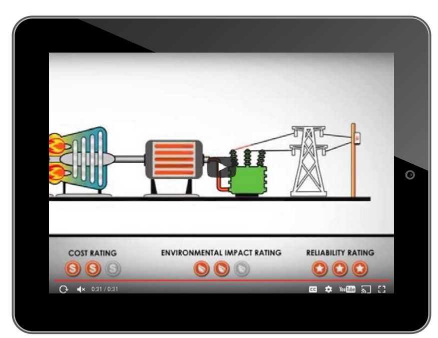
ASSESSMENT:

Expectations Checklist (pg. 54).

RESOURCES:

Search saskpower.com for:

- How Our Power Stations Work » Natural Gas



"Using Natural Gas to Generate Electricity"

https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/How-Our-Power-Stations-Work

[SELECT NATURAL GAS]

Lesson 2.2 Natural Gas Teacher Answer Key

(For worksheet on pg. 16)

1. Natural gas is
- a. A renewable energy source
- ***b. A non-renewable energy source***
- c. Is not an energy source

2. Where are natural gas plants located in Saskatchewan?
- a. In the far north
- b. On every street corner
- ***c. Western part of the province***
- d. There aren't any natural as plants in Saskatchewan

3. A benefit from using natural gas is
- a. A lot of air pollution is created
- ***b. Produces less than half of the emissions of a coal plant***
- c. No air pollution is created
- d. There are many rainbows created

4. A concern about natural gas is
- a. Not reliable
- b. It is very flammable and can explode
- c. Once it's burned it's gone for good
- ***d. Both b and c***

5. What are simple cycle gas turbines?
- ***a. Uses heat from when the gas is burned to turn a turbine and produce electricity***
- b. Found in coal plants
- c. Runs your car
- d. None of the above

6. What are combined cycle gas turbines?
- ***a. Uses hot air from the burning gas to create steam which powers a turbine to generate electricity***
- b. Powers wind turbines
- c. Not efficient
- d. None of the above

DEFINITIONS

See Glossary (pg.56)

Lesson 2.2 Natural Gas Student Worksheet

Visit saskpower.com to find the answer and circle the correct one.

1. **Natural gas is**
   a. A renewable energy source
   b. A non-renewable energy source
   c. Is not an energy source

2. **Where are natural gas plants located in Saskatchewan?**
   a. In the far north
   b. On every street corner
   c. Western part of the province
   d. There aren't any natural as plants in Saskatchewan

3. **A benefit from using natural gas is**
   a. A lot of air pollution is created
   b. Produces less than half of the emissions of a coal plant
   c. No air pollution is created
   d. There are many rainbows created

4. **A concern about natural gas is**
   a. Not reliable
   b. It is very flammable and can explode
   c. Once it's burned it's gone for good
   d. Both b and c

5. **What are simple cycle gas turbines?**
   a. Uses heat from when the gas is burned to turn a turbine and produce electricity
   b. Found in coal plants
   c. Runs your car
   d. None of the above

6. **What are combined cycle gas turbines?**
   a. Use hot air from the burning gas to create steam which powers a turbine to generate electricity
   b. Powers wind turbines
   c. Not efficient
   d. None of the above

Add the following terms and their definitions to your personal glossary:

Natural Gas

Fossil Fuels

Extract

Methane

Non-renewable

Natural Gas Power Station in Landis, SK

Lesson 2.3 Hydro Information Sheet

WHAT IS HYDROELECTRICITY?

Hydroelectricity comes from flowing water, which turns turbines to generate electricity. There are two types of hydroelectric power stations:

1. Reservoir power plants store water upstream by building a dam. Water flow through the dam can be adjusted like a tap to generate only the amount of power needed.
2. Run-of-river power plants don't use dams. Instead, water takes a detour from the river through a tube. The flow of the water in the tube produces electricity and is then sent back into the river. The amount of electricity generated depends on the flow of the river.

HOW DOES IT PRODUCE ENERGY?

Most hydroelectric power stations use water held in dams to drive turbines and generators, which turn mechanical energy into electrical energy. The water from reservoirs flows through channels, called penstocks, which connect them to a station. The moving water turns a hydraulic turbine, which rotates a generator and produces energy. Once the water has been through the turbine, it is directed into the exit, called a tailrace. The water is then returned to the river below the dam where it continues downstream toward its natural destination. A dam is a barrier constructed to hold water back and raise its level, the resulting reservoir being used in the generation of electricity or water supply. By holding water in the reservoir, the potential for immediate electricity is stored. Excess water from heavy rains or spring run-off can be released from the reservoir through spillway gates, if required.

WHAT ARE THE BENEFITS OF USING HYDROELECTRICITY?

Hydroelectricity is a renewable resource. That means that as long as the water system is cared for there will be water to use to turn the turbines. It is a domestic source of energy and is an affordable cost of power when spread out over the lifetime of the plant. Water levels can be adjusted and even conserved according to the need for power and it is safe compared with the use of fossil fuels and nuclear.

WHAT ARE THE NEGATIVE IMPACTS OF HYDROELECTRICITY?

Hydroelectricity can have a negative impact on the surrounding area where the dams and power stations are built. Sometimes the areas around the dams need to flooded, which is a change from the natural flow of the water. But, the water is often returned to its natural path further downstream. The initial expense to build a hydro power station is high and droughts can have a serious impact on how much hydro power can be produced.

Visit saskpower.com/supplyoptions to learn more about hydro

20% OF OUR TOTAL GENERATING CAPACITY IN SASKATCHEWAN COMES FROM HYDRO.

2.3 Lesson 2.3 Hydro Activity

ACTIVITY

In addition to what is learned in the information sheet (pg. 17), students will watch a video to complete their worksheet on hydro.

Make sure students watch for definitions of terms to add to their glossary and encourage them to keep track of this non-renewable source in the All Fuel Sources Chart (pg. 32).

SUGGESTED TIME:

30 minutes or one class period or work as a jigsaw activity with lessons 2.1-2.5.

APPROACH:

1) Make copies and distribute the information sheet to each student. Review the content to suit your classroom.

2) Watch the hydro video and have students take notes on what they learn.

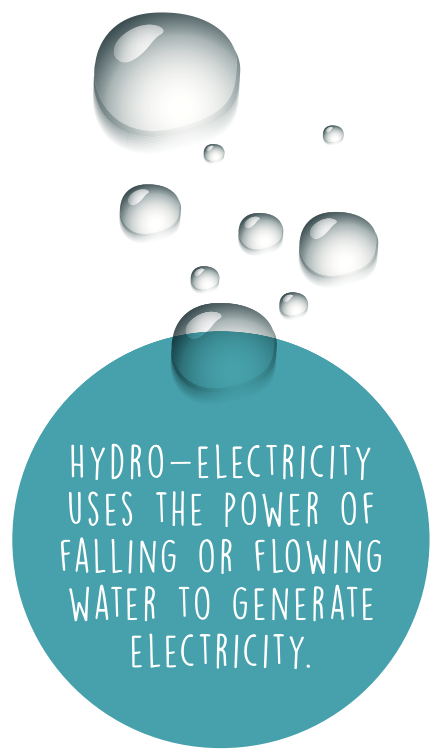
3) Allow students time to web search saskpower.com and other sources to complete their glossary, All Fuel Sources Chart (pg. 32), and worksheet.

ASSESSMENT:

Expectations Checklist (pg. 54).

RESOURCES:

https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/How-Our-Power-Stations-Work



source: https://canadahydro.ca/facts/

Search saskpower.com for:
- How Our Power Stations Work » Hydroelectric Stations

Lesson 2.3 Hydro Teacher Answer Key

(For worksheet on pg. 20)

TRUE OR FALSE ANSWERS

FALSE A. Hydroelectricity comes from the wind. *It comes from water.*

TRUE B. Hydroelectricity is a renewable source of energy.

FALSE C. Saskatchewan's hydroelectric power stations are in Estevan and Coronach. *They are primarily in northern Saskatchewan and along the Saskatchewan river.*

TRUE D. Flowing water turns turbines which generate electricity.

FALSE E. Low water levels have no impact on the amount of electricity that can be generated.

TRUE F. Run-of-river power stations don't use dams. *Instead water flows through a tube.*

TRUE G. Hydroelectricity has a relatively low environmental impact.

DISCUSSION QUESTIONS

1. **What makes Northern Saskatchewan an ideal place to produce energy using hydroelectricity?**

   Look for answers that include abundant water supply.

2. **What concerns do you think people who live near a hydro power station might have?**

   Damming the river might harm the fish life; power station may harm the environment by removing trees and potential flooding.

DEFINITIONS

See Glossary (pg.56)

Lesson 2.3 Hydro Student Work Sheet

TRUE OR FALSE?

_______ A. Hydroelectricity comes from the wind.

_______ B. Hydroelectricity is a renewable source of energy.

_______ C. Saskatchewan's hydroelectric power stations are in Estevan and Coronach.

_______ D. Flowing water turns turbines which generate electricity.

_______ E. Low water levels have no impact on the amount of electricity that can be generated.

_______ F. Run-of-river power stations don't use dams.

_______ G. Hydroelectricity has a relatively low environmental impact.

Add the following terms and their definitions to your personal glossary:

Hydroelectricity

Dam

Penstocks

Run-of-River

Reservoir

DISCUSSION QUESTIONS

1. What makes Northern Saskatchewan an ideal place to produce energy using hydroelectricity?

____

____

____

____

____

2. What concerns do you think people who live near a hydro power station might have?

____

____

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____

____

Hydro Power Station in Nipawin, SK

Lesson 2.4 Wind Information Sheet

WHAT IS WIND ENERGY?

Wind energy is a renewable source of energy that has been used for thousands of years. Saskatchewan currently has two wind facilities and some independent wind facilities.

HOW DOES IT PRODUCE ENERGY?

Wind turbines capture the kinetic energy available from wind and convert it into electrical energy. Large rotor blades mounted on tall towers rotate a shaft connected to a gearbox and generator to produce electricity. The clean electricity created is then sent to a transmission line connected to the provincial grid, supplying electricity to homes and businesses.

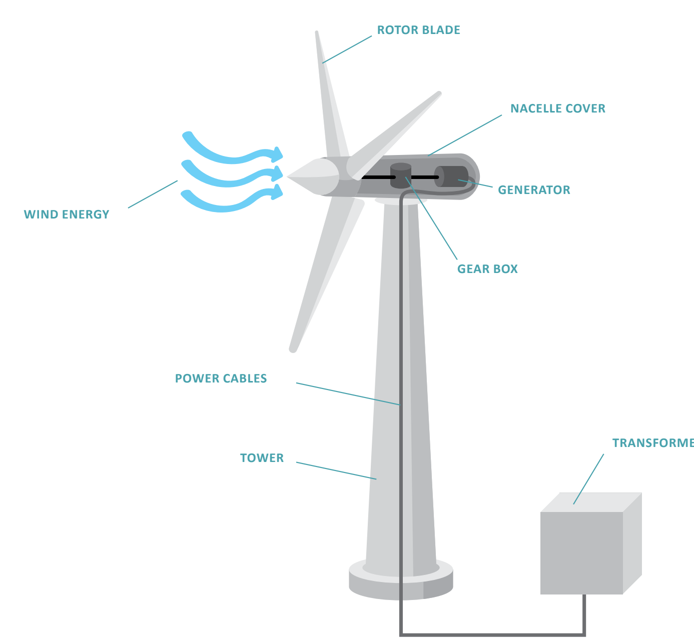
WHAT ARE THE BENEFITS OF USING WIND ENERGY?

Since wind is a natural resource, it is free, renewable and there are no air emissions created, therefore keeping the atmosphere clean.

WHAT ARE THE NEGATIVE IMPACTS OF WIND ENERGY?

Unfortunately, we cannot control the speed or rate that the wind will blow. Turbines usually operate with wind speeds between 15 and 90 kilometres per hour. They cease operating when temperatures fall below -30°C. A large area of land is needed for the turbines and impact on wildlife and native plants must be considered.

Visit saskpower.com/supplyoptions to learn more about wind



SASKPOWER HAS A GOAL OF ENSURING THAT THERE WILL BE UP TO 30% WIND POWER CAPACITY IN SASKATCHEWAN BY 2030.

2.4

Lesson 2.4 Wind Activity

ACTIVITY

In addition to what is learned in the information sheet (pg. 21), students will complete a worksheet on wind turbines.

Make sure students watch for definitions of terms to add to their glossary and encourage them to keep track of this non-renewable source in the All Fuel Sources Chart (pg. 32).

SUGGESTED TIME:

30 minutes or one class period or work as a jigsaw activity with lessons 2.1-2.5.

APPROACH:

1) Make copies and distribute the information sheet to each student. Review the content to suit your classroom.

2) Watch the wind video and have students take notes on what they learn.

3) Allow students time to web search saskpower.com and other sources to complete their glossary, All Fuel Sources Chart (pg. 32), and worksheet.

ASSESSMENT:

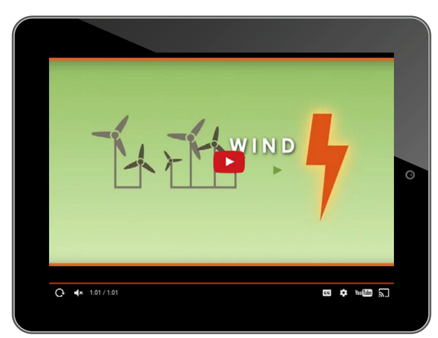
Expectations Checklist (pg. 54).

RESOURCES:

https://www.saskpower.com/Our-Power-Future/Our-Electricity/Electrical-System/How-Our-Power-Stations-Work

TODAY, THERE ARE OVER 268,000 WIND TURBINES OPERATING AROUND THE WORLD IN OVER 90 COUNTRIES

Source: http://canwea.ca/wind-facts/



Search saskpower.com for:

- How Our Power Stations Work » Wind Facilities

Lesson 2.4 Wind Teacher Answer Key

(For worksheet pg. 24)

1) What isn't part of a wind turbine?

a) Nacelle

b) River dam

c) Generator

d) Rotor blade

2) How much wind capacity does SaskPower plan to have by 2030?

a) 100%

b) 50%

c) 30%

d) 10%

3) Identify 3 benefits of wind power.

1. Wind is free

2. Wind is renewable

3. Wind has no emissions

4) What are 3 negatives of wind power?

1. It won't work below -30˚C

2. It won't produce power when the wind isn't blowing

3. Wind speed cannot be controlled

4. A large area of land is required

5) What renewable source powers the turbines?

a) Natural gas

b) Water

c) Coal

d) Wind

DEFINITIONS

See Glossary (pg.56)

Lesson 2.4 Wind Student Work Sheet

Visit saskpower.com and review the information sheet to answer the following questions.

1) What isn't part of a wind turbine?

a) Nacelle

b) River dam

c) Generator

d) Rotor blade

2) How much wind capacity does SaskPower plan to have by 2030?

a) 100%

b) 50%

c) 30%

d) 10%

3) Identify 3 benefits of wind power.

____

____

____

4) What are 3 negatives of wind power?

____

____

____

5) What renewable source powers the turbines?

a) Natural gas

b) Water

c) Coal

d) Wind

Add the following terms and their definitions to your personal glossary:

Wind energy

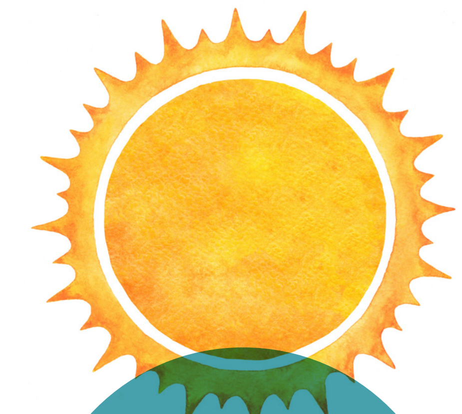
Rotor Blade

Renewable energy

Turbine Generator

Wind facility near Swift Current, SK

2.5 Solar, Nuclear, Biomass and Geothermal Activity



THERE ARE MANY WAYS TO GENERATE ELECTRICITY. MAINTAINING A SUSTAINABLE, RELIABLE AND ENVIRONMENTALLY SOUND MIX IS THE CHALLENGE.

BACKGROUND

It's all about balance. The most balanced system of power production would include a mix of different types of electricity generation. Solar, Nuclear, Biomass and Geothermal are other ways to generate electricity. It's important to learn how they might work as part of a future supply mix.

ACTIVITY

Students will review the information sheet for solar, nuclear, biomass and geothermal technologies to help them complete a worksheet (pg. 31) addressing all of these technologies.

Make sure students watch for definitions of terms to add to their glossary and encourage them to keep track of these sources in the All Fuel Sources Chart (pg. 32).

SUGGESTED TIME:

30 minutes or one class period or work as a jigsaw activity with lessons 2.1-2.5.

APPROACH:

1) Make copies and distribute the information sheets for each source to students. Review the content to suit your classroom.

2) Watch videos for each source and have students take notes on what they learn.

3) Allow students time to web search saskpower.com and other sources to complete their glossary, All Fuel Sources Chart (pg. 32) and worksheet.

ASSESSMENT:

Expectations Checklist (pg. 54)

RESOURCES:

Search saskpower.com for:

- How Our Power Stations Work

Lesson 2.5.1 Solar Information Sheet

WHAT IS SOLAR ENERGY?

Solar energy comes from the sun in the form of radiated heat and light.

HOW DOES IT PRODUCE ELECTRICITY?

Solar panels convert sunlight into direct current (DC). An inverter converts electricity from DC to alternating current (AC). The AC powers your home or business. Extra electricity is sent to the power grid.

WHAT ARE THE BENEFITS?

Solar energy is a clean energy source which means nothing is emitted into the atmosphere. Solar is renewable and sustainable. Takes up little space as panels can be installed on rooftops. Solar is beneficial in powering remote areas that are not able to access traditional power grids and it is a quiet technology not adding to noise pollution.

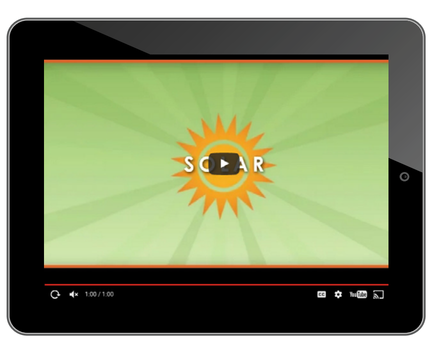
WHAT ARE THE DISADVANTAGES?

Solar power is expensive to set up initially. It is only able to produce power during the daytime when the sun is out, so might not be a solution for places that see little sunlight. With current technology, a large area of photovoltaic cells is required to adequately power a home. This may be an issue where space is limited. And, batteries needed to store solar energy are heavy, large and expensive.

Visit saskpower.com/supplyoptions to learn more about solar

KINDERSLEY, SWIFT CURRENT, ESTEVAN, BROADVIEW AND WEYBURN, SASKATCHEWAN ARE SOME OF THE SUNNIEST PLACES IN CANADA AVERAGING SUN OVER 300 DAYS A YEAR.

https://www.currentresults.com/Weather-Extremes/Canada/sunniest-places.php



Search saskpower.com for:

- How Our Power Stations Work » Solar

Lesson 2.5.2 Nuclear Information Sheet

WHAT IS NUCLEAR ENERGY?

Nuclear energy is the energy in the center (or nucleus) of an atom. Atoms make up everything in the universe and are held together with great force. In a process called fission, atoms are broken apart, and the energy released can be used to generate electricity at power plants.

HOW DOES IT PRODUCE ENERGY?

Atoms of uranium, a common element that can be mined from the Earth, are used in nuclear reactions. In fission, a tiny particle called a neutron hits a uranium atom, the atom splits, releasing more neutrons and generating a chain reaction. That reaction releases huge amounts of energy. That energy can boil water to create steam, which in turn causes turbines to spin, generating electricity in a power plant.

WHAT ARE THE ADVANTAGES?

Nuclear energy has a low impact on the environment since it does not release any gases like carbon dioxide or methane into the atmosphere. Electricity at a nuclear power plant can be produced 24/7 unlike solar or wind, which is dependent on weather conditions. And, the cost of uranium, which is used as a fuel in generating electricity, is quite low and very little of it is required to produce energy. Saskatchewan has a substantial supply of uranium.

WHAT ARE THE DISADVANTAGES?

The waste produced by nuclear reactors needs to be disposed of at a safe place since it is extremely hazardous and can leak radiations if not stored properly. Nuclear accidents like the ones at Chernobyl or Fukushima can cause severe damage to the environment and humans. Even small leaks can cause devastating effects and risk exposure to radiation.

Visit saskpower.com/supplyoptions to learn more about nuclear

Fission and Fusion

Fusion is a way of combining the atoms to make a new atom. For example, the energy from the sun is produced by fusion. Inside the sun, hydrogen atoms are combined to make helium. Helium doesn't need that much energy to hold it together, so the extra energy produced is released as heat and light.

Fission is a way of splitting an atom into two smaller atoms. The two smaller atoms don't need as much energy to hold them together as the larger atom, so the extra energy is released as heat and radiation. Nuclear power plants use fission to make electricity. By splitting uranium atoms into two smaller atoms, the extra energy is released as heat.

Lesson 2.5.3 Biomass Information Sheet

WHAT IS BIOMASS?

Biomass is the energy contained inside plants and animals - plants absorb energy from the sun through the process of photosynthesis. When biomass is burned, this stored energy is released as heat.

HOW DOES IT PRODUCE ELECTRICITY?

The most common method is as simple as burning wood or wood pellets to heat a boiler and create steam to turn a turbine. Wood can also be combined with coal.

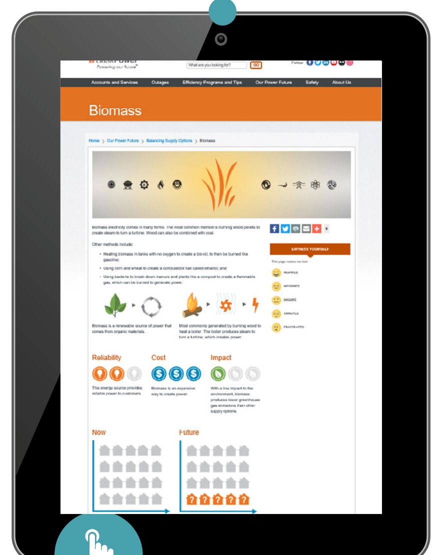
Other biomass methods include: heating biomass in tanks with no oxygen to create a bio-oil, which can then be burned like gasoline; or using corn and wheat to create a combustible fuel called ethanol. Bacteria can even break down manure and plants like a compost to create a flammable gas, which can be burned to generate power.

WHAT ARE THE BENEFITS?

Burning biomass releases carbon dioxide. However, plants also take carbon dioxide out of the atmosphere and use it to grow their leaves, flowers, branches, and stems. That same carbon dioxide, then, is returned to the air when the plants are burned. Biomass is abundant and renewable. As long as there is something living on earth there will be sources for biomass. Biomass can greatly reduce landfills as it can take waste and turn it into something useful.

WHAT ARE THE DISADVANTAGES?

It can be expensive. Also, there can be an odor and emissions associated with burning waste materials. Biomass would not be suitable for large scale power generation as companies would have to clear considerable forest area resulting in major changes to landscape and disrupting habitat.



Visit saskpower.com/supplyoptions to learn more about biomass

Search saskpower.com for:
- How Our Power Stations Work » Biomass

Lesson 2.5.4 Geothermal Information Sheet

WHAT IS GEOTHERMAL?

In its simplest terms, geothermal means earth-heat. The further you travel toward the earth's core, the hotter it gets. Geothermal energy uses the earth's heated core to produce power.

HOW DOES IT PRODUCE ELECTRICITY?

Geothermal energy uses the escaping heat from Earth's core as a means to heat water and produce electricity. By drilling deep into the Earth's interior, we find temperatures suitably high to produce electricity.

WHAT ARE THE BENEFITS OF GEOTHERMAL?

As a renewable source of energy geothermal is cheaper and more reliable than most renewable sources. This fuel source can be used for direct heating of homes and offices. It does not create any pollution, and helps to reduce our reliance on fossil fuels.

WHAT ARE THE NEGATIVE IMPACTS OF GEOTHERMAL?

Geothermal is expensive to set up, is only suited to particular regions of the country, and geothermal energy can not be easily transported.

Visit saskpower.com/supplyoptions to learn more about geothermal

CANADA'S BEST GEOTHERMAL PLAYS, WHERE YOU HAVE TO DIG THE LEAST DISTANCE AND THE WATER IS HOTTEST, ARE IN BRITISH COLUMBIA AND THE YUKON.[2]

[2] source: http://www.desmog.ca/2014/02/26/top-5-reasons-why-geothermal-power-nowhere-canada

Search saskpower.com for:
- How Our Power Stations Work » Geothermal

Did you know?

The Temple Gardens Mineral Spa in Moose Jaw, SK is heated by geothermal energy? By the time the naturally heated mineral water reaches the spa through an insulated pipeline it is around 45˚C.

Lesson 2.5 Solar, Nuclear, Biomass and Geothermal Teacher Answer Key

(For worksheet on pg. 31)

SOLAR: TRUE OR FALSE

A. Solar power can be captured at night. **FALSE**

B. Solar energy is obtained from sunlight. **TRUE**

C. Photovoltaic cells convert sunlight directly into electricity. **TRUE**

D. Saskatchewan has large scale solar generating power stations. **FALSE**

E. Some homeowners in Saskatchewan get their electricity from solar panels installed on the roofs of their homes. **TRUE**

NUCLEAR DISCUSSION

Advantages:

- Nuclear power generation emits no carbon dioxide (CO_2).
- This technology is readily available, it does not have to be developed first.
- Uranium is mined in Saskatchewan.

Disadvantages:

- The waste from nuclear energy is extremely dangerous and it has to be carefully looked after for several years.
- Despite a generally high security standard, accidents can still happen.
- The energy source for nuclear energy is Uranium. Uranium is a scarce resource with a supply that once gone, it can't be replenished.
- The time frame needed for formalities, planning and building of a new nuclear power station is 10 - 15 years.

1) What is the most common method of providing biomass?

Burning wood or wood pellets to heat a boiler and create steam to turn a turbine. Wood can also be combined with coal.

2) Identify two other biomass methods.

Other biomass methods include: heating biomass in tanks with no oxygen to create a bio-oil, which can then be burned like gasoline; or using corn and wheat to create a combustible fuel called ethanol. Bacteria can even break down manure and plants like a compost to create a flammable gas, which can be burned to generate power.

3) What is the environmental impact of biomass?

Low. Biomass produces fewer greenhouse gas emissions than other supply options.

1) How does geothermal work?

Geothermal energy uses the earth's heated core to produce power.

2) What are the environmental benefits of geothermal?

It is renewable, emits no carbon into the atmosphere.

Lesson 2.5 Solar, Nuclear, Biomass and Geothermal Student Work Sheet

SOLAR: TRUE OR FALSE?

_______ A. Solar power can be captured at night

_______ B. Solar energy is obtained from sunlight.

_______ C. Photovoltaic cells convert sunlight directly into electricity.

_______ D. Saskatchewan has large scale solar generating power stations.

_______ E. Some homeowners in Saskatchewan get their electricity from solar panels installed on the roofs of their homes.

Add the following terms and their definitions to your personal glossary:

Solar

Nuclear

Geothermal

Biomass

NUCLEAR DISCUSSION

Nuclear power plants have a relatively good safety record but there is strong debate about the potential risk they pose. List three advantages and disadvantages of nuclear power in Saskatchewan:

Advantages:

1 ____________________

2 ____________________

3 ____________________

Disadvantages:

1 ____________________

2 ____________________

3 ____________________

1) What is the most common method of providing biomass?

2) Identify two other biomass methods.

3) What is the environmental impact of biomass?

4) How does geothermal work?

5) What are the environmental benefits of geothermal?

Lesson 2.6 All Fuel Sources Chart
Student Worksheet

Fill out chart below after learning about each fuel source.

Generation Source	Renewable or Non Renewable	Pros	Cons

Section 3: Powering Saskatchewan

Section 3.0

Electricity powers our lives every day, and every day we're using more and more of it. In Saskatchewan, demand for electricity is growing fast with population growth and new businesses starting up. Keeping up with this demand is a challenge that each generation will be faced with – especially in light of environmental considerations and aging infrastructure.

Producing power in a province as large and diverse geographically as ours can be a challenge. Our power grid is past its prime, and much of it must be renewed or replaced. The power industry globally faces stricter environmental regulations, which make a lot of the electricity we produce now more expensive or obsolete. There needs to be enough power for everyone in Saskatchewan, while reducing environmental impact and finding new ways to generate power. That is a very big job.

In this section, students will move through a series of four activities all designed to help them understand what it takes to power a province the size of Saskatchewan.

OUTCOME:

EL6.1
Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

INDICATOR:

c) Locate and categorize by type the large-scale electrical energy generation facilities in Saskatchewan and explain how electrical energy is transmitted from those facilities to locations throughout the province.

TEACHER BACKGROUND

Students will learn how electricity gets to them, why power sometimes goes out, how power is generated and where power generation facilities are located in Saskatchewan. Using a variety of web search, and group projects and discussions will stimulate the minds of students and get them thinking about issues related to bringing electricity to a province as big and diverse as Saskatchewan.

Lesson 3.1 Power Lines Information Sheet

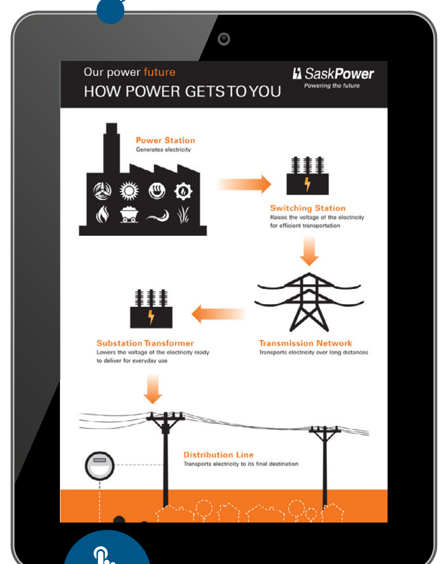
POWER LINES, ALSO KNOWN AS TRANSMISSION AND DISTRIBUTION LINES

Turning on your lights is the end result of an electrical journey that begins with a generation facility and is made possible thanks to a reliable transmission and distribution system. When everything is in working order, and there are no problems, electricity finds its way to you.

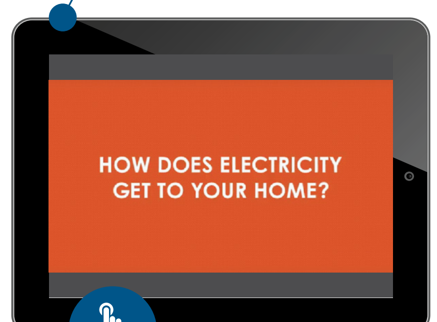
Electricity leaves a generating plant and is raised to a high voltage to travel efficiently over long-distance transmission lines to a substation. From there, voltage is lowered through a series of smaller substations and transformers to reach customers in a safe, low-voltage form along distribution lines.

SOMETIMES THE POWER GOES OUT

If the power goes out in your home, call SaskPower at **310-2220** (toll-free, 24/7) to report it. By following SaskPower on twitter (@SaskPower) you can find out where the power is out and when it will be restored.



See pg. 55



Check out our YouTube channel and search for:

- How Power Gets To You

Electric and Magnetic Fields

Electric fields are produced by voltage and formed whenever a connection is made with an outlet. The higher the voltage, the stronger the electric field.

Magnetic fields are produced when an electric current is flowing through an appliance or wire. The greater the current, the stronger the magnetic field.

When you plug the power cord of an appliance into a wall socket, the connection creates an electric field along the cord. When you turn the appliance on, the flow of electricity through the cord also creates a magnetic field.

Electricity - A form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

3.1 Powering Saskatchewan Power Lines Activity

ACTIVITY

Students will be introduced to the transmission and distribution side of delivering electricity.

The challenges of building power lines and ensuring the power is always on are common in the electrical industry. Students will complete a worksheet to demonstrate their knowledge of these areas and related issues.

SUGGESTED TIME:

30 - 60 minutes.

APPROACH

1) Review the video, "How does electricity get to your home?" or review the reference on pg. 55. Teachers may prefer to print it out and hand a copy to each student for easy reference.

2) View the video "Sometimes Power goes out".

3) Discuss with the class some of the key findings of both videos.

4) Have students complete the worksheet.

ASSESSMENT

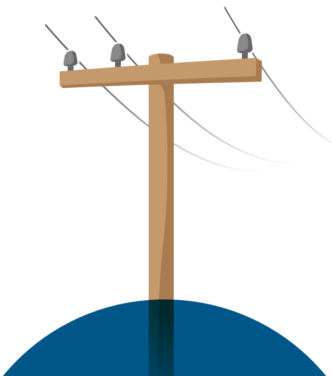
Expectations checklist (pg. 54)

RESOURCES

- How Power Gets to You infographic (pg. 55).

SaskPower YouTube Channe:

- How Does Electricity Get To Your Home
- How SaskPower finds and fixes power outages



IN SASKATCHEWAN THERE ARE MORE THAN 156,000KM OF POWER LINES OVER A GEOGRAPHIC AREA OF ABOUT 652,000KM²

Lesson 3.1 Power Lines Teacher Answer Key

(For worksheet on pg. 37)

1) What 7-digit phone number should you call if the power goes out in your home?

310-2220

2) What are the four main causes of power outages in Saskatchewan?

Old equipment; nature (animals); accidental contact (vehicles, vandalism); and weather.

3) What is a planned power outage?

When power is shut off by the power company to maintain equipment before it breaks.

4) During a wide-spread outage where would power be restored first?

Hospitals, nursing homes, police and fire stations, water treatment and sewage facilities.

5) Describe how power gets to you.

Electricity leaves a generating plant and is raised to a high voltage to travel efficiently over long-distance transmission lines to a substation. From there voltage is lowered through a series of smaller substations and transformers to reach customers in a safe, low-voltage form along distribution lines.

6) What are electric and magnetic fields (EMF)?

Electric fields are produced by voltage and formed whenever a connection is made with an outlet. The higher the voltage, the stronger the electric field. Magnetic fields are produced when an electric current is flowing through an appliance or wire. The greater the current, the stronger the magnetic field.

DEFINITIONS

See Glossary (pg.56)

Powering Saskatchewan Power Lines 3.1

Lesson 3.1 Power Lines Student Work Sheet

Search for the answers to the following questions at saskpower.com

1) What 7-digit phone number should you call if the power goes out in your home?

2) What are the four main causes of power outages in Saskatchewan?

3) What is a planned power outage?

4) During a wide-spread outage where would power be restored first?

5) Describe how power gets to you.

Add the following terms and their definitions to your personal glossary:

Electricity

Transmission

Distribution

6) What are electric and magnetic fields (EMF)?

Lesson 3.2 Power Stations Information Sheet

We're lucky in Saskatchewan because when it comes to power sources ... we do have options. From coal to hydro, wind to natural gas there is no shortage of ways to generate electricity.

While there is no one best option, sometimes the best option is a whole bunch of methods working together. Saskatchewan's power comes from a variety of methods to ensure an adequate supply of electricity. The right mix will be a blend of a few sources of energy, along with new technologies, and reminders for us all to use only the power we need and to unplug electronics when they're not being used.

The most balanced system would include a mix of these types of electricity generation:

BASELOAD

These types of systems operate all day, every day and produce the basic amount of power that is needed for our province.

INTERMEDIATE

These options are kind of like backup plans that boost power when demand increases, like during the cold winter months.

INTERMITTENT

Intermittent systems work only when conditions are right, for example: wind turbines need a breeze to rotate in order to generate power.

PEAKING

These systems kick in for a short time when power demand spikes, like when the Rider game is on TV.

To see SaskPower's current mix of electricity generation visit

Our Energy Mix

Visit www.saskpower.com/supplyoptions

THE SHAND CARBON CAPTURE TEST FACILITY IN ESTEVAN (*PICTURED*) AND THE CCS KNOWLEDGE CENTRE AT INNOVATION PLACE RESEARCH PARK IN REGINA SERVE AS TWO SOURCES FOR FURTHER RESEARCH INTO CARBON CAPTURE AND STORAGE TECHNOLOGIES.

3.3 Powering Saskatchewan Power Sources Map Quest

ACTIVITY

Students will discover what generating sources currently produce power for Saskatchewan and where they are located.

Students will conduct a search of the electrical system map of the province.

SUGGESTED TIME

30 minutes.

APPROACH

Discuss the electrical system map with students pointing out the locations of the power stations.

Hand out the map quest chart (pg. 41) and instruct the students to complete the chart based on the information they find on the map.

After completing the chart, have student's note three things they observe in their notebook. Discuss observations as a class.

EXTENSION

As a classroom, discuss where a solar power station could be, or biomass or geothermal or nuclear.

ASSESSMENT:

Use this as a completed or participation mark. You can mark the exit slips, or journal entries at your own discretion and preference.

RESOURCES

- Print out of Electrical System Map (pg. 42).

Lesson 3.3 Powering Saskatchewan Map Quest - Teacher Answer Key

To find the most up-to-date answers to this table, search saskpower.com for: system map

	Number of Generating Stations	*Total Megawatts produced*
Hydro	*6*	*889*
Coal	*3*	*1,530*
Natural Gas	*9*	*1,771*
Wind	*5*	*221*
Solar	*0*	*0*
Nuclear	*0*	*0*
Geothermal	*0*	*0*
Biomass	*0*	*0*
*Small IPP**		*26*
TOTAL CAPACITY		*4,437*

* Small Independent Power Producers not shown on map.

DEFINITIONS

See Glossary (pg.56)

Lesson 3.3 Powering Saskatchewan Student Work Sheet - Map Quest

To find the answers to this table, search saskpower.com for: system map

Go on to saskpower.com. Fill in the chart below with the correct information.

	Number of Generating Stations	*Total Megawatt Net Capacity*
Hydro		
Coal		
Natural Gas		
Wind		
Solar		
Nuclear		
Geothermal		
Biomass		
Small IPP		
TOTAL CAPACITY		

Add the following terms and their definitions to your personal glossary:

Megawatt

Capacity

Transformer

Lesson 3.3 Powering Saskatchewan SaskPower System Map

To see the most up-to-date version of this map, search saskpower.com for: system map

HYDRO - TOTAL CAPACITY 889 MW

1. Athabasca Hydroelectric System
   - Wellington (5 MW)
   - Waterloo (8 MW)
   - Charlot River (10 MW)
2. Island Falls Hydroelectric Station - 111 MW
3. Manitoba Hydro Northern Power Purchase Agreement - 25 MW *(Owned by Manitoba Hydro)*
4. E.B. Campbell Hydroelectric Station - 289 MW
5. Nipawin Hydroelectric Station - 255 MW
6. Coteau Creek Hydroelectric Station - 186 MW

NATURAL GAS - TOTAL CAPACITY 1,771MW

1. Meadow Lake Power Station - 44 MW
2. Meridian Cogeneration Station* - 210 MW
3. North Battleford Generating Station* - 260 MW
4. Yellowhead Power Station - 138 MW
5. Ermine Power Station - 92 MW
6. Landis Power Station - 79 MW
7. Cory Cogeneration Station - 228 MW
   (Owned by SaskPower International and ATCO Power Canada)
8. Queen Elizabeth Power Station - 634 MW
9. Spy Hill Generating Station* - 86 MW

WIND - TOTAL CAPACITY 221 MW

1. Cypress Wind Power Facility - 11 MW
2. SunBridge Wind Power Facility* - 11 MW
3. Centennial Wind Power Facility - 150 MW
4. Morse Wind Energy Facility* - 23 MW
5. Red Lily Wind Energy Facility* - 26 MW

COAL - TOTAL CAPACITY 1,530 MW

1. Poplar River Power Station - 582 MW
2. Boundary Dam Power Station - 672 MW
3. Shand Power Station - 276 MW

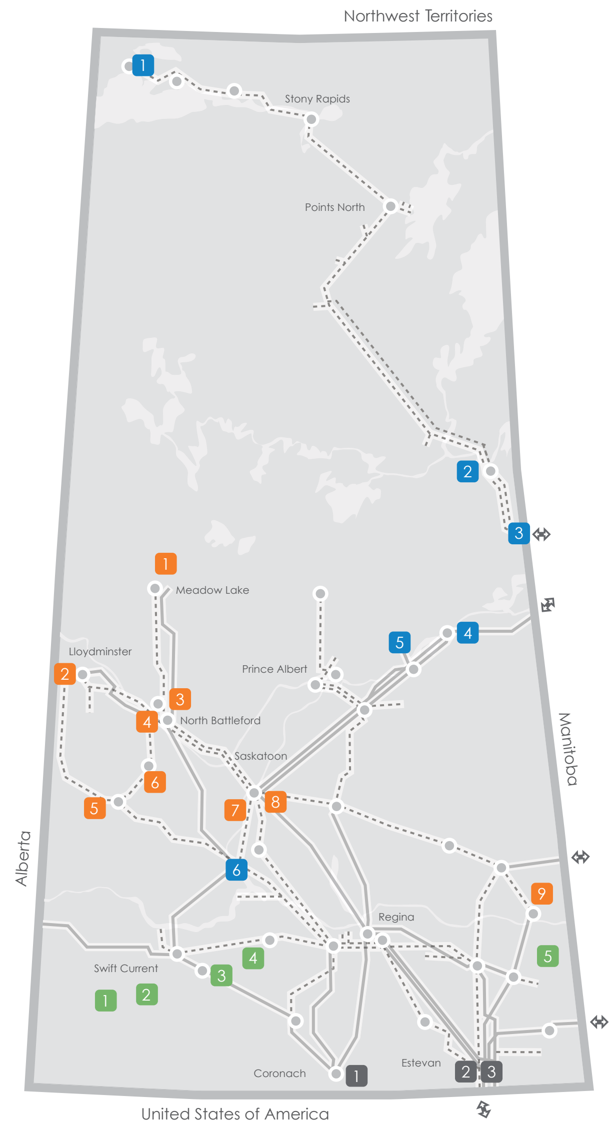
TOTAL AVAILABLE **GENERATING CAPACITY** FROM ALL SOURCES - **4,437 MW**

TRANSMISSION

230 kV
138 kV/115 kV/110 kV
Switching station
Interconnection

Small Independent Power Producers (not shown on map)- Total Capacity 26 MW

** Large Independent Power Producer*



Section 4: Conserving Electricity

Section 4.0

Electricity use is on the rise and as important as it is for power companies to keep up with the demand, consumers of electricity can also help by conserving electricity. Conserving means that there is less demand put on power plants to generate electricity. This is good for the environment, and great for the consumer.

In this section, students will discover ways to conserve electricity. Knowledge gained in this section will allow students to become leaders of change in their own families and communities.

OUTCOME:

EL6.1
Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

INDICATOR:

d) Identify factors that affect electrical energy consumption at home, school, and in the workplace and propose methods of decreasing electrical energy consumption that can help to conserve natural resources and protect the environment..

TEACHER BACKGROUND

This section provides tools to get students thinking about ways to conserve power and behaviour changes that they can make in their homes. Students who share this information with their families are key in promoting a generation of using less electricity.

Lesson 4.1 Conserving Electricity Information Sheet

WHY CONSERVE ELECTRICITY

The idea of conserving electricity means that you should only use it when necessary and avoid wasting it. This means doing simple things, like turning off lights when you leave a room, as well as more involved processes, such as replacing standard light bulbs and appliances with those that use less electricity. While you may not notice much of an impact on your day-to-day life when you make these types of changes, the environmental impact of your actions will be much larger.

WHY IS IT IMPORTANT TO CONSERVE ELECTRICITY?

- The accumulated savings in power bills at the end of the year.
- The ability to use less fossil fuels. It's important to save energy to give researchers more time to find alternatives to fossil fuels that are affordable and practical.
- Reduce pollution and greenhouse gas emissions. Producing electricity creates pollution. Even the production of solar panels can create pollutants during the manufacturing process.

CONSERVING ELECTRICITY IN THE HOME

There are many ways you can conserve electricity in your home.

- Turn off lights when they are not in use
- Turn off electronics when not in use
- Use LED light bulbs
- Seal air leaks in your home
- Buy energy efficient appliances
- Plug electronic games and computers into a power bar
- Close blinds or drapes, especially those with direct sunlight

Don't feed the phantom

Power used by electronic devices when they are plugged in but not being used is called phantom power. Some devices work better when plugged in all the time (e.g. refrigerator, freezer) while others can be turned off (e.g. gaming devices) when not in use. Here's what you can do:

- Plug your entertainment system into a power bar and switch it off when you're not using it.
- Unplug small appliances when all they are doing most of the time is displaying a clock (e.g. coffee pot).
- All the little red or green lights in your home indicate things that are drawing power. Even plugged in chargers are drawing electricity even though they aren't connected to your device.
- Anything that can be turned off with a remote is consuming power.

4.1 Conserving Electricity Checklist and House Projects

ACTIVITY

Students will discover how to conserve energy and the importance of doing this. This lesson is a combination of in class and take home work that will allow students to introduce or reinforce the notion of conservation with their families.

This lesson is intended to help students assess and change behaviours.

SUGGESTED TIME

In class time 30-60 minutes.

Take home chart can be conducted over an evening or week depending on your class schedule.

LESSON

1. Read the information sheet to class.
2. Discuss with the class what conserving electricity means.
3. Is there Phantom Power in the classroom?
4. Review the content on saskpower.com.
5. On a whiteboard in class or in groups create a web or a list of ways to conserve energy in the home.
6. Hand out the home audit and tell students to take it home and complete it with their family and bring back to class for sharing.
7. Hand out the House Activity Sheet (pg. 47) and have students complete it in class.

EXTENSION ACTIVITY

Have students create a conservation checklist for their school and complete it as a class.

ASSESSMENT

Use this as a completed or participation mark. You can mark the exit slips, or journal entries at your own discretion and preference.

RESOURCES

- Conservation checklist
- Conserving electricity student handout

Search saskpower.com for:

• Efficiency Programs And Tips

LIGHT-EMITTING DIODE (*LED*) LIGHT BULBS USE UP TO 80 PER CENT LESS ELECTRICITY AND LAST UP TO 15 TIMES LONGER THAN INCANDESCENT BULBS.

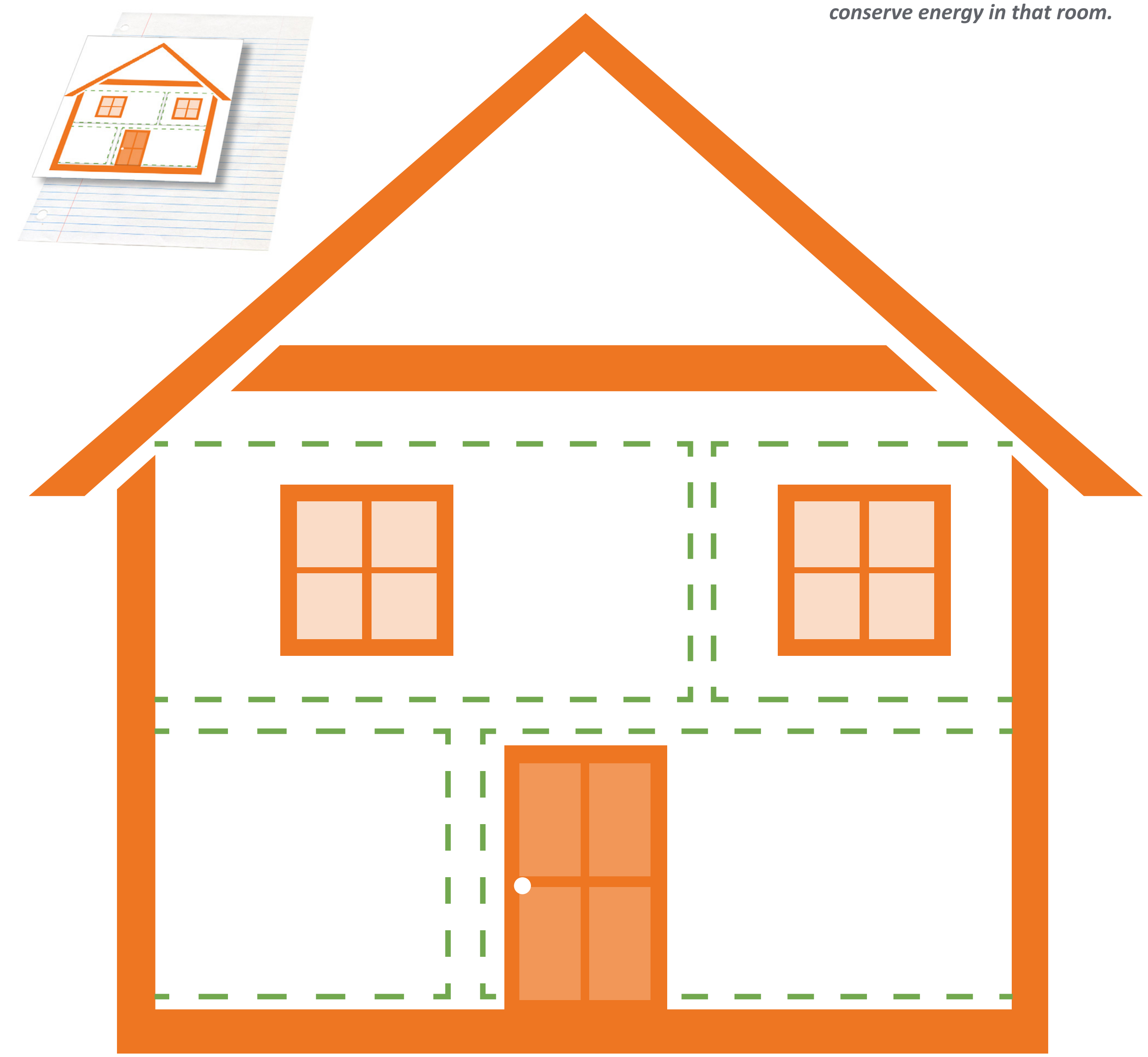
Lesson 4.1 Conservation Checklist Student Worksheet

Behaviours	*Your Findings*	*Check*
Do you have LED light bulbs in your home?	*YES (2 pts)*	
	NO (0 pts)	
	If YES, how many? ________	
Do you power off your computer every night when you are done?	*YES (2 pts)*	
	NO (0 pts)	
	Great job. Using a power bar might make that easier.	
Do you unplug your charger from the power source when it is not charging a device?	*YES (2 pts)*	
	NO (0 pts)	
	Encourage your family to unplug their chargers to save energy.	
Is your vehicle plugged in no more than 4 hours in the winter?	*YES (5 pts)*	
	NO (0 pts)	
	Using a block heater timer makes this easy.	
Do you turn lights off when you leave a room?	*YES (5 pts)*	
	NO (0 pts)	
	Remind your family to do so also.	
Do you turn off the TV when you leave the room?	*YES (3 pts)*	
	NO (0 pts)	
	An unwatched TV is just sad.	
Does your family hang clothes on a clothes line to dry?	*YES/SOMETIMES (3 pts)*	
	NO (0 pts)	
	Clothes dryers use a lot of electricity.	
Do you open the curtains and let the sun shine in your home in the winter?	*YES (5 pts)*	
	NO (0 pts)	
	Sunlight will naturally warm your room so you can turn down your thermostat.	
Do you or someone in your family turn the thermostat down during the day when no one is home?	*YES (3 pts)*	
	NO (0 pts)	
	Great way to save energy when no one's home.	
30 points = You're a Conservation Rock Star. / *20-29 = Keep up the good work.* / *0-19 = Try some of these behaviors and see the difference they make.*	***TOTAL POINTS***	

Lesson 4.1 Conserving Electricity Student Project

STEPS:

1. *Label and design the following rooms in this house:* Bedroom, Bathroom, Living Room, and Kitchen.
2. *Cut the house out from this sheet, then cut on the green dotted lines only.*
3. *Paste this onto a poster board or your science notebook.*
4. *Lift the flaps for your rooms and write out at least three ways to conserve energy in that room.*



Section 5:
Safety Around Electricity

Section
5.0

Electricity is everywhere and learning how to use it safely is everyone's responsibility. Whether at home, at school, on the playground, or on the farm, knowing where the risks are and how to avoid them is key to ensuring everyone can enjoy the benefits of electricity.

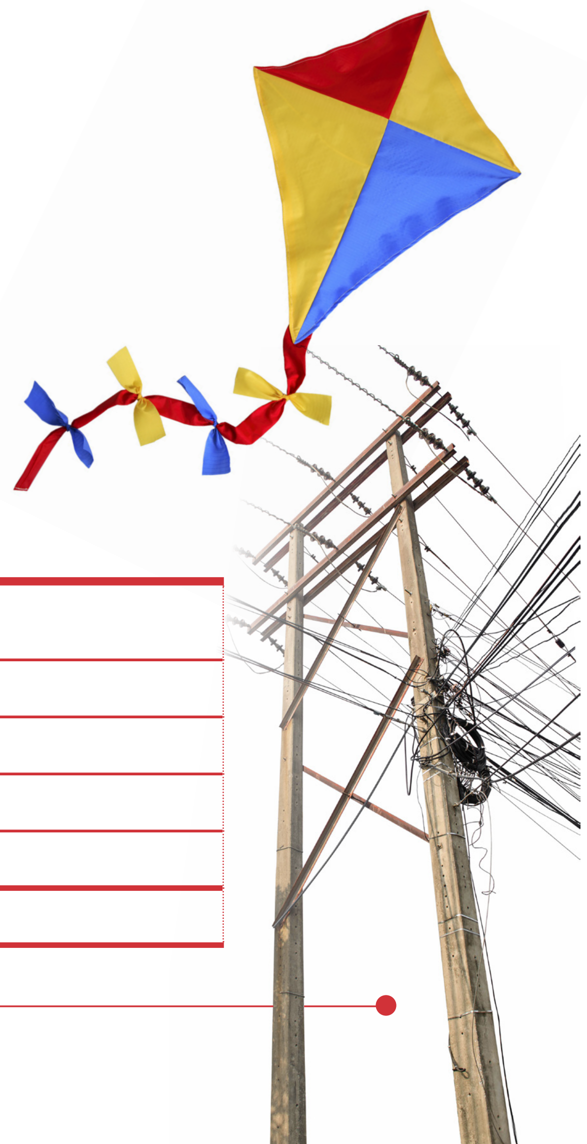
In this section, students will discover ways to be safe around electrical equipment. Knowledge gained in this section will allow students to become leaders of change in their own families and communities.

OUTCOME:

EL6.1
Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

INDICATOR:

e) Explain potential dangers of electricity at home, school, and the workplace and suggest ways individuals can minimize those dangers.



TEACHER BACKGROUND

Students will gain valuable knowledge on how to be safe around electricity and the impacts of not being safe around electricity. The lesson encourages group discovery, research and presentation skills.

ASSESSMENT:

Presentation addresses	*Points*	*Comments*
At least 5 safety problems & rules to address each problem	*/ 10*	
Correct number to call if electrical incident	*/ 5*	
Correct number to call if someone is injured	*/ 5*	
Creativity of project and execution	*/ 5*	
Grammar and punctuation	*/ 5*	
TOTAL:		

Lesson 5.1 Electrical Safety Information Sheet

Everyone wants you to stay safe around electricity. If an electrical incident happens, someone can be seriously injured … or worse. It's important to know the rules and be aware of any electrical hazards both inside and outside the home.

RULES

Prevent:

Look up and live when helping in the yard/ farm. Plan your work in advance, lower equipment and have someone watching to prevent contact with overhead power lines.

Look up and live when playing. Always keep flying toys like kites and play structures like tree houses well away from overhead power lines. Electricity can travel through them back to you.

Before you dig. If anyone you know is about to dig, remind them to contact Sask 1st Call to locate underground power lines first.

Water and electricity don't mix. Never leave power cords or anything electrical near the tub, sink, toilet or swimming pool. This includes electronic toys and devices.

Stay away from electrical infrastructure. Electrical infrastructure like substations, towers, transformers and power poles are not play structures. They are dangerous if you get too close.

Respect power outlets. Never ever stick anything into electrical outlets except proper electrical cord plugs. But remember, too many plugs in one outlet can cause a fire.

Always unplug. If something goes wrong with your electrical appliance or device, shut it off before unplugging it. Never try to fix anything electrical yourself, always ask an adult for help.

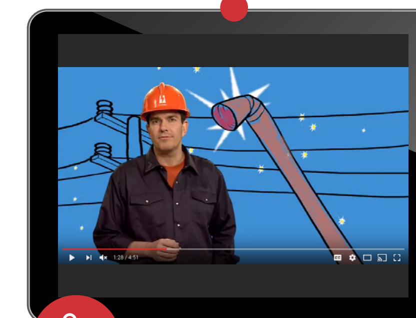
React:

Stay back. If you see a broken power line, keep everyone back at least 10 metres. Call SaskPower at 310-2220 or call 911.

Stay put. If a vehicle you're in contacts a power line and there is no fire call SaskPower at 310-2220 or call 911 and stay inside until help arrives.

Getting out safely. If a vehicle you are in contacts a power line and there is fire or smoke, you must exit the vehicle. Learn the proper technique here: http://www.saskpower.com/safety/electrical-safety/homeowner-safety/vehicle-accidents-and-electrical-safety/

As a class, watch these safety videos



Watch "Farm Safety Around Power Lines" on our YouTube channel

Watch "Test your power safety knowledge" on our YouTube channel

5.1 Test your power safety knowledge-Group project

ACTIVITY

This lesson will provide students with an opportunity to present information on electrical safety in a way that both educates and engages them. Final projects will demonstrate the students research capabilities as well as their writing, and presentation skills. This project will also reinforce facts and persuasion skills and show off creativity as they work towards talking about a very serious subject in an engaging way.

In addition to the information sheet and the in-class videos, students are encouraged to seek out other websites and references that feature electrical safety rules.

SUGGESTED TIME

1-2 classes.

APPROACH

1. As a class, review the Rules on the information sheet and watch the videos You've Got a Lot on the Line, Test Your Power Safety Knowledge and Auto Accidents and Electrical Safety.

2. Divide students up into 4 groups giving each group a theme: home; neighborhood; school; or farm.

3. Have the students record all possible safety hazards they can think of for their theme, and ways to eliminate or reduce the hazard.

4. Announce to the class that they will be creating a presentation to raise awareness about electrical safety. They can select any method they wish to present their project: PowerPoint, Brochure, Essay, Poster, Video, Interview with family, or another idea.

5. Ask students to be as creative as they want but make sure they include the following:
   - At least 5 safety problems. For example, if their theme is farm, list possible scenarios where someone could get injured by electricity on the farm.
   - A rule to address the safety problem.
   - Who to call and the number if you contact a power line.
   - Who to call and the number if someone is injured.

6. Students will present their findings in class.

EXTENSION

Have students present to younger grades as a way to share this knowledge.

THIS BEAR IS VERY LUCKY THAT HE DIDN'T GET ELECTROCUTED. THE REASON HE DIDN'T WAS PURE LUCK. AS HE CLIMBED THE POWER POLE HE LIKELY STAYED VERY CLOSE TO IT AND DID NOT COME IN CONTACT WITH THE WIRE.

Even as he is napping at the top of the pole, the fact that he isn't touching the wire in front of the glass insulators is probably keeping him safe. Luckily, this bear made it down alive, but the message for all of us is that being anywhere near power lines is dangerous for animals and humans.

RESOURCES

SaskPower YouTube Channel:

• "Test Your Power Safety Knowledge"

Search saskpower.com for:

• Vehicle Accidents And Electrical Safety

Section 6: Careers with electricity

Section 6.0

In this section, students will discover what kinds of jobs are available within the electric industry and what kinds of qualifications are required. As Saskatchewan's provincial power company, SaskPower requires many different jobs and always has a need to fill high demand jobs.

This activity will introduce students to many different jobs in the electrical industry – even some they probably didn't even know existed.

OUTCOME:

EL6.1
Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts. [CP, DM]

INDICATOR:

f) Research employers and careers related to electrical energy generation, distribution, and conservation in Saskatchewan.

TEACHER BACKGROUND

A job fair is a way to help students develop their research and writing skills while learning about a possible career. Making the job fair accessible to other grades in the school is a great idea to share this information - especially with older grades.

6.1 Careers Lesson Electricity Job Fair

ACTIVITY
Students will research a job that they are interested in and create a presentation to help inform others.

SUGGESTED TIME
Two classes (one for research and one for presentation).

APPROACH:
1. Introduce students to the career paths and jobs in demand areas on SaskPower's website.
2. Ask students to select one career they feel they would be most interested in and have them research it and create a presentation for a mini electricity job fair.

RESOURCES:
Career path information - search saskpower.com:

- Career Paths
- Careers

CRITERIA
Presentation must be researched, well written and include:

- ***Job Title and Description*** – describe the basic task of the career, what responsibilities are required.
- ***Education*** – What education, high school and post-secondary courses, are required?
- ***Personality Attributes*** – Do you like to work outdoors? Do you like to work in an office? What is required for the chosen profession? If none are listed, consider attributes that you think would be beneficial to the job.
- ***Physicality*** – Describe if there is heavy lifting, climbing or working underground involved. Or do you sit at a desk or do you work from a vehicle?
- ***Location*** – If it isn't indicated, describe where you think this job might be located (outdoors, office building…).
  Why SaskPower should hire you – Describe how you think this job would suit you and why SaskPower should hire you.

ASSESSMENT:

	Points	Comments
Job Description	/ 5	
Education	/ 5	
Personality Attributes	/ 5	
Physicality	/ 5	
Location	/ 5	
Why should SaskPower hire you	/ 5	
TOTAL:	/ 30	

T Rubric

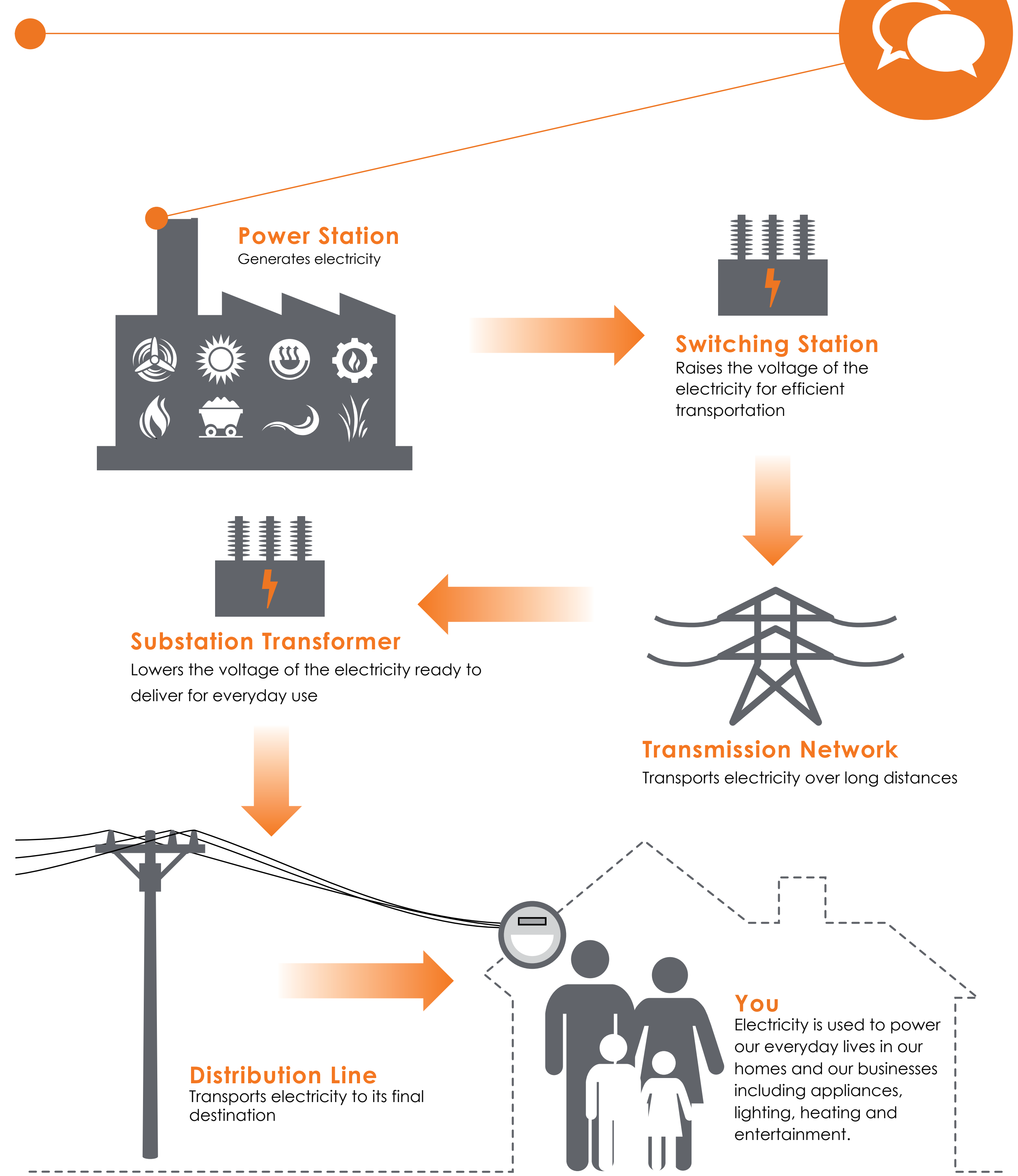
CONCERNS AREAS THAT NEED WORK	CRITERIA STANDARDS FOR THIS PERFORMANCE	ADVANCED EVIDENCE OF EXCEEDING THE STANDARDS

COMMENTS:

Expectations Checklist

OUTCOMES:	EL6.1 Access personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduct those impacts. [CP, DM]														
INDICATORS:	Provide examples of the types of energy sources used to provide heat and light to homes in the past and describe ways in which electricity-based technologies have changed the way people work, live, and interact with the environment in Saskatchewan.	Describe how electrical energy is generated from hydroelectric, coal, natural gas, nuclear, geothermal, biomass, solar, and wind sources and categorize these resources as renewable or non-renewable.						Locate and categorize by type the large-scale electrical energy generation facilities in Saskatchewan and explain how electrical energy is transmitted from those facilities to locations throughout the province.	Identify factors that affect electrical energy consumption at home, school, and in the workplace and propose methods of decreasing electrical energy consumption that can help to conserve natural resources and protect the environment.			Explain potential dangers of electricity at home, school, and the workplace and suggest ways individuals can minimize those dangers.		Research employers and careers related to electrical energy generation, distribution, and conservation in Saskatchewan.	
LESSON:	a.1	b.1	b.2	b.3	b.4	b.5	b.6	c.1	d.1	d.2	d.3	e.1	e.2	f.1	f.2
STUDENT NAME:															

How Power Gets To You



Glossary of Terms

Baseload - systems that run 24/7.

Biomass - any plant or animal material that can be safely burned and makes good fuel.

Capacity - the maximum electric output an electricity generator can produce under specific conditions.

Carbon Capture and Storage– to capture emissions and use it for other purposes instead of releasing it into the air and water.

Coal - a fossil fuel that can be burned to make electricity.

Conservation - using less of something.

Dam - a barrier constructed to hold water back and raise its level.

Distribution - process for moving electric energy at lower voltages from major substations to customers.

Electricity - a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

Emissions - the production and discharge of something.

Extract - to take out of the ground.

Fission – the action of dividing or splitting something into two or more parts.

Fossil Fuel - the organic remains of plants and animals.

Fusion - the process or result of joining two or more things together to form a single entity.

Generator - a device that creates electricity from an energy source.

Geothermal - heat trapped under Earth's surface.

Hydroelectricity - electricity generated by the force of water.

Megawatt - a unit of bulk power equal to 1000 kilowatts. A kilowatt equals the total amount of power needed to light ten 100 watt light bulbs.

Methane - a flammable gas.

Natural Gas - a clear gas found underground.

Non-Renewable - a source of energy that can only be used once and cannot be replaced.

Nuclear - energy produced by the breakdown of the smallest units of matter.

Penstock – a channel that carries water from a reservoir to a hydro turbine.

Phantom Power – power used by electronic devices when they are plugged in but not being used.

Reclamation - the act of returning something to a former better state.

Renewable Energy - a source of energy that can be used over and over or replaced.

Reservoir – water that is blocked by a dam.

Rotor Blade – something that lifts and rotates when wind is blown over this causing a rotor to spin. Most wind turbines have three.

Run-of-River - instead of dams, water is detoured from the river through a tube to produce electricity.

Solar - the energy from the sun.

Transmission - process for moving electric power in bulk at higher voltages from the source of supply to distribution centres.

Turbine - a machine for producing continuous power in a wheel or rotor.

Transformer – an apparatus for reducing or increasing the voltage of an alternating current.

Wind Energy - rotates rotor blades to produce electricity.

Student Glossary

Baseload - ______________________________

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Biomass - ______________________________

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Capacity - ______________________________

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Carbon Capture and Storage– ____________________

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Coal - ______________________________

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Conservation - ______________________________

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Dam - ______________________________

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Distribution - ______________________________

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Electricity - ______________________________

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Emissions - ______________________________

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Extract - ______________________________

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Student Glossary

Fission – ______________________________

Fossil Fuel - ______________________________

Fusion - ______________________________

Generator - ______________________________

Geothermal - ______________________________

Hydroelectricity - ______________________________

Megawatt - ______________________________

Methane - ______________________________

Natural Gas - ______________________________

Non-Renewable - ______________________________

Nuclear - ______________________________

Penstock – ______________________________

Student Glossary

Phantom Power – ______________________________

Reclamation - ______________________________

Renewable Energy - ______________________________

Reservoir – ______________________________

Rotor Blade – ______________________________

Run-of-River - ______________________________

Solar - ______________________________

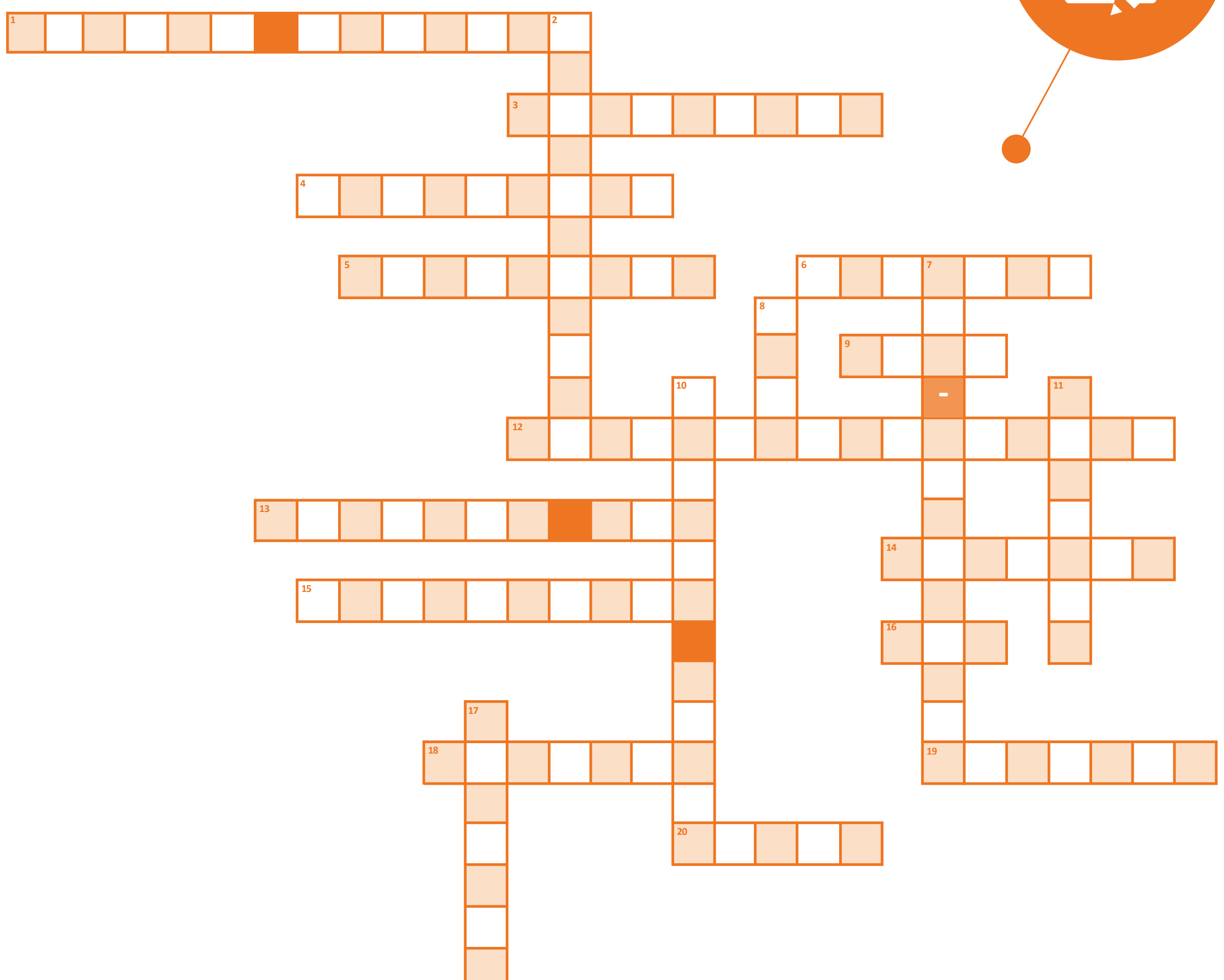
Transmission - ______________________________

Turbine - ______________________________

Transformer – ______________________________

Wind Energy - ______________________________

Student Activity Crossword Puzzle



ACROSS

1 2-words, to capture emissions and use it for other purposes instead of releasing it into the air and water

3 A source of energy that can be used over and over or replaced

4 A device that creates electricity from the energy of its spinning

5 The production and discharge of something

6 A metal found in rock

9 Rotates rotor blades to produce electricity.

12 Electricity generated by the force of water

13 A clear gas found underground

14 A flammable gas

15 Heat trapped under Earth's surface

16 A barrier constructed to hold water back and raise its level

18 A machine for producing continuous power in a wheel or rotor

19 To take out of the ground

20 The energy from the Sun

DOWN

2 A form of energy that can flow through conductors

7 A source of energy that can only be used once and cannot be replaced

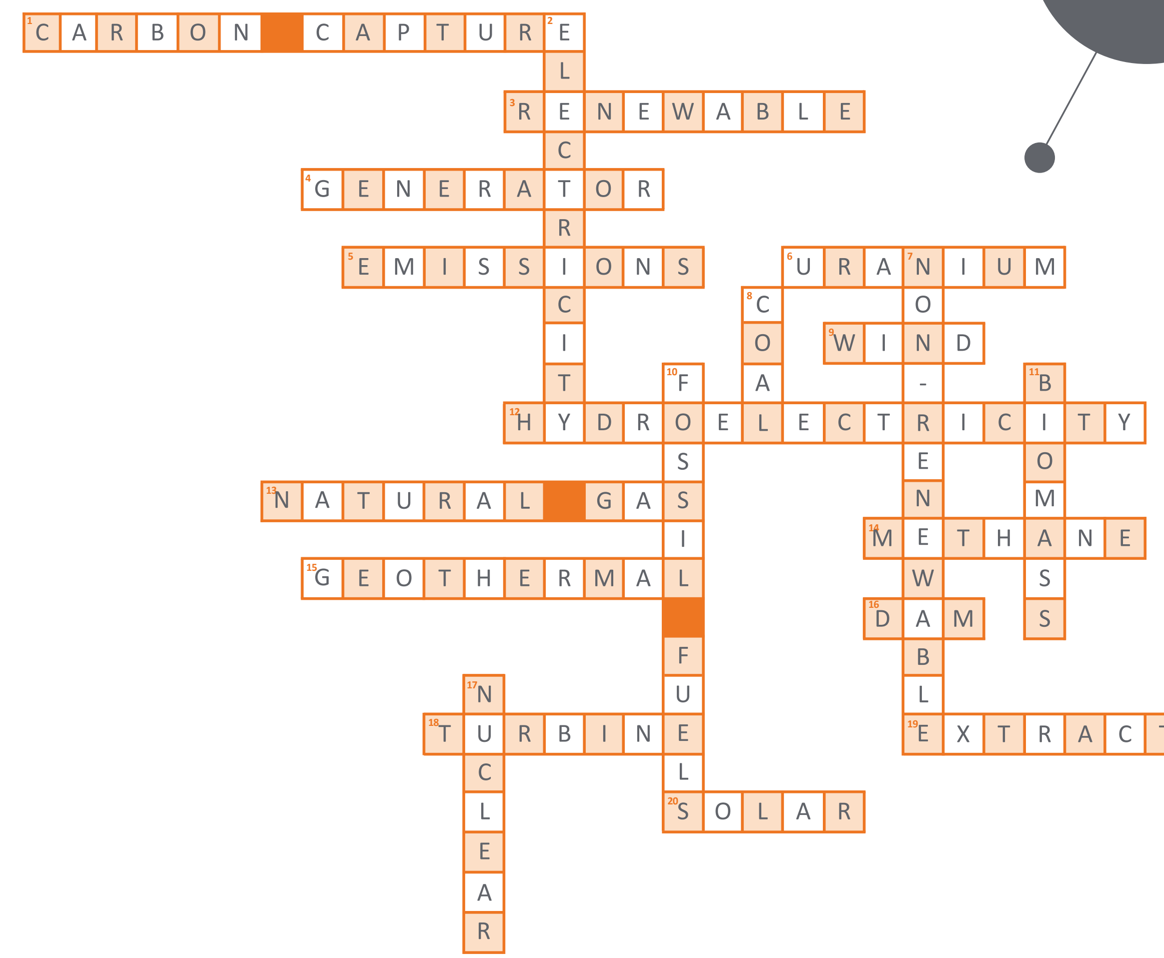
8 A fossil fuel that can be burned to make electricity or used to make other products

10 The organic remains of plants and animals

11 Any plant or animal material that can be safely burned and makes good fuel

17 Energy produced by the breakdown of the smallest units of matter

Teacher Answer Key Crossword Puzzle



ACROSS

1 *Carbon Capture* - capture emissions and use it for other purposes instead of releasing it into the air and water

3 *Renewable* - a source of energy that can be used over and over or replaced

4 *Generator* - a device that creates electricity from the energy of its spinning

5 *Emissions* - the production and discharge of something The production and discharge of something

6 *Uranium* - a metal found in rock

9 *Wind* - rotates rotor blades to produce electricity.

12 *Hydroelectricity* - electricity generated by the force of water

13 *Natural Gas* - a clear gas found underground

14 *Methane* - a flammable gas

15 *Geothermal* - heat trapped under Earth's surface

16 *Dam* - a barrier constructed to hold water back and raise its level

18 *Turbine* - a machine for producing continuous power in a wheel or rotor

19 *Extract* - to take out of the ground

20 *Solar (Energy)* - the energy from the Sun

DOWN

2 *Electricity* - a form of energy that can flow through conductors

7 *Non-Renewable* - a source of energy that can only be used once and cannot be replaced

8 *Coal* - a fossil fuel that can be burned to make electricity or used to make other products

10 *Fossil Fuels* - the organic remains of plants and animals

11 *Biomass* - any plant or animal material that can be safely burned and makes good fuel

17 *Nuclear* - energy produced by the breakdown of the smallest units of matter

Student Activity
Word Search

Highlight the words that go with non-renewable in BLUE.

Highlight the words that go with renewable in PINK.

Highlight the words that go with both in GREEN.

N	M	T	Y	J	L	A	S	G	D	K	S	C	P	X	U	O	D	A	G	Z	T	S	U	L
F	O	U	U	Y	P	S	Z	C	P	D	H	I	O	A	P	V	M	D	Z	Z	M	N	V	Z
V	P	I	X	R	A	Y	U	N	A	T	U	R	A	L	G	A	S	N	X	P	W	O	I	P
L	A	E	T	M	B	G	Z	V	L	Q	S	T	R	O	T	A	R	E	N	E	G	I	J	Z
V	V	H	O	U	W	I	Q	M	H	Z	A	C	J	U	I	X	H	Q	E	E	D	S	N	V
Y	B	I	B	N	L	E	N	C	D	R	C	E	Z	S	M	O	N	Q	E	F	L	S	J	S
K	B	S	M	A	W	L	Y	E	L	G	Y	L	U	V	S	F	J	I	V	B	K	I	L	Y
G	U	G	D	E	M	K	O	X	D	Y	T	E	S	B	B	B	J	Z	F	I	Q	M	C	F
L	E	A	W	L	G	G	D	P	I	A	W	O	O	I	H	L	A	Q	M	Y	R	E	R	S
I	N	O	B	C	Y	B	O	U	L	M	O	R	F	I	P	Y	N	K	R	Y	G	K	D	G
G	V	D	T	X	P	Z	C	W	N	F	U	D	O	E	U	X	K	M	Q	F	D	O	V	S
V	G	X	L	H	W	N	U	Y	E	O	E	Y	S	Z	D	Y	J	M	D	U	T	Y	D	T
C	O	R	E	W	E	R	E	H	H	L	D	H	S	X	Q	T	G	B	X	Z	U	H	H	C
S	V	X	S	X	A	R	L	T	B	M	R	V	I	Z	E	H	O	U	I	K	R	T	X	C
A	K	U	D	N	A	I	M	A	G	E	D	B	L	G	N	N	T	Y	P	E	W	E	E	P
B	Q	R	I	T	T	G	W	A	N	Y	B	C	F	R	X	C	L	K	T	T	L	I	U	M
L	A	U	L	O	F	E	T	E	L	G	M	S	U	Q	A	S	B	A	Q	I	L	P	N	Y
W	M	Y	A	A	N	R	W	M	M	V	N	V	E	J	M	L	W	Y	P	G	F	T	H	D
A	T	W	A	E	Q	A	M	E	C	H	J	Z	L	Y	G	C	O	A	L	G	J	U	P	T
P	F	N	R	V	B	F	K	T	B	X	Y	G	N	R	J	F	I	S	L	Q	S	Z	J	V
U	H	N	K	L	D	S	Y	H	Z	R	K	J	Q	G	K	N	X	N	S	J	N	N	K	G
Y	O	D	E	Z	T	D	Z	A	L	P	N	U	C	L	E	A	R	H	T	Y	B	D	J	R
N	L	O	T	X	T	Z	S	N	H	T	Q	C	N	H	N	B	B	U	A	V	G	Z	N	O
Y	G	R	E	N	E	R	X	E	I	N	S	G	B	J	K	U	V	X	K	G	F	W	N	E
Z	E	B	J	K	H	U	F	C	Q	Y	F	B	Z	K	M	H	I	N	Z	P	A	T	K	D

BIOMASS	FOSSIL FUEL	NATURAL GAS	SOLAR
CLEAN	GENERATOR	NONRENEWABLE	TURBINE
COAL	GEOTHERMAL	NUCLEAR	URANIUM
EMISSIONS	HYDROELECTRIC	POLLUTION	WATER
ENERGY	METHANE	RENEWABLE	WIND

Teacher Answer Key
Word Search

Highlight the words that go with non-renewable in BLUE.

Highlight the words that go with renewable in PINK.

Highlight the words that go with both in GREEN.

N	M	T	Y	J	L	A	S	G	D	K	S	C	P	X	U	O	D	A	G	Z	T	S	U	L
F	O	U	U	Y	P	S	Z	C	P	D	H	I	O	A	P	V	M	D	Z	Z	M	N	V	Z
V	P	I	X	R	A	Y	U	N	A	T	U	R	A	L	G	A	S	N	X	P	W	O	I	P
L	A	E	T	M	B	G	Z	V	L	Q	S	T	R	O	T	A	R	E	N	E	G	I	J	Z
V	V	H	O	U	W	I	Q	M	H	Z	A	C	J	U	I	X	H	Q	E	E	D	S	N	V
Y	B	I	B	N	L	E	N	C	D	R	C	E	Z	S	M	O	N	Q	E	F	L	S	J	S
K	B	S	M	A	W	L	Y	E	L	G	Y	L	U	V	S	F	J	I	V	B	K	I	L	Y
G	U	G	D	E	M	K	O	X	D	Y	T	E	S	B	B	B	J	Z	F	I	Q	M	C	F
L	E	A	W	L	G	G	D	P	I	A	W	O	O	I	H	L	A	Q	M	Y	R	E	R	S
I	N	O	B	C	Y	B	O	U	L	M	O	R	F	I	P	Y	N	K	R	Y	G	K	D	G
G	V	D	T	X	P	Z	C	W	N	F	U	D	O	E	U	X	K	M	Q	F	D	O	V	S
V	G	X	L	H	W	N	U	Y	E	O	E	Y	S	Z	D	Y	J	M	D	U	T	Y	D	T
C	O	R	E	W	E	R	E	H	H	L	D	H	S	X	Q	T	G	B	X	Z	U	H	H	C
S	V	X	S	X	A	R	L	T	B	M	R	V	I	Z	E	H	O	U	I	K	R	T	X	C
A	K	U	D	N	A	I	M	A	G	E	D	B	L	G	N	N	T	Y	P	E	W	E	E	P
B	Q	R	I	T	T	G	W	A	N	Y	B	C	F	R	X	C	L	K	T	T	L	I	U	M
L	A	U	L	O	F	E	T	E	L	G	M	S	U	Q	A	S	B	A	Q	I	L	P	N	Y
W	M	Y	A	A	N	R	W	M	M	V	N	V	E	J	M	L	W	Y	P	G	F	T	H	D
A	T	W	A	E	Q	A	M	E	C	H	J	Z	L	Y	G	C	O	A	L	G	J	U	P	T
P	F	N	R	V	B	F	K	T	B	X	Y	G	N	R	J	F	I	S	L	Q	S	Z	J	V
U	H	N	K	L	D	S	Y	H	Z	R	K	J	Q	G	K	N	X	N	S	J	N	N	K	G
Y	O	D	E	Z	T	D	Z	A	L	P	N	U	C	L	E	A	R	H	T	Y	B	D	J	R
N	L	O	T	X	T	Z	S	N	H	T	Q	C	N	H	N	B	B	U	A	V	G	Z	N	O
Y	G	R	E	N	E	R	X	E	I	N	S	G	B	J	K	U	V	X	K	G	F	W	N	E
Z	E	B	J	K	H	U	F	C	Q	Y	F	B	Z	K	M	H	I	N	Z	P	A	T	K	D

BIOMASS	FOSSIL FUEL	NATURAL GAS	SOLAR
CLEAN	GENERATOR	NONRENEWABLE	TURBINE
COAL	GEOTHERMAL	NUCLEAR	URANIUM
EMISSIONS	HYDROELECTRIC	POLLUTION	WATER
ENERGY	METHANE	RENEWABLE	WIND

Student Activity
"I have... Who has..."

I have... **TRANSMISSION.**
Who has something that lifts and rotates when wind is blown over it, causing a rotor to spin? Most wind turbines have three of them.

I have... **HYDROELECTRICITY.**
Who has the action of dividing or splitting something into two or more parts?

I have... **SOLAR.**
Who has energy produced by the breakdown of the smallest units of matter?

I have... **CARBON CAPTURE AND STORAGE.**
Who has a flammable gas?

I have... **METHANE.**
Who has to capture emissions and use it for other purposes instead of releasing it into the air and water?

I have... **BASELOAD.**
Who has heat trapped under the earth's surface?

Student Activity
"I have... Who has..."

I have... **NATURAL GAS.**
Who has a barrier constructed to hold water back and raise the level?

I have... **GENERATOR.**
Who has a machine for producing continuous power in a wheel or rotor?

I have... **TURBINE.**
Who has energy from the sun?

I have... **RUN-OF-RIVER.**
Who has a channel that carries water from a reservoir to a hydro turbine?

I have... **COAL.**
Who has electricity generated by the force of the wind?

I have... **BIOMASS.**
Who has a source of energy that can be used over and over or replaced?

Student Activity
"I have... Who has..."

I have... **NON-RENEWABLE.**

Who has the production and discharge of something?

I have... **GEOTHERMAL.**

Who has a device that creates electricity from an energy source?

I have... **TRANSFORMER.**

Who has power used by electronic devices when they are plugged in but not being used?

I have... **CAPACITY.**

Who has the organic remains of plants and animals?

I have... **NUCLEAR.**

Who has source of energy that can only be used once and cannot be replaced?

I have... **PHANTOM POWER.**

Who has systems that run 24/7?

Student Activity
"I have... Who has..."

I have... **CONSERVATION.**

Who has an apparatus for reducing or increasing the voltage of an alternating current?

I have... **FISSION.**

Who has a form of energy resulting from the existence of charged particles?

*I have...***WIND ENERGY.**

Who has to take out of the ground?

I have... **RENEWABLE ENERGY.**

Who has the maximum electric output an electricity generator can produce under specific conditions?

I have... **A DAM.**

Who has the process or result of joining two or more things together to form a single entity?

I have... **FOSSIL FUEL.**

Who has any plant or animal material that can be safely burned and makes good fuel?

Student Activity
"I have... Who has..."

I have... **ELECTRICITY.**

Who has water that is blocked by a dam?

I have... **FUSION.**

Who has instead of dams water is detoured from the river through a tube to produce electricity?

*I have...***PENSTOCK.**

Who has using less of something?

I have... **RESERVOIR.**

Who has a unit of bulk power equal to 1000 kilowatts?

I have... **EMISSIONS.**

Who has electricity generated by force of water?

I have... **MEGAWATT.**

Who has a clear gas found underground?

Student Activity
"I have... Who has..."

I have... **EXTRACT.**

Who has a fossil fuel that can be burned to make electricity?

I have... **RECLAMATION.**

Who has a process for moving electric energy at lower voltages from major substations to customers?

I have... **DISTRIBUTION.**

Who has a process for moving electric power in bulk at higher voltages from the source of supply to distribution centres?

I have... **ROTOR BLADE.**

Who has the act of returning something to a former or better state?

Teacher Answer Key
"I have... Who has..."

I have... **BASELOAD.**
Who has heat trapped under the earth's surface? **GEOTHERMAL**

I have... **BIOMASS.**
Who has a source of energy that can be used over and over or replaced? **RENEWABLE ENERGY**

I have... **CAPACITY.**
Who has the organic remains of plants and animals? **FOSSIL FUEL**

I have... **CARBON CAPTURE AND STORAGE.**
Who has a flammable gas? **METHANE**

I have... **COAL.**
Who has rotates rotor blades to produce electricity? **WIND ENERGY**

I have... **CONSERVATION.**
Who has an apparatus for reducing or increasing the voltage of an alternating current? **TRANSFORMER**

I have... **DAM.**
Who has the process or result of joining two or more things together to form a single entity? **FUSION**

I have... **DISTRIBUTION.**
Who has a process for moving electric power in bulk at higher voltages from the source of supply to distribution centres. **TRANSMISSION**

I HAVE... **ELECTRICITY.**
Who has water that is blocked by a dam? **RESERVOIR**

I have... **EMISSIONS.**
Who has electricity generated by force of water? **HYDROELECTRICITY**

I have... **EXTRACT.**
Who has a fossil fuel that can be burned to make electricity? **COAL**

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Who has any plant or animal material that can be safely burned and makes good fuel? **BIOMASS**

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Who has instead of dams water is detoured from the river through a tube to produce electricity? **RUN-OF-RIVER**

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Who has a machine for producing continuous power in a wheel or rotor? **TURBINE**

I have... **GEOTHERMAL.**
Who has a device that creates electricity from an energy source? **GENERATOR**

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Who has the action of dividing or splitting something into two or more parts? **FISSION**

I have... **MEGAWATT.**
Who has a clear gas found underground? **NATURAL GAS**

I have... **METHANE.**
Who has to capture emissions and use it for other purposes instead of releasing it into the air and water? **CARBON CAPTURE & STORAGE**

I have... **NATURAL GAS.**
Who has a barrier constructed to hold water back and raise the level? **DAM**

I have... **NON-RENEWABLE.**
Who has the production and discharge of something? **EMISSIONS**

I have... **NUCLEAR.**
Who has source of energy that can only be used once and cannot be replaced? **NON-RENEWABLE ENERGY**

I have... **PENSTOCK.**
Who has using less of something? **CONSERVATION**

I have... **PHANTOM POWER.**
Who has systems that run 24/7? **BASELOAD**

I have... **RECLAMATION.**
Who has a process for moving electric energy at lower voltages from major substations to customers? **DISTRIBUTION**

I have... **RENEWABLE ENERGY.**
Who has the maximum electric output an electricity generator can produce under specific conditions? **CAPACITY**

I have... **RESERVOIR.**
Who has a unit of bulk power equal to 1000 kilowatts? **MEGAWATT**

I have... **ROTOR BLADE.**
Who has the act of returning something to a former or better state? **RECLAMATION**

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Who has to take out of the ground? **EXTRACT**