ENERGY UNIT

Middle School & High School

TEACHER GUIDE

Unit Overview

Title/Time Needed	GLCEs & CCSSs Being Met	Materials Needed
Lesson 1 (p. 10) Energy and the Need for Growth One day of instruction (typical 55 minute class)	**6th Science GLCE** S.RS.06.14, S.RS.06.16, P.EN.06.12, P.EN.06.41 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3 **6th ELA CCSS** RI.6.7, SL.6.1 **7th Science GLCE** S.RS.07.14, S.RS.07.16, E.ES.07.42 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** RI.7.7, SL.7.1 **8th Social Studies GLCE** 8-P 4.2.2, P4.2.3 **8th ELA CCSS** RI.8.7, SL.8.1 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.7	• Copies of the *Energy Past & Present* Worksheet (found in Appendix A) • Copies of graphs to project • Computer w/ projection ability
Lesson 2 (p. 15) Introduction to Consumers Energy & Sources of Energy (Renewable vs. Non-Renewable) Two days of instruction (typical 55 minute class)	**6th Social Studies GLCE** 6-P4.2.2, P4.2.3 **6th ELA CCSS** SL.6.1, SL.6.4, SL.6.5, L.6.1, L.6.2, L.6.3 **7th Social Studies GLCE** 7-P4.2.2, P4.2.3 **7th ELA CCSS** SL.7.1, SL.7.4, SL.7.5, L.7.1, L.7.2, L.7.3 **HS Earth Science HSCE** S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 **8th Social Studies GLCE** 8 – P4.2.2, P4.2.3	• Copies of *Poster Directions* and *Exit Slip* (found in Appendix B) • Markers • Glue • Poster board • Internet access to review background information from this website: http://protectearth.net/category/alternative-energy/ • Scissors • Misc. magazines, newspapers, etc.

Lesson 2 Continued	<u>**8th ELA CCSS**</u> SL.8.1, SL.8.4, SL.8.5, L.8.1, L.8.2, L.8.3 <u>**Literacy in History/Social Studies, Science, and Technical Subjects**</u> RST.6-8.1, RST.6-8.7, WHST.6-8.7, WHST.6-8.8, WHST.6-8.9	
Lesson 3 **(p. 20)** Water & Hydroelectricity One to two days of instruction (typical 55 minute class)	<u>**6th Science GLCE**</u> S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 <u>**6th Social Studies GLCE**</u> 6–P 4.2.2, P 4.2.3 <u>**6th ELA CCSS**</u> RI.6.7, W.6.7, W.6.9, SL.6.1, SL.6.4, L.6.1, L.6.3 <u>**7th Science GLCE**</u> S.IP.07.12, S.IP.07.13, S.IA.07.13, S.RS.07.18 <u>**7th Social Studies GLCE**</u> 7–P 4.2.2, P 4.2.3 <u>**7th ELA CCSS**</u> RI.7.7, W.7.7, W.7.9, SL.7.1, SL.7.4, L.7.1, L.7.3 <u>**HS Earth Science HSCE**</u> S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 <u>**8th Social Studies GLCE**</u> 8 – P4.2.2, P4.2.3 <u>**8th ELA CCSS**</u> W.8.7, W.8.9, SL.8.1, SL.8.4, L.8.1, L.8.3 <u>**Literacy in History/Social Studies, Science, and Technical Subjects**</u> RST.6-8.2 , RST.6-8.3, RST.6-8.6, RST.6-8.9, WHST.6-8.7, WHST.6-8.9	• Copies of *Timeline Activity* (found in Appendix C) • Copies of *Hydropower Experiment* (found in Appendix D) • Pencil • Ruler • Crayons/colored pencils/markers • Poster board • Map of Michigan • Access to internet • Half gallon paper milk carton (empty and washed out) • Gallon of water to fill carton with • Nail • Masking tape • Ruler • Permanent marker • Scissors • Pencil • Tub of water or sink

Lesson 4 (p. 26) Thermal Power Using Coal Two days of instruction (typical 55 minute class)	**<u>6th Science GLCE</u>** S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 **<u>6th Social Studies GLCE</u>** 6–P 4.2.2, P 4.2.3 **<u>6th ELA CCSS</u>** RI.6.7, W.6.7, W.6.9, SL.6.1, SL.6.4, L.6.1, L.6.3 **<u>7th Science GLCE</u>** S.IP.07.12, S.IP.07.13, S.IA.07.13, S.RS.07.18 **<u>7th Social Studies GLCE</u>** 7–P 4.2.2, P 4.2.3 **<u>7th ELA CCSS</u>** RI.7.7, W.7.7, W.7.9, SL.7.1, SL.7.4, L.7.1, L.7.3 **<u>HS Earth Science HSCE</u>** S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 **<u>8th Social Studies GLCE</u>** 8–P 4.2.2, P 4.2.3 **<u>8th ELA CCSS</u>** W.8.7, W.8.9, SL.8.1, SL.8.4, L.8.1, L.8.3 **<u>Literacy in History/Social Studies, Science, and Technical Subjects</u>** RST.6-8.2 , RST.6-8.3, RST.6-8.6, RST.6-8.9, WHST.6-8.7, WHST.6-8.9	• Copies of *Background Information: Coal* (found in Appendix E) • Bituminous or soft coal samples (available from science catalogs or coal distributors) • Ice cream sandwiches • Wax paper (approximately 12” in length) • Construction paper • Rolling pin • Clear 2-liter pop bottle • Scissors • Pie plate • Sand and soil • Plant matter, leaves, and small sticks • Oil or nonstick cooking spray
Lesson 5 (p. 29) How is the Sun a Source? Let’s Talk Solar Two days of instruction (typical 55 minute class)	**<u>6th Science GLCE</u>** S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 **<u>6th Social Studies GLCE</u>** 6-P4.2.2, P4.2.3 **<u>6th ELA CCSS</u>** RI.6.7, W.6.7, SL.6.1, SL.6.4, L.6.1, L.6.3 **<u>7th Science GLCE</u>**	• Copies of *Solar Oven Activity* (found in Appendix F) • Pizza box (a used one is fine, but many local pizza businesses will donate materials) • Aluminum foil • Black construction paper or cardstock • Clear plastic (heavy plastic laminate works best, but cling wrap will work)

Lesson 5 Continued	S.IP.07.12, S.IP.07.13, S.IA.07.13, S.RS.07.18 **7th Social Studies GLCE** 7-P4.2.2, 4.2.3 **7th ELA CCSS** RI.7.7, W.7.7, SL.7.1, SL.7.4, L.7.1 **8th Social Studies GLCE** 8-P4.2.2, 4.2.3 **8th ELA CCSS** W.8.7, SL.8.1, SL.8.4, L.8.1 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.3, RST.6-8.6, RST.6-8.9, WHST.6-8.7, WHST.6-8.9	• Non-toxic glue or tape • Scissors • Ruler • Markers • Straw or wooden dowel • Plan activity on a sunny day for best results.
Lesson 6 **(p. 31)** Poop to Power – Also known as Biogas Two days of instruction (typical 55 minute class) Plus about 3 weeks of observation	**6th Science GLCE** S.IP.06.12, S.IP.06.13, S.IP.06.15, S.IP.06.16, S.IA.06.11, S.IA.06.13, S.RS.06.18 **6th Social Studies GLCE** 6–P 4.2.2, 6-P 4.2.3 **6th ELA CCSS** RI.6.7, W.6.7, W.6.9, SL.6.1, SL.6.4, L.6.1, L.6.3 **7th Science GLCE** S.IP.07.12, S.IP.07.13, S.IP.07.15, S.IP.06.16, S.IA.07.11, A.IA.07.13, S.RS.07.18 **7th Social Studies GLCE** 7–P 4.2.2,P 4.2.3 **7th ELA CCSS** RI.7.7, W.7.7, W.7.9, SL.7.1, SL.7.4, L.7.1, L.7.3 **8th Social Studies GLCE** 8–P 4.2.2, P 4.2.3 **8th ELA CCSS** W.8.7, W.8.9, SL.8.1, SL.8.4,	• Copies of *Methane Production Experiment* (found in Appendix G) • 6 bottles (1 liter clear plastic; wide mouth preferred) • 6 balloons (thick quality latex) • Permanent markers • Large spoon • Funnel • Rulers • String • 4 cups of raw vegetable scraps and grass. • 6 cups of soil from outdoors (NOT bagged potting soil)

Lesson 6 Continued	L.8.1, L.8.3 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.3, RST.6-8.6, RST.6-8.9, WHST.6-8.7, WHST.6-8.9	
Lesson 7 (p. 34) The Power of Wind One day of instruction (typical 55 minute class)	**6th Science GLCE** S.IP.06.12, S.IP.06.13, S.IA.06.13, S.RS.06.18 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3 **6th ELA CCSS** RI.6.7, W.6.7, W.6.9, SL.6.1, SL.6.4, L.6.1, L.6.3 **7th Science GLCE** S.IP.07.12, S.IP.07.13, S.IA.07.13, S.RS.07.18 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** RI.7.7, W.7.7, W.7.9, SL.7.1, SL.7.4, L.7.1, L.7.3 **8th Social Studies GLCE** 8-P 4.2.2, P4.2.3 **8th ELA CCSS** W.8.7, W.8.9, SL.8.1, SL.8.4, L.8.1, L.8.3 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.2, RST.6-8.3, RST.6-8.6, RST.6-8.9, WHST.6-8.7, WHST.6-8.9	• 1 copy of *Wind Action Cards* (found in Appendix H) • 1 copy per student – *Beaufort Scale* (found in Appendix I) • 15 juice or milk cartons, ½ gallon, emptied and washed Possible Materials for Windmills • Dowels, 12" long and approximately ¼" in diameter • 60 washers, medium sized • String • Paper cups (3 or 5 oz.) • Pen/Pencils • Index cards • Craft sticks • Coffee stirrers • 3" foam balls • Masking or duct tape • Tissue paper • Wax paper • Aluminum foil • Sandwich/freezer bags • Felt rectangles • Scissors • Fan, large • Crayons, markers, colored pencils • Rulers
Lesson 8 (p. 39) Transmission – How Does the Electricity Get from Consumers Energy to You?	**6th Science GLCE** S.RS.06.15, P.EN.06.42 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3 **6th ELA CCSS** RI.6.7, W.6.7	• Computers with internet connection • Access to YouTube • Various materials to make individual models (paper, markers, tape, glue, clay, paper clips, tooth picks, string or yarn, dental floss,

Lesson 8 Continued Three days of instruction (typical 55 minute class)	**7th Science GLCE** S.RS.07.15 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** RI.7.7, W.7.7 **8th Social Studies GLCE** _8-P 4.2.2, P4.2.3 **8th ELA CCSS** RI.8.7, W.8.7 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.6, RST.6-8.7	wire, sticks, cardboard, small toys)
Lesson 9 (p. 41) Energy Efficiency Two days of instruction (typical 55 minute class)	**6th Science GLCE** S.IP.06.15, S.IP.06.16 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3 **6th ELA CCSS** RI.6.1, W.6.7, SL.6.2 **7th Science GLCE** S.IP.07.15, S.IP.07.16, E.ES.07.42 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** RI.7.1, W.7.7, SL.7.2 **8th Social Studies GLCE** 8-P 4.2.2, P4.2.3 **8th ELA CCSS** RI.8.1, W.8.7, SL.8.2 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.6, WHST.6-8.7	• Copies of the *Energy Guide Worksheet* (found in Appendix J) • Copies of the *Energy Guide Homework* Assignment (found in Appendix K) • Copies of the *Exit Slip* (found in Appendix L) • Computers with internet connection
Lesson 10 (p. 44) Energy Conservation One to Two days of instruction (typical 55 minute class)	**6th Science GLCE** S.IP.06.11, S.IP.06.13, S.IA.06.13, S.RS.06.15, S.RS.06.18, P.EN.06.42 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3	• Copies of *Energy Brainstorm Chart* (found in Appendix M) • Copies of *Light Bulb Worksheet* (found in Appendix N) • Copies of *Electric Meters Worksheet* (found in Appendix O)

Lesson 10 Continued	**6th ELA CCSS** SL.6.1, SL.6.2, W.6.9 **7th Science GLCE** S.IP.07.11, S.IP.07.13, S.IA.07.13, S.RS.07.15, S.RS.06.18 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** SL.7.1, SL.7.2, W.7.9 **8th Social Studies GLCE** 8-P 4.2.2, P4.2.3 **8th ELA CCSS** SL.8.1, SL.8.2, W.8.9 **Literacy in History/Social Studies, Science, and Technical Subjects** RST.6-8.6, WHST.6-8.7	• Pencils • Rulers • Crayons • Colored pencils • Markers • Poster board • Map of Michigan
Lesson 11 (p. 51) Exploring Energy Careers Two days of instruction (typical 55 minute class)	**6th Science GLCE** S.RS.06.12, S.RS.06.15 **6th Social Studies GLCE** 6-P 4.2.2, P4.2.3 **6th ELA CCSS** SL.6.1, SL.6.2, W.6.9 **7th Science GLCE** S.RS.07.12, S.RS.07.15 **7th Social Studies GLCE** 7-P 4.2.2, P4.2.3 **7th ELA CCSS** SL.7.1, SL.7.2, W.7.9 **8th Social Studies GLCE** 8-P 4.2.2, P4.2.3 **8th ELA CCSS** SL.8.1, SL.8.2, W.8.9 **Literacy in History/Social Studies, Science, and Technical Subjects** WHST.6-8.7	• Copies of *Careers Worksheet* (found in Appendix P) • Copies of *Careers Project Worksheet* (found in Appendix Q) • Computer with internet connection • Materials to make a visual aid (Ex: PowerPoint software, poster board, etc.)
Lesson 12 (p. 53) Safety	6th Science GLCE S.RS.06.12, S.RS.06.15 6th Social Studies GLCE 6-P 4.2.2, P4.2.3	• Copies of *Electric Safety Awareness* (found in Appendix R) • Copies of *BINGO worksheet* (found in Appendix S)

Lesson 12 Continued One to two days of instruction (typical 55 minute class)	6th ELA CCSS SL.6.1, SL.6.2, W.6.9 7th Science GLCE S.RS.07.12, S.RS.07.15 7th Social Studies GLCE 7-P 4.2.2, P4.2.3 7th ELA CCSS SL.7.1, SL.7.2, W.7.9 8th Social Studies GLCE 8-P 4.2.2, P4.2.3 8th ELA CCSS SL.8.1, SL.8.2, W.8.9 Literacy in History/Social Studies, Science, and Technical Subjects WHST.6-8.7	• Computers with internet connection • Access to YouTube • Materials to make a visual aid (Ex: PowerPoint software, tablet and a recording app) • Poster decorating supplies – poster board, crayons, markers, pencils, etc.
Appendix Printable Materials		• Access to a printer

OVERVIEW

This unit helps integrate energy education into your existing curriculum by providing instructional materials to supplement your current content. Each section contains complete lesson plans with background information, discussion questions, activities and follow-up suggestions. The units are correlated to the GLCE's and CCSS. Essential question(s) can be used to frame your lesson as a problem to be solved. Write the question on the board and have each student answer it in a journal or a scrap piece of paper. When applicable, resources listed can include books, articles, websites and other publications to enhance the lesson. Any handouts included should be copied one per group or student as specified in the overview of each section.

ICEBREAKERS AND TEAM BUILDERS

(These are a few ideas on how to break the ice before starting the unit with a new class or how to pair individuals together in non-traditional or student-formed groups)

Comic Strip Chaos: Select a number of multiple-frame strip cartoons from the Sunday funnies. Cut them into individual frames and place the frames in a container. Each participant picks one comic frame from the container. After everyone has a frame, participants search for others with the same comic strip sequence. After participants have found everyone in their group, they must arrange themselves so the sequence of frames is in correct order. Upon completion of sequence, the newly formed group sits down together.

Toss a Name: Standing in a circle, the person with the ball calls someone by name and tosses the ball to them. When the other person catches it, they say, "Thank you, ______________" (the name of the person who threw it to him/her) and then calls upon another person to toss the ball to. After the balls have been tossed for a couple of minutes, start a second ball going at the same time, then a third and finally a fourth.

M & M®s: When a group is meeting for the first time, bring a large bag of M&Ms to introduce the group to each other. Have the group sit in a circle and help themselves to the candy, but not to eat them yet. When the bag has been around the full circle, each person must tell one thing about themselves for every M&M they took. A variation is to assign a number of things a person must tell about themselves to every color. Of course, don't tell people about this aspect of the game until they have already grabbed a handful.

Red:	Favorite Color	Green:	Memorable Vacation
Blue:	Favorite Food	Brown:	Fact of your choice
Yellow:	Favorite Movie	Orange:	Favorite Song

Lesson 1

Energy and the Need for Growth

OBJECTIVES:
- Students will be able to explain the two categories of energy.
- Students will be able to explain how energy use has changed over time.
- Students will assess how their energy use compares to previous generations and why this is important to understand.

ESSENTIAL QUESTION(S):
- What exactly is energy?

MATERIALS NEEDED/TIME (ONE, 55 MINUTE CLASS PERIOD):
- Copies of graphs to project
- Copies of the *Energy Past & Present* Worksheet (found in Appendix A)
- Computer with projection ability

INTRODUCTION:
Read the following information to students, stopping for explanation as needed:

Energy comes from many different sources. These sources are either renewable— they can be replenished within our life-time— or non-renewable— they cannot be replenished within our lifetime. Examples of renewable resources include water, wind, solar, biomass and geothermal. Examples of non-renewable resources include coal, oil, natural gas and nuclear.

What is energy? When most people think of energy, they think of electricity. Electricity is a form of energy, but there are many more. Energy is the ability to change or do work. All energy falls into two categories:

1. **POTENTIAL ENERGY:** Energy that is stored or is based on position.

   Nuclear Energy - Energy stored in the nucleus of an atom until split apart through nuclear fission

   Chemical Energy - Energy stored in atoms and molecules until released

   Gravitational Energy - Energy caused by the position of an object and influenced by gravity

2. **KINETIC ENERGY:** Energy made through motion.

   Electrical Energy - Energy created through the movement of electrons

Thermal Energy (Heat) - Energy created through the movement of atoms

Motion Energy - Energy created when objects move after a force is applied

Radiant Energy (Light) - Electromagnetic energy that travels in waves

People have used energy for thousands of years. Burning wood in a fire to cook a meal and using a sail to travel the ocean are both examples of early energy use. Although some of the energy we use today is similar to the energy people used long ago, most of our energy today comes from sources that are not easily replenished.

Our energy mostly comes from sources like coal and natural gas, which although plentiful, cannot be replenished quickly. Because these sources cannot easily be replaced, they are called non-renewable. Sources our ancestors used, such as wind and wood, that can be easily replenished are called renewables.

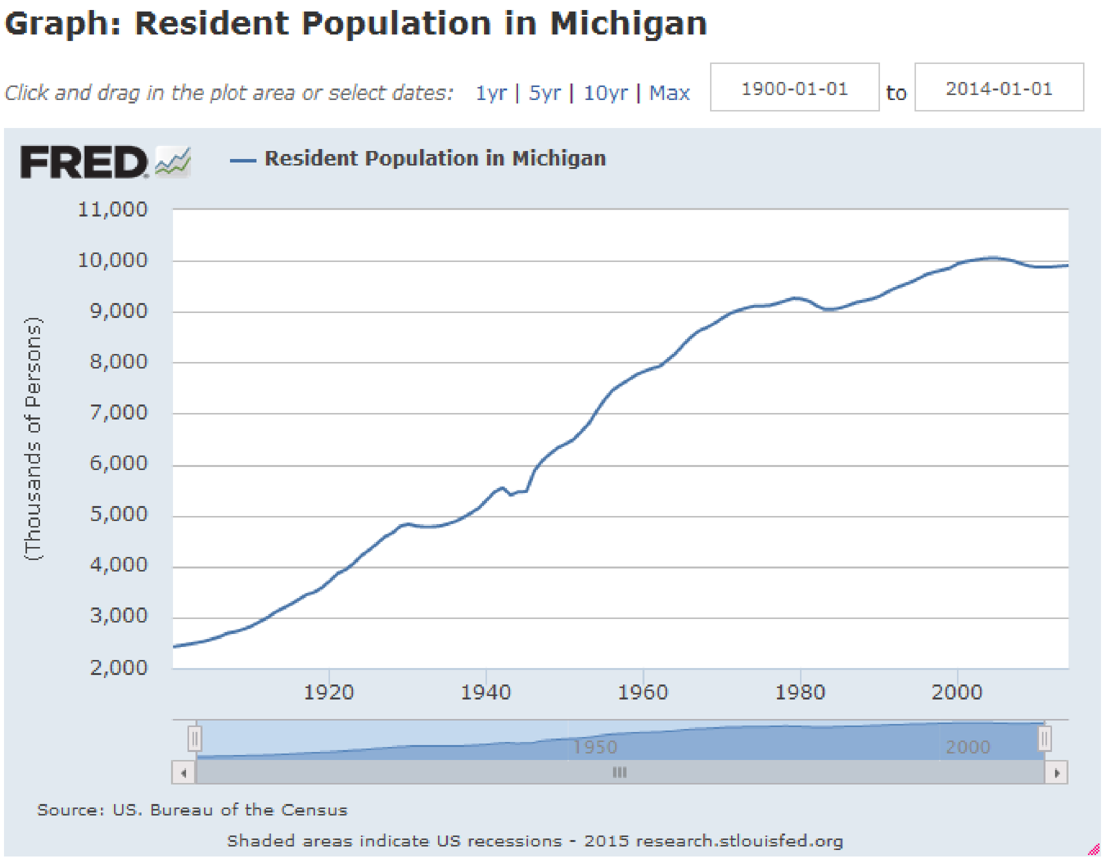
In recent years, there has been an increased interest in using renewable energy. Society is starting to recognize relying solely on non-renewable sources of energy means we will eventually run out. Using a balance of renewable and non-renewable energy sources is a more responsible and sustainable way to ensure future generations have access to affordable and reliable energy.

We are using more energy than ever before, mostly through the use of electric appliances. Items like cell phones, MP3 players, tablets, Blu-ray players, flat-screen TVs and more didn't even exist several decades ago and now are considered standard in many households. Most households even have more than one of these devices.

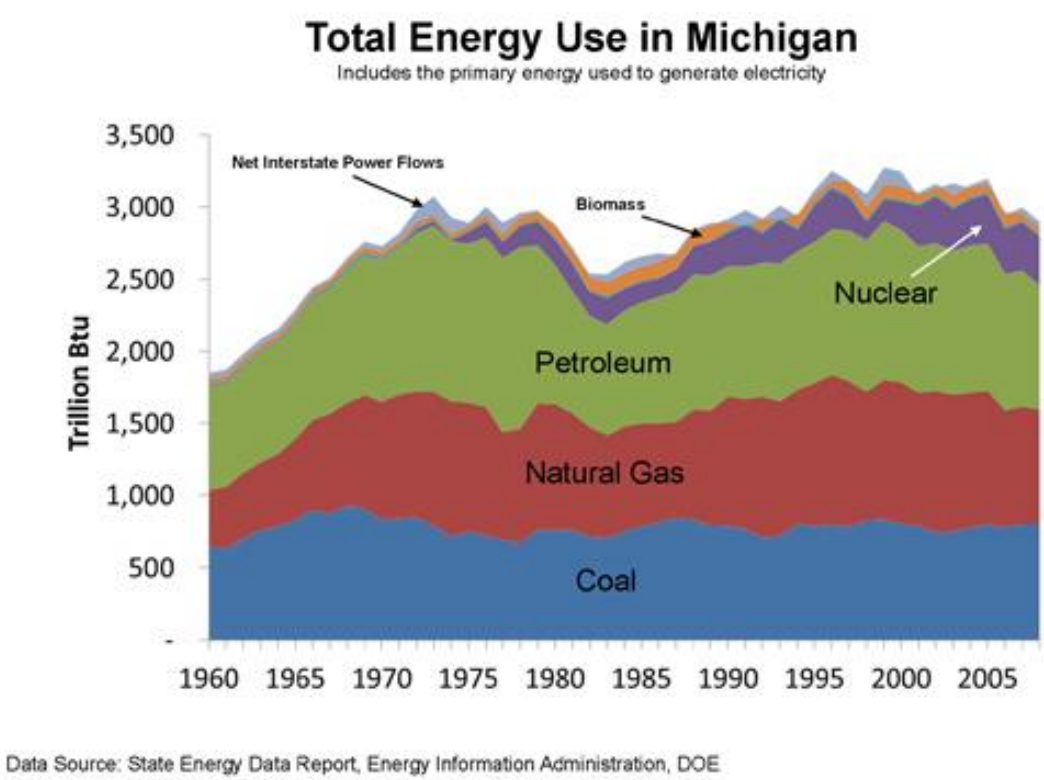
Population growth can also impact our energy use. Although the population in Michigan has declined in recent years, the trend over the last 100 years shows significant growth. More people using more energy means our overall use of energy is unlikely to decline anytime soon.

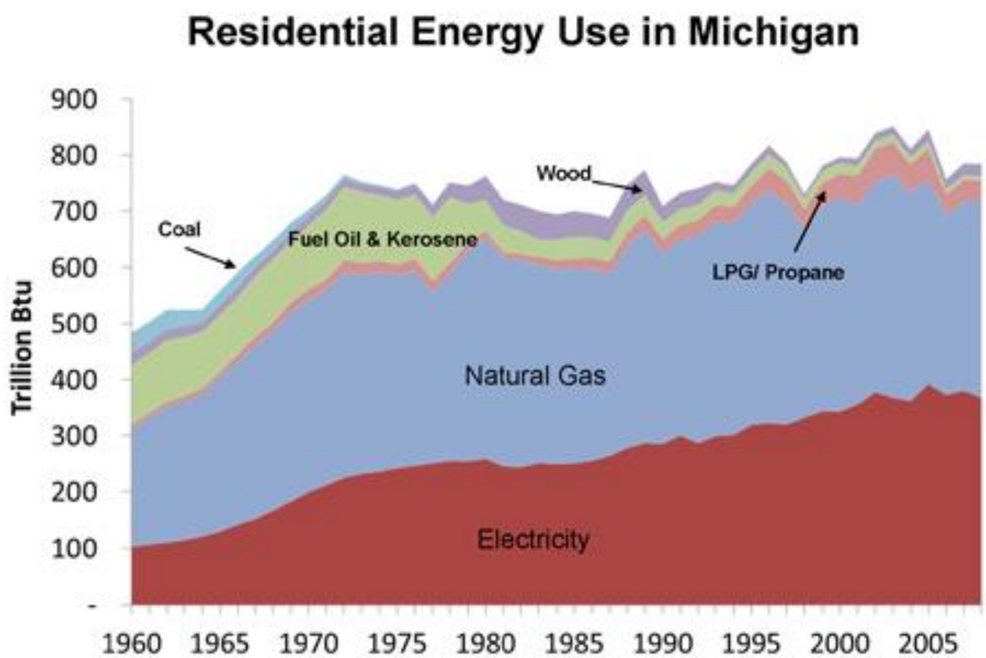
Note: Use graphs below to project in front of class and have students complete *Energy Past and Present* worksheet found in Appendix A.

Graph of Michigan Population from 1900 to the present



Graph of Michigan Energy Use over time
http://www.dleg.state.mi.us/mpsc/reports/energy/energyoverview/





Data Source: State Energy Data Report, Energy Information Administration, DOE

ENERGY PAST AND PRESENT HANDOUT (APPENDIX A) ANSWERS:

1. **What are some of the reasons energy use in Michigan has increased?**

   More technology, TVs, appliances, handheld devices, etc.

2. **What types of energy were used in the past for cooking, heating, and transportation? What about today?**

   Wood, natural gas, etc.

3. **Think about an appliance such as a dishwasher or washing machine. Using these items increases our energy use. What benefits do these items provide? How do we decide whether the benefit and convenience of an item is worth the increased use of energy?**

   These appliances allow us to wash more than one item at a time. It's a personal choice whether the amount of time it takes to complete a task is worth the amount of energy used.

4. **Our technological advances have benefited our society by creating new products that make our lives easier and more fun. Why should we be concerned about increasing energy consumption?**

   Increased consumption means increased use of energy sources.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **What do you think the chart might look like in the future when your children are filling it out?**

  The numbers in the graph will continue to grow over time.

- **Are there things you can do to decrease your energy use without negatively impacting your quality of life?**

  Yes, such as turning off things I'm not using and unplugging my chargers when I'm not charging my devices.

Lesson 2

Introduction to Consumers Energy & Sources of Energy

(RENEWABLE VS. NON-RENEWABLE)

OBJECTIVES:

- Students will be able to list at least three forms each of renewable and nonrenewable energy sources.
- Students will be able to explain how each source impacts the human population and the environment.
- Students will create a poster depicting the relative availability, uses and impact of each source.

ESSENTIAL QUESTION(S):

- How do renewable and nonrenewable energy sources impact the human population and the environment?

MATERIALS NEEDED/TIME (TWO, 55 MINUTE CLASS PERIODS):

- Copies of *Poster Directions* and *Exit Slip* (found in Appendix B)
- Markers
- Glue
- Poster board
- Scissors
- Misc. magazines, newspapers, etc.
- Internet access to read background information together from this website: http://protectearth.net/category/alternative-energy/

INTRODUCTION:

Consumers Energy, Michigan's largest utility, is the principal subsidiary of CMS Energy, providing natural gas and electricity to 6.6 million of the state's 10 million residents in all 68 Lower Peninsula counties. They have been in business for nearly 130 years.

What items in your house or at school use electricity?

Answer: TV, lights, telephone, computer, fridge, microwave, dishwasher, stove, washer, etc.

What items in your house or at school use natural gas?

Answer: Furnace, water heater, stove, dishwasher, etc.

Does anyone recall how we get electricity to make these things work?

Answer: Coal, oil, natural gas, wind, water, sun/solar, etc.

Remember that there are two types of sources where our energy can come from; one is renewable and the other is non-renewable.

What is the definition of a renewable source?

Answer: Something you can use over and over again. It can be replenished in a short amount of time and it is usually good for the environment. Some examples are wind, water, sun and biogas.

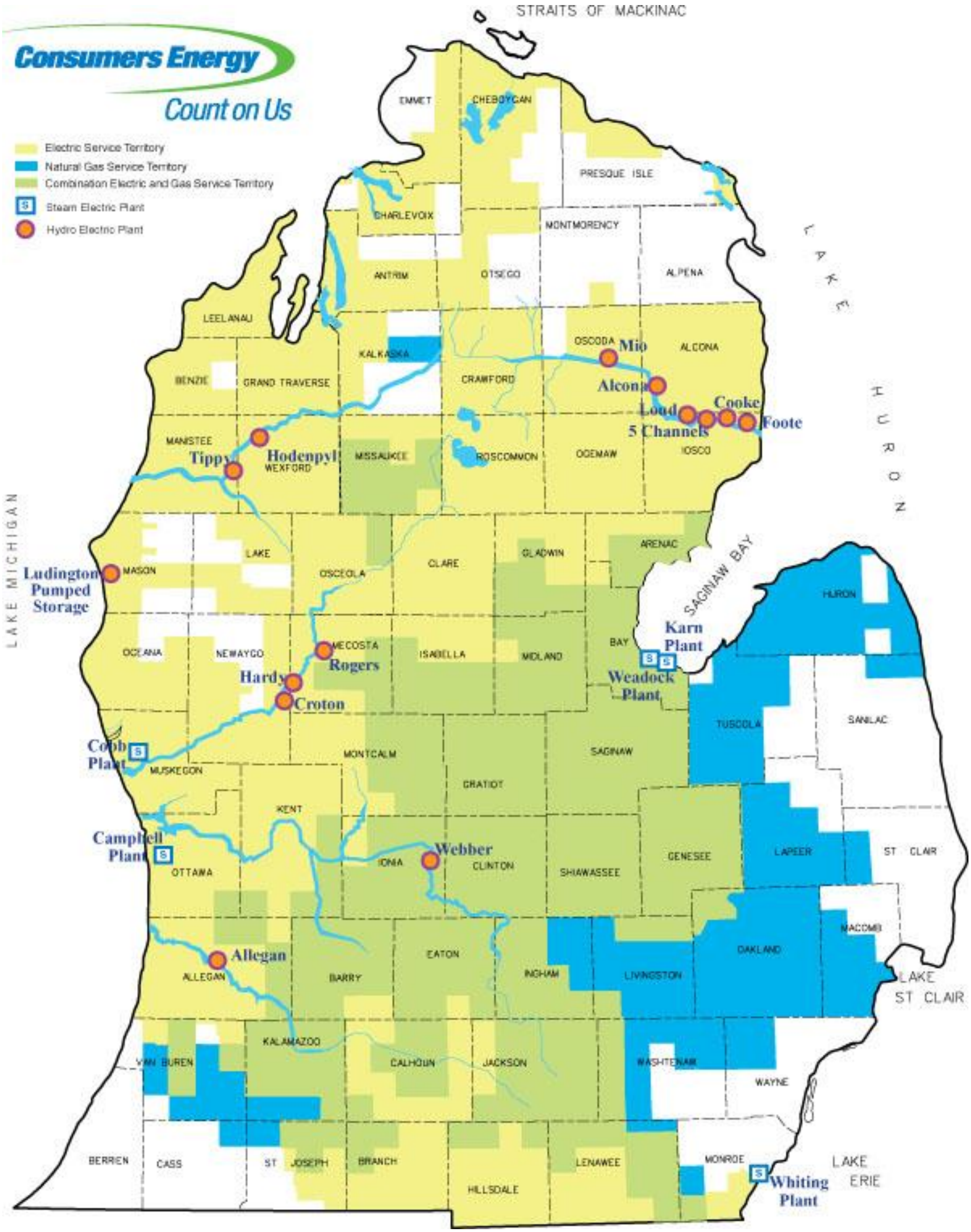
What is the definition of a non-renewable source?

Answer: Once you use it you lose it. Often these sources come from fossil fuels – which are coal, oil, and natural gas. They were formed over millions of years. Another non-renewable source is nuclear energy, which involves splitting uranium atoms in a process called nuclear fission.

Consumers Energy balances the two to make our energy environment better.

Note: Use *Electric and Gas Service Territories* map below to project in front of class.

Electric and Gas Service Territories



All energy sources have both positive and negative impacts on society and the environment. Students will discuss the positive and negative effects of each source with regard to availability, uses, and impacts upon humans and the environment.

ACTIVITY:

- Ask students to think about the different forms of energy they used this morning:
  - Did you listen to the radio, TV or alarm clock?
  - Did you turn on the water to brush your teeth?
  - Did you take a shower? Did you eat breakfast—hot or cold?
  - How did you get to school this morning?
  - Where did all of these types of energy originate?
- Direct students to make a quick thinking map listing all of the energy sources they have used so far today. Remind them to include the energy for making meals, transportation to school and the energy at school.
- Have volunteers share their listing of energy sources.

PROCEDURE:

1. Assign students into groups of 2-3. Have students think back to the types of energy they used today. Ask students to discuss in their groups/pairs, What is the source of this energy? (fossil fuels, solar, wind, etc.) Are these types of energy renewable or non-renewable?
2. Have students discuss, using what they already know, what the impact of these types of energy is on humans? What is the impact of these types of energy on our environment?
3. Explain: Students will create a poster depicting a different type of renewable and nonrenewable energy. How are these energy sources used? How do they impact humans and the environment?

Note: Print off *Poster Directions,* located in Appendix B, for students to reference.

4. Give students adequate amount of time to prepare their poster presentations.
5. Student groups will take turns presenting their poster to the class, explaining the origin of each energy type, how the energy is used and how it affects us and our environment. The posters will be displayed around the room and the class will collaboratively discuss any additional energy sources or effects not addressed.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **Why do we care about the type of energy we are using?**

  We care because our energy use affects our environment and how much we pay for our energy.

- **Why do we need to explore other types of energy?**

  We need to explore other types of energy because some types may eventually run out. We want options that are renewable and good for the environment.

Note: As a closure activity, each student should complete the *Exit Slip*, found in Appendix B for this activity.

TEACHER INFORMATION PAGE:

Conserve Energy Future—Be Green and Stay Green

http://www.conserve-energy-future.com/

The Children's University of Manchester
http://www.childrensuniversity.manchester.ac.uk/interactives/science/energy/renewable/

Non-renewable and Renewable Resources! Power Point

http://www.google.com/url?sa=t&rct=j&q=renewable%20and%20nonrenewable%20resources&source=web&cd=9&ved=0CEUQFjAI&url=http%3A%2F%2Feducation.jlab.org%2Fjsat%2Fpowerpoint%2F0708_renewable_nonrenewable.ppt&ei=K-QBVbfMNYqvyQTU_oLQCQ&usg=AFQjCNEPwzZO1RadvbB61ya4dvtSEHdERA&sig2=hfBfkE1G8b8KOBUbnF3B5w&bvm=bv.88198703,d.aWw

Quest
http://science.kqed.org/quest/2014/02/13/nonrenewable-and-renewable-energy-resources/

Energy Kids

http://www.eia.gov/kids/energy.cfm?page=nonrenewable_home-basics

Renewable and Non-renewable Resources—Environment and Ecology Series

http://pubs.cas.psu.edu/FreePubs/pdfs/uh177.pdf

Lesson 3

The Power of Water and Hydroelectricity

OBJECTIVES:

- Discuss the ways humans have utilized water in the past and present.
- Explain and draw a dam and the process of how electricity is made.
- Discuss the pros and cons of this renewable resource.

ESSENTIAL QUESTION(S):

- How does the power of water and hydroelectricity improve the quality of life?

MATERIALS NEEDED/TIME (TWO, 55 MINUTE CLASS PERIODS):

- Copies of *Timeline Activity* (found in Appendix C)
- Copies of *Hydropower Experiment* (found in Appendix D)
- Pencil
- Ruler/meter stick
- Crayons/colored pencils/markers
- Poster board
- Map of Michigan
- Access to internet
- Two days of instruction (typical 55 minute classes) **dependent upon what you assign for homework and class work

INTRODUCTION TO HYDROPOWER:

We have used the power of moving water throughout history. The earliest use of water's energy was with a water wheel. This type of wheel was propelled by the force of water falling against the blades and was used more than 2,000 years ago. Water wheels have been used to grind grain, mill lumber, weave, and perform other tasks.

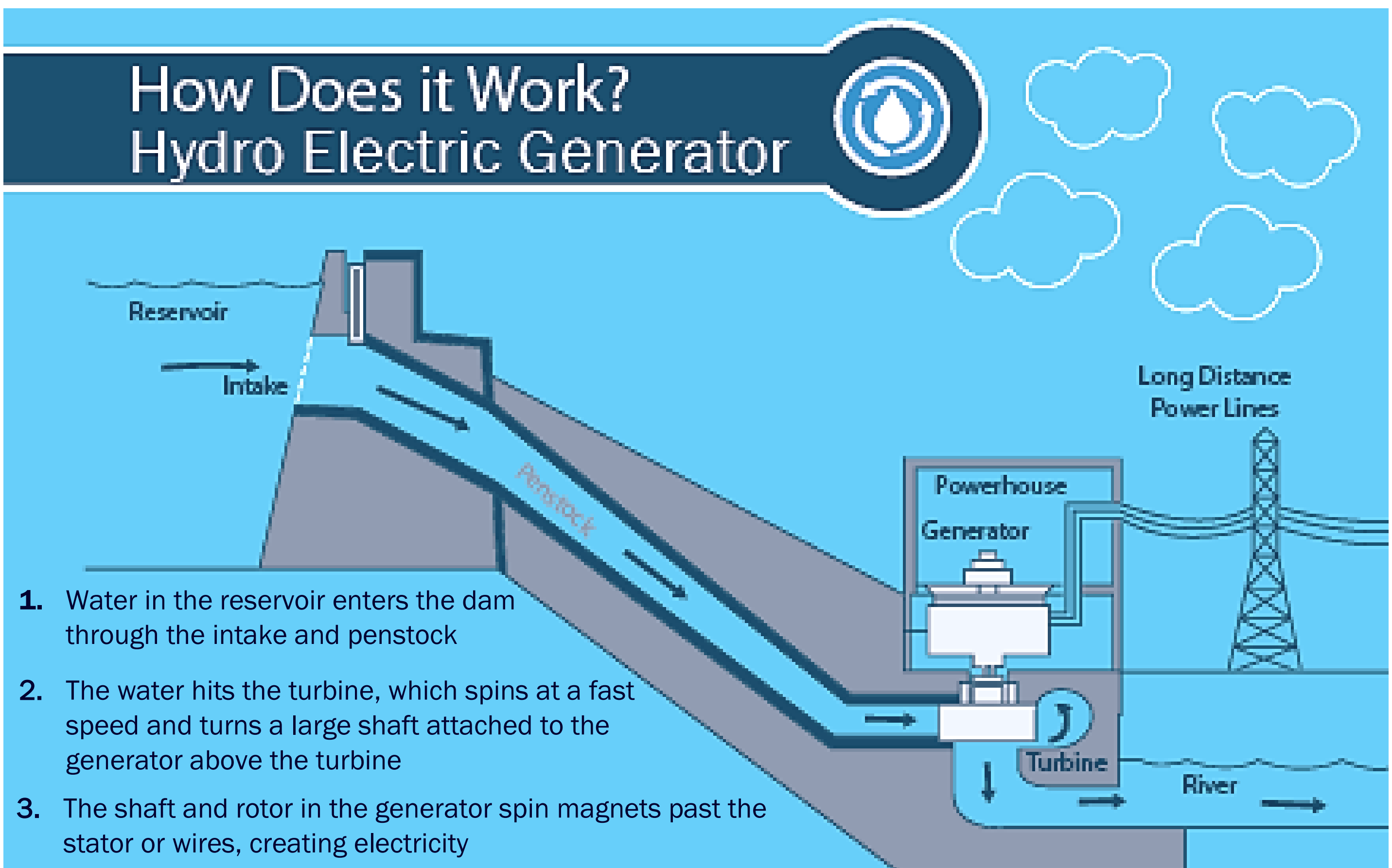
Many of these wheels have been abandoned over the years, but we still use giant turbines at hydroelectric dams to transfer the energy of moving water to generate electricity right here in Michigan.

<u>Kinetic Energy</u> – Energy produced through motion. Water wheels converted water energy into mechanical energy and powered grinding stones and other machinery. Water turbines were then developed and used to power electric generators more than 100 years ago.

Michigan has more than 100 hydros and Consumers Energy owns 13 located on five rivers. (Show map of hydros in Michigan or give locations and have the students plot them out by visiting our website).

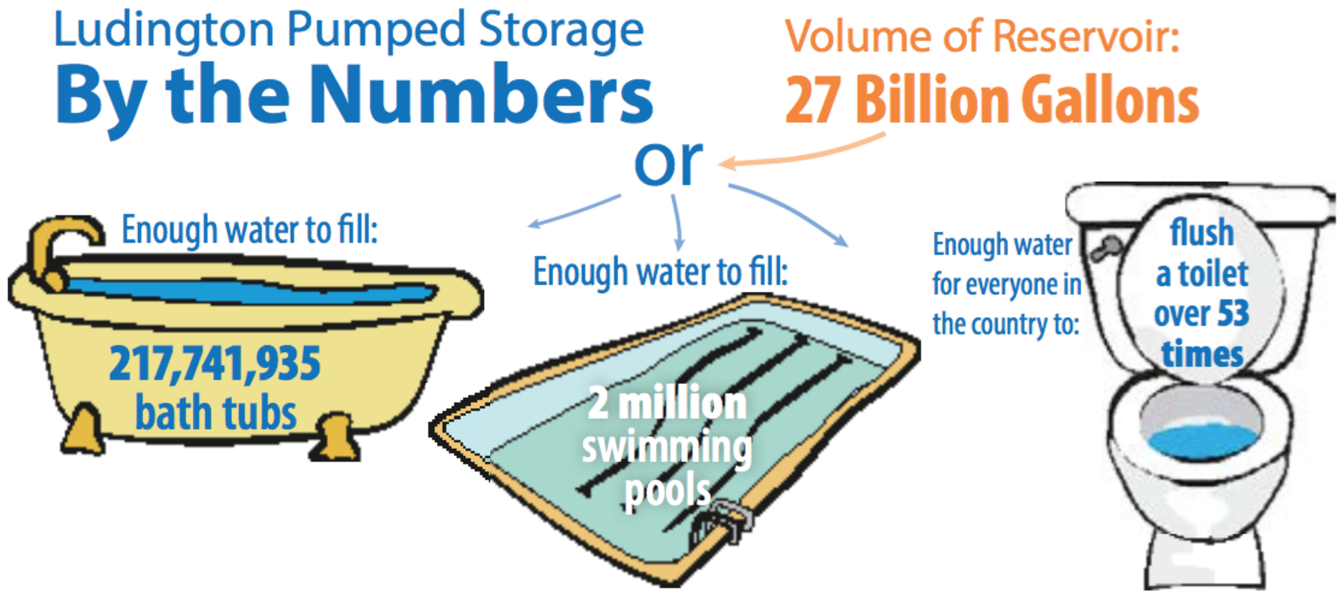
Hydropower creates 1 percent of Michigan's electricity. Rainfall and snow level affect the output and levels of the rivers and lakes where hydros operate.

A hydro dam was built to store water and generate electricity. The dam's powerhouse, which houses all of the generating equipment, is located at the base or the front side of the dam. Dams have several turbines and generators inside. The water turns the turbine by flowing downstream through the dam passageway called a penstock. It then passes through a chamber where it turns the turbine blades. The force of the water being pulled down through the penstock exerts pressure. Water flow is controlled by a wiki gate at the opening of the penstock. When the gate is closed no electricity is produced, but when the gate is opened the generator begins to produce electricity. After the water turns the turbine, the water then leaves the dam and flows into the river downstream.



1. Water in the reservoir enters the dam through the intake and penstock
2. The water hits the turbine, which spins at a fast speed and turns a large shaft attached to the generator above the turbine
3. The shaft and rotor in the generator spin magnets past the stator or wires, creating electricity
4. The generator has many wires inside the stator collecting the electricity. Those wires condense to a large power line, which takes the electricity to a transformer that steps up voltage from the powerhouse to the large power lines/towers on the outside of the dam.
5. The large power lines/towers take the electricity to businesses and homes where it is used to power lights, appliances, etc.

The Ludington pumped storage facility works in a similar way. However, first we pump water up into a reservoir at night when electricity is the least expensive. Once the reservoir is filled to capacity, the water is sent down the penstocks and the gates are opened to allow the water to flow through the turbine blades, generating electricity during the day when it is needed. This facility is used to quickly meet increased demand for electricity or replace generating capacity when other plants experience an outage. Water levels and the aquatic life are closely monitored.



Here is how it works:

1 At night, when electric demand is low and the cost of electricity is cheaper, Ludington's reversible turbines pump water from Lake Michigan through the penstocks 363 feet uphill to the intake building and into the reservoir.

2 During the day, when electric demand is high and the cost of electricity is more expensive, the pumps are reversed and when the water enters through the intake in the reservoir, the water travels back down the penstock.

3 The water spins the turbine at a fast speed, which then turns a large shaft attached to the generator that sits above the turbine.

4 The shaft and rotator in the generator spin magnets past the stator or wires, which creates electricity.

5 There are wires inside the stator that collect the electricity. Those wires condense to a larger power line which takes the electricity to a transformer that steps up voltage from the powerhouse to the larger power lines and towers.

6 The large power lines and towers take the electricity to businesses and homes where it is used to power lights and appliances.

7 Ludington Pumped Storage produces up to 1,872 megawatts, enough to power a city of nearly 1.4 million people. By comparison, the Hardy Hydro dam — which has the highest generating capacity of the 13 river hydros — produces about 30 megawatts.

Note: Use graphics in this section to project in front of the class.

Pros	Cons
Least expensive way to generate electricity	Dam changes the river and its valley when releasing water
A free natural resource	Water is oxygen deficient when released, so it must be aerated to protect wildlife

ACTIVITY 1:

1. Have students identify past and present hydropower uses in our communities in Michigan by doing research on the internet or at the local library. Are there any old mills in their area or a dam nearby?
2. Break the students into groups and print out the *Timeline Activity* worksheet found in Appendix C to give to each group.
3. Tell them that each group is going to draw a timeline of the history of water in our Great Lakes state and list 15-20 facts about the history of water and hydroelectricity. Allow them enough class time and resources to complete this part of the lesson or assign this as a take-home piece.
4. Once each group has created their timeline, have them report out to the class and create one classroom timeline on larger paper to post for the duration of the lesson/week.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **Review the history of hydropower in Michigan.**
- **Will hydropower continue to be a source of generation for the future, why or why not?**

  Yes, because we will always be able to use water as a source of energy.
- **Ask the students to discuss the pros and cons of hydropower and list them on their paper.**

  Pros: Renewable and a plentiful resource in Michigan with the Great Lakes.
  Cons: Doesn't make a lot of electricity and has limited locations.

ACTIVITY 2:

INTRODUCTION

Students will identify how hydroelectric facilities use water pressure to generate electricity. They will construct a makeshift dam using common household materials. They will discuss how water pressure, the flow of the water and distance using gravitational force create electricity.

This activity will provide students an opportunity to take a look at how water pressure and the force of water can turn a turbine at a hydroelectric dam and create electricity. Students will learn that electricity can be made using water, a renewable resource, and what amounts of water pressure are needed to produce electricity.

Print off one *Hydropower Experiment* worksheet, found in Appendix D, per student group. Compile the supplies in the W*hat You'll Need* section on the handout of the experiment for each group.

PROCEDURE:

1. Start the lesson by discussing how electric power was pioneered in Michigan along its rivers, and today Consumers Energy continues to operate 13 hydroelectric plants along five waterways (Au Sable, Kalamazoo, Manistee, Muskegon and Grand Rivers). The hydros were built between 1906 and 1935 and have a combined generating capacity of approximately 130 megawatts, enough to serve about 70,000 people. Near our hydros are campgrounds, boat launches, picnic areas and other recreational facilities. They are popular spots for canoeing and fishing, and many visitors also enjoy bird watching and exploring the nearby nature trails.
   - Hydropower uses the energy of moving water for a variety of useful applications.
   - Hydroelectricity is generated by harnessing the gravitational force of falling water.
   - Most hydroelectric power stations use water held in dams to drive turbines and generators which turn mechanical energy into electrical energy.
   - Hydroelectricity is a form of renewable energy.
   - Hydropower has been used to power watermills for thousands of years.
   - The most common type of watermill grinds grains into flour.

2. For the *Hydropower Experiment*, watch the streams of water flow and have the students record the distance of each stream in their experiment to communicate findings of how dams make hydroelectricity.
   1. Divide the class into small groups.
   2. Give each group one of the worksheets to complete.
   3. Have the groups follow the directions on their handout and record their findings.
   4. Repeat the experiment a few times to measure the stream of water and calculate the average of your measurements if time permits.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **How far away did the stream of water fall from the carton?**

  Answers will vary.

- **Was there a difference between the streams of water from the bottom hole to the top hole? If so, why do you think this is?**

  Yes, the top hole's stream was longer due to more water being in the container, causing more pressure.

Additional resources regarding information about dams Consumers Energy owns and operates can be acquired at http://www.consumersenergy.com/content.aspx?ID=1710.

Lesson 4

Thermal Power Using Coal

OBJECTIVES:

- Students will investigate the following coal-related topics: identification & formation, mining, energy, environmental impacts and legislation.
- Students will be educated about the practices in developing coal, which is a massive energy resource.
- Students will be exposed to the developments that are being made in the technology of renewable energy.

ESSENTIAL QUESTION(S):

- What do you think was the most prevalent source of electricity in the past? Do you think this source will remain as important in the future? Why or why not?

MATERIALS NEEDED/TIME:

- Copies of *Background Information: Coal* (found in Appendix E)
- Bituminous or soft coal samples (available from science catalogs or coal distributors)
- Ice cream sandwiches
- Wax paper (approximately 12" in length)
- Construction paper
- Rolling pin
- Clear 2-liter pop bottle
- Scissors
- Pie plate
- Sand and soil
- Plant matter, leaves and small sticks
- Oil or nonstick cooking spray

REVIEW:

- Ask students: "How do you define energy?" *(Energy is the ability to do work.)*
  Review: Work is done when something changes or moves. Kinetic energy is energy in motion, while potential energy is stored energy contained in an object.

- "What types of energy can you identify?" Ask students to list five activities they do each day that using energy *(think, walk, use a light, drive, etc.).*

- Ask the students, “What forms of energy do you know?” Listen to their answers and summarize their statements. *Examples: Electrical, heat, mechanical, chemical, light & nuclear*
- Discuss the fuels or resources needed to produce energy. Relate how our bodies use food as fuel to help give us energy. As a class, list types of energy resources or fuels used to produce energy. Examples: petroleum, coal, natural gas, solar, wood, water, wind, etc.
- Explain the concept of renewable vs. non-renewable energy.
    - **Renewable Energy** – Sources that do not run out or can be replenished within a short period of time (examples: solar, wind, water, biomass, geothermal).
    - **Non-Renewable Energy** – Sources that cannot be replenished within a short period of time (examples: coal, oil, natural gas, nuclear).

ACTIVITY:

1. Distribute coal samples and ask students if they can verify characteristics of this material based on their prior knowledge. (Do not tell students this is coal yet.) Have students work with partners to describe and list characteristics of samples: texture, color, luster, smell and hardness.

2. Students should create their own data chart to collect this information.

3. Review as a class and list characteristics collected. Verify samples as "coal" and brainstorm to determine students’ knowledge of coal. Have students share knowledge or experiences they have had with coal.

4. Distribute copies of *Background Information: Coal,* found in Appendix E, for students to read. (Procedure for this is up to individual teacher: small groups, silent read, whole class read.)

COAL CREATION OPTION #1

1. On a display table, place a sheet of construction paper on wax paper. Set three ice cream sandwiches on top of each other and then place them on the construction paper. Explain the ice cream represents moisture and the dark wafers represent compressed plant matter.
2. Press the ice cream sandwiches together with an oiled rolling pin.
3. Ask students how this represents the formation of coal. Continue pressing ice cream sandwiches to a depth of approximately 1 cm. Discuss observations.
4. Define coal as a fossil fuel. (It is a sedimentary rock formed by the burial and compression of accumulated plant material.)

5. Allow pressed ice cream sandwiches to dry out for several days. Observe changes. (The wafers should be compressed into a dry, firm mass.) Discuss observations and have students relate activity to the formation of coal, a fossil fuel.

COAL CREATION OPTION #2

1. Carefully cut a 2-liter soda bottle in half. Coat the inside of the bottle with oil or nonstick spray. Place approximately 50 ml. of water on bottom.
2. Add layer (4-5 cm.) of sand and soil. Add layer (5-6 cm.) of leaves and small twigs.
3. Cover with layer of soil and sand (fill to top of bottle). Poke ten or more holes near bottom of soda bottle.
4. Over the next few days, instruct volunteer to press down material in bottle with palm of hand or flat surface. (This will press out excess water.) Allow to set for several days.
5. Invert bottle on pie pan and have students make observations.
6. Facilitate class discussion comparing activity to the coal formation process.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **What did you observe after completing the coal creation activity?**

  The plant and animal remains turned into coal.

- **How do the plant and animal remains turn into coal?**

  Over time, the pressure and heat caused chemical and physical changes, turning the remains into coal.

ENRICHMENT ACTIVITIES:

- Assign research to investigate mining practices, both past and present. Topics should include the basic process of excavating coal, efficiency of operations, health and safety of miners, economic ramifications and environmental impacts. Land reclamation issues should be included. (Specific dates indicating changes in the industry should be collected for next lesson.) Encourage students to use a variety of resources to gather information, which may include personal interviews of miners.

Suggested Websites for Coal Research:

- Energy kids: http://www.eia.gov/kids/energy.cfm?page=coal_home-basics
- Kid's Korner: http://www.fplsafetyworld.com/?ver=kkblue&utilid=fplforkids&id=16201
- Kentucky Geological Survey: http://www.uky.edu/KGS/education/coal.htm

Lesson 5

How is the Sun a Source – Let's Talk Solar

OBJECTIVES:

- Students will investigate solar power.
- Students will discuss how individuals and companies harness the energy from the sun to make heat and electricity.

ESSENTIAL QUESTION(S):

- How did people from the past use the sun to help them in their daily lives? How is solar power a sustainable energy option?

MATERIALS NEEDED/TIME:

- Copies of *Solar Oven Activity* (found in Appendix F)
- Pizza box (a used one is fine, but many local pizza businesses will donate materials)
- Aluminum foil
- Black construction paper or cardstock
- Clear plastic (heavy plastic laminate works best, but cling wrap will work)
- Non-toxic glue or tape
- Scissors
- Ruler
- Markers
- Straw or wooden dowel
- Plan activity on a sunny day for best results

***This lesson is adapted from "Cook Your Own Snack" -GrowNYC*

INTRODUCTION:

The sun's energy can heat water or generate electricity, an effective way to help reduce the need for more energy plants and to reduce pollution. What is solar energy? What have you seen in the community that generates energy? How do you think the sun and wind are sources of energy? After a brief discussion continue on to the activity.

ACTIVITY:

- Ask students, "What do you use at home to cook your food? Where does the energy come from to power those appliances?" Discuss these questions as a class.

- Have students work in pairs to answer the following prompt, “What do we use the sun for? Describe what you know about our sun.” Share answers from small pairs to whole group.

- Tell students they are going to make their own solar oven from a pizza box. Ask students, “How hot do you think a pizza box solar oven can reach?” Have students share their predictions.
  (Answer: The pizza box solar oven can reach temperatures of 275 degrees, hot enough to cook food and to kill germs in water.)

Note: Print off *Solar Oven Activity*, found in Appendix F, to give to students.
When cooking outdoors with boxes, be sure to place them where insects, like ants, can’t get into them. You may need to tape weights to the box on a windy day.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **What are the benefits of cooking our food with the sun?**

  It’s free and we use less non-renewable resources because the sun is a renewable source.

- **What were some difficulties cooking with the sun?**

  It may take longer than other sources and may not be available all of the time.

- **How else can we capture and use the sun’s energy?**

  We can use solar panels to make electricity.

- **What is another renewable energy source?**

  Wind, water, biogas, etc.

- **What are other ways we can save energy?**

  Turning off lights and TVs when we aren’t using them.

SUGGESTED WEBSITES FOR EXTENSION:

- RecycleWorks has a solar oven, curriculum, and lots of resources related to resource conservation available for loan to schools, visit www.RecycleWorks.org for more information or call 1-888-442-2666.
- Solar School House: www.solarschoolhouse.org/ssh.html
- Sun Oven: http://sunoven.com/recipes.asp
- Project Learning Tree: www.plt.org

Lesson 6

Poop to Power – Also Known As Biogas

OBJECTIVES:

- Students will experiment with creating and capturing biogas.
- Students will get an opportunity to look at how energy is created from waste – using biomass, a renewable resource.
- Students will be exposed to the developments that are being made in technology of renewable energy.

ESSENTIAL QUESTION(S):

- How does society deal with waste created from humans and animals?

MATERIALS NEEDED/TIME: (USE THE AMOUNTS BELOW TO MAKE SIX MODEL DIGESTERS)

- Copies of *Methane Production Experiment* (found in Appendix G)
- 6 bottles (1 liter clear plastic; wide mouth preferred)
- 6 balloons (thick quality latex)
- Permanent markers
- Large spoon
- Funnel
- Rulers
- Duct tape
- String or yarn to measure circumference of balloon
- 4 cups of raw vegetable scraps and grass
- 6 cups of soil from outdoors (NOT bagged soil)

INTRODUCTION:

How do you create energy from waste? In this lesson, you will learn how electricity can be made from using biomass, a renewable resource. You will explore how manure is converted into methane gas, a type of biogas.

ACTIVITY:

- Discuss biogas as a form of energy. Biogas is energy that comes from living things. It is generally made from animal manure. People use biogas digesters to convert manure into methane gas, a type of biogas.

PROCEDURE:

1. Distribute the copies of *Methane Production Experiment,* found in Appendix G, for students to record measurements during the experiment. Students should work in groups of four or five per bottle.

2. Explain to the class the goal of this experiment is to create methane gas (a type of biogas). You will be doing this by using microbes (living organisms so small you cannot see them without a microscope) in the soil. When you feed the microbes food scraps, a byproduct of digestion is the emission of methane gas.

Note: Make sure to place the bottles out of reach of students so they don't touch them when they aren't supposed to. It may be difficult to measure the circumference of the balloon, so let students know to be gentle when measuring so they don't squeeze out any gas and alter their results.

METHANE PRODUCTION EXPERIMENT ANSWERS:

1. **As the days went by, what happened to the circumference of the balloon?**
   The circumference increased.
2. **As the days went by, what happened to the level of the mixture in the bottle?**
   The mixture level decreased or went down.
3. **What caused the circumference of the balloon to change?**
   The gases created by the mixture.
4. **What caused the level of the mixture to change?**
   The gases created by the mixture.
5. **How did the microbes get into the bottle?**
   We put them in the bottle when we added the soil.
6. **Was your prediction correct? How do you know?**
   Answers will vary.

CLOSURE/DISCUSSION QUESTIONS:
Discuss the following questions with students individually, in pairs or as a whole group.

- After all of the data has been collected, discuss how underdeveloped countries can use their livestock's manure to create energy. Biogas is a source of energy. Example: https://www.youtube.com/watch?v=e1WO4YLjysU
- **Is biogas a renewable source of energy or not?**
  You must first consider the source of the energy: Manure from animals.

- **Is this source of energy renewable?**
  Yes, because you can continue to get manure from the animals as long as they are alive.

Suggested Websites on Biogas:

- How to make a biogas digester: https://www.youtube.com/watch?v=eVEZfxGdV5A
- What is Biogas and What is it Good for?: http://www.greenworld365.com/what-is-biogas-and-whats-it-good-for/
- Biomass Energy 101: https://www.greenmountainenergy.com/why-green/renewable-energy-101/biomass-energy-101/
- Energy Information Association: http://www.ei.lehigh.edu/eli/energy/resources/readings/biomass.pdf

Lesson 7

The Power of Wind

OBJECTIVES:

- Students will investigate wind power.
- Students will discuss how individuals and companies harness the energy.
- Students will learn that energy from wind is renewable, plentiful and easy to harness by building and using a turbine.

ESSENTIAL QUESTION(S):

- How have people harnessed wind power throughout history?

MATERIALS NEEDED/TIME:

- 1 copy of *Wind Action Cards* (found in Appendix H)
- 1 copy per student – *Beaufort Scale* (found in Appendix I)
- 15 juice or milk cartons, ½ gallon, emptied and washed

Possible Materials for Windmills

- Dowels, 12” long and approximately ¼” in diameter
- 60 washers, medium sized
- String
- Paper cups (3 or 5 oz.)
- Pens/pencils
- Index cards
- Craft sticks
- Coffee stirrers
- 3” foam balls
- Masking or duct tape
- Tissue paper
- Wax paper
- Aluminum foil
- Sandwich/freezer bags
- Felt rectangles
- Scissors
- Fan, large
- Crayons, markers, colored pencils
- Rulers

INTRODUCTION:

Wind power is a sustainable energy option and energy source used in the United States. There are many windmills across the United States used by companies and individuals to harness energy. Have your seen these windmills? The energy stored is determined by the velocity of the wind.

ACTIVITY:

- Instruct students to, "Imagine a day when it seemed like there was nothing happening; it was almost as if though there was "no weather"—although technically that is never true."

- Ask students, "What do you see, hear, and feel?"
  Common response: Everything is still and silent. Nothing is changing or happening outside.

- Tell students they are going to make comparisons between that very still day and other types of days.

PROCEDURE:

1. Print off *Wind Action Cards* found in Appendix H and select eight students to act them out.

2. Each student volunteer shares and acts out the words on their card. Students should think about the amount of energy it takes to go from the still condition to what is described on the card. The goal is to consider each action and then rank all of the actions from the "least energy required to make this action happen" to the "most energy required to make this action happen."

3. To establish a baseline for these action cards, give the first volunteer the card that says "Trees Stand Still." Ask that student to stand on the far left of the classroom in the front of the room and act out a tree on a very still day.

4. Ask another student to stand up, read the description on their card and act it out. Ask the whole group: "Did that action take more or less energy than the tree standing still? A lot more energy or just a little bit? Where should the person holding this card stand on the energy continuum?"

5. Repeat Step 4 with the remaining six volunteers. At the end of the exercise, you should have eight participants standing at the front of the room in a long energy continuum.

6. Ask students, "Can you actually see the energy it takes to do these movements?" *Common response: No*

   Ask students, "So how did you know which action required lower or higher energy? What are you looking at for your clues?"
   Common responses: I was looking at the movement–bigger and faster movements need more energy while slower and smaller movements need less.

BEAUFORT SCALE

7. Tell students, "The action descriptions on the energy continuum are part of a scale called the Beaufort (Bow-Fert) Scale. The Beaufort Scale was developed in 1805 as a way to figure out relative wind conditions for sailors. The card descriptions acted out here are the land measurements used to approximate wind speed or energy."

   Note: Print off and have students complete *Beaufort Scale Worksheet*, found in Appendix I.

BEAUFORT SCALE WORKSHEET ANSWERS:

How can high wind speed be a problem for humans?

Students may cite tornadoes, hurricanes or dust storms. Some may suggest situations where wind affects airplane flights, or sporting events--like golf or tennis--that are difficult in strong winds.

Are there situations where too little or no wind is a problem for humans? If so, what examples can you give?

Some students might suggest recreational activities that depend upon wind such as sailing, para-gliding or kite flying. Others may suggest that having little wind makes a hot summer day difficult to stand and is a sign that the weather will not be changing soon. Yet others may suggest that machines that depend upon wind, such as water windmills or wind energy generators, may not work.

ENGINEERING CHALLENGE

8. Tell students they will be working as a mechanical engineer to design a windmill that will be able to harness the wind's energy to lift a container with at least five

washers. Ask them to brainstorm what they know about windmill materials and their properties.

9. Brainstorm as a class the following questions. Decide as a class what procedures will work for you.
    - What materials are available?
    - What is your timeline?
    - What is the wind source?

10. Have students work in pairs to plan a design for windmill blades that will catch wind. Tell students to focus on the unanswered question of "What is the setup of the windmill?" and "What kind of work will the windmill be doing?"
    - They will be designing windmill blades to be placed into a foam ball rotor.
    - The blades will transfer wind energy into spinning the rotor.
    - The spinning rotor will turn an axle that winds up a string and lifts a cup carrying small weights.

11. Walk around during planning and tell pairs of students, "The more wind energy their windmill blades can capture, the more weights their windmill will be able to lift. Therefore, the success of their windmill will be evaluated by the maximum number of weights that can be lifted." (To reduce frustration, it is critical for students to think about the fact that there are many different factors to think about in their windmill design.)

12. Supply students with materials requested after you have checked their designs. A great deal of time will be needed for them to create and improve their design.

13. As students complete the challenge of raising five washers, have them improve their design by lifting more, using fewer materials, or varying the wind speed of the fan.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **Given the differences, what are some of the variables that you need to consider next time you design a windmill?**

  Common responses: Materials and their properties, blade shape, blade size, number of blades, blade angle, etc.

- **Which of these variables do you still want to explore further while designing your windmill?**

Common responses: Blade angle, number of blades, more exploration of blade shape.

- **What properties of materials work best for your windmill?**

  Answers will vary

- **What blade shape and size work best?**

  Answers will vary

Suggested Websites for Extension:

- Beaufort Wind Scale: http://www.spc.noaa.gov/faq/tornado/beaufort.html
- Movie & Worksheet on Beaufort Scale: http://busyteacher.org/15974-beaufort-scale-youtube-video.html
- Lift Flap Activity on Beaufort Scale: https://www.tes.co.uk/teaching-resource/lift-up-flap--beaufort-scale-activity-6423614

Lesson 8

Transmission – How Does the Electricity Get from Consumers Energy to You?

OBJECTIVES:

- Students will explain the steps electricity takes from the power plant to their home.
- Students will understand how voltage changes through the transmission process.
- Students will understand what is dangerous in the process of transmission of electricity.

ESSENTIAL QUESTION(S):

- How do you have electricity instantly in your home when flipping on a light switch or plugging in a cord to an outlet?

MATERIALS NEEDED/TIME (THREE, 55 MINUTE CLASS PERIODS):

- Computers with internet connection
- Access to YouTube
- Various materials to make individual models (paper, markers, tape, glue, clay, paper clips, tooth picks, string or yarn, dental floss, wire, sticks, cardboard, small toys)

INTRODUCTION:

Electricity is made at the power plant, but how does it get from the power plant to your home? There are multiple steps in the process of transmitting electricity. In addition, the voltage must be changed before you can actually use the electricity in your home.

Show students this video that describes how power gets to your home.
https://www.youtube.com/watch?v=pXasvq1ivnw

ACTIVITIES:

Class period 1

- After watching the video, split the class into groups of 4-5 students. Use the class period for research, brainstorming and planning in those small groups. Have each group research the steps electricity makes in the transmission process on the internet. Students will be building a model to show how electricity gets from the power plant to their home. Have students brainstorm different materials they can use in their model and decide who will bring in which materials the next day to make the model.
  - Examples: Use string or dental floss for transmission lines, make a substation out of clay, make a small house out of cardboard and glue.

Class period 2

- Students bring materials to class and build their models with their small group. Have students come up with two or three safety messages about electricity and what could be dangerous in the transmission process. (Students may research online for this.)

Class period 3

- Have groups present their model to the class and explain what materials they used. Each group should explain their safety messages as well.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **Why is electricity carried at such high voltage, but brought down before reaching your house?**

  Less electricity is lost when it is carried at a high voltage, so the voltage in the wire is increased for transportation after leaving the substation. The voltage is decreased when the electricity reaches your neighborhood so that is safe and useable in your home.

- **What are the pros and cons of underground transmission lines?**

  Underground lines are less affected by weather and can be safer since there is a decreased chance of exposure. However, the cost of insulated cables and underground systems is higher than overhead and finding faults in underground lines also takes longer to locate and repair.

- **What are some possible dangers of power lines, substations and transformers?**

  Power lines, substations and transformers are all dangerous. You should never go near them or interact with them. They have danger signs on them to tell you to stay away. You could be shocked, burned or electrocuted. A shock causes a tingly feeling, an electrical burn can cause permanent damage to muscles and nerves and electrocution means death from electric shock.

Lesson 9

Energy Efficiency

OBJECTIVES:

- Students will define energy efficiency.
- Students will learn about Energy Star and what this program is for.
- Students will explore how to determine which appliance is most energy efficient.

ESSENTIAL QUESTION(S):

- Which items in your home do you think use the most electricity? How could you find out for sure?

MATERIALS NEEDED/TIME (TWO, 55 MINUTE CLASS PERIODS):

- Computers with internet connection
- Copies of the *Energy Guide Worksheet (found in Appendix J)*
- Copies of the *Energy Guide Homework Assignment* (found in Appendix K)
- Copies of the *Exit Slip* (found in Appendix L)

INTRODUCTION/ACTIVITY:

Tell students a popular term in the energy world right now is energy efficiency. Energy efficiency is simply using less energy to reach the same result. Ask students, "Why would anyone want to do this?"

Present the following example to students:

You want to visit your friend's house down the street. You can ask your parent for a ride in the car or you can ride your bike. Both of these choices will get you to your friend's house, but the energy used is not the same.

Car: runs on gasoline, which costs $3.50 a gallon

Your bike: runs on your pedaling, which costs $0.00.

This would mean that riding your bike would be more energy efficient because you are using less overall energy.

Many household appliances like refrigerators and television sets use different amounts of energy. By choosing to buy energy efficient items for your house, your family can save energy every day. When a family uses less energy, they can save money on their energy bills and help the environment because the overall amount of energy being used is reduced.

Ask students, "How does a person know how much energy an appliance is using and whether that amount is energy efficient?"

One great place to start is Energy Star. Energy Star is a program created by the U.S. Environmental Protection Agency. Products that are energy efficient are given a special label by Energy Star that lets a shopper know that the item they are buying is energy efficient. Shoppers can buy an Energy Star item and know that they will be saving energy compared to items sold without an Energy Star label.

Ask students, "Do you think all Energy Star items are the same?"

No. Each type of item, like a Blu-ray player or a dishwasher, has specific requirements to determine whether it will receive an Energy Star label based on the type of item it is. To further complicate things, even when you look at all the same type of items with an Energy Star label, some may be more energy efficient than others, so it's always important to look at the Energy Guide when buying a new appliance.

PROCEDURE:

1. Print out the *Energy Guide Worksheet,* found in Appendix J, to use with students in pairs or small groups.
2. Take students to a computer lab to do research as they complete the Energy Guide worksheet.
3. After students do the research on Energy Star ratings, you may choose to assign the *Energy Guide Homework Assignment,* found in Appendix K. Print out the assignment and pass out to students to complete individually.

ENERGY GUIDE WORKSHEET (APPENDIX J) ANSWERS:

- **What appliance is this Energy Guide for?**

  Refrigerator - freezer
- **What is the model number?**

  ABC-L
- **How much does it cost to run this appliance for a year?**

  $67

- **This guide shows that similar models can cost somewhere between $57 a year and $74 a year. How does this model compare to other models?**

  Average

- **What is the estimated amount of electricity per year that this appliance will use?**

  630 kwh

- **Is this model an Energy Star appliance?**

  Yes

1. **What two reasons are listed for why the Energy Star label was established?**

   To help save money and to protect our climate

2. **The website lists many items that can earn the Energy Star label. List at least four items you can buy that have been labeled as "Energy Star" efficient.**

   Dryers, washers, refrigerators, and dishwashers

3. **Which of the following actions can save energy?**

   All except D and F

4. **Visit the "Take The Pledge" section of the website and look at some simple actions people can do to be more energy efficient. Which of these actions could you do at your house?**

   a. *Replace standard lightbulb with LED lightbulb*
   b. *Have your computer go into sleep mode when you aren't using it*

5. **What other interesting facts did you learn from www.energystar.gov and www.energystar.gov/kids?**

   Energy Star homes use 30 percent less energy than a typical home
   A typical energy bill for a home for a year is about $1,900

CLOSURE/DISCUSSION QUESTIONS:

As a closure activity, each student should complete the *Exit Slip*, found in Appendix L, with the questions below. You can also assign the homework assignment found in Assignment K or complete it as class work.

- **Pretend that you need to buy a new washing machine for your house. Based on what you've learned, what are some energy related questions you should ask?**

  What is the estimated yearly operating cost?
  What are the key features of the model?
  Does it have the Energy Star logo?

Lesson 10

Energy Conservation

OBJECTIVES:

- Students will learn about energy conservation and how this concept can impact our lives.
- Students will explore different types of lightbulbs and discuss the advantages and disadvantages of each type.
- Students will learn about smart meters and discuss how they can help us with energy conservation and energy efficiency.

ESSENTIAL QUESTION(S):

- Knowing what you do about how energy use has changed over time, why do you think it might be important for people to develop ways of using less energy?

MATERIALS NEEDED/TIME (ONE TO TWO, 55 MINUTE CLASS PERIODS):

- Copies of *Energy Brainstorm Chart* (found in Appendix M)
- Copies of *Light Bulb Worksheet* (found in Appendix N)
- Copies of *Electric Meters Worksheet* (found in Appendix O)
- Pencils
- Rulers
- Crayons
- Colored pencils
- Markers
- Poster board
- Map of Michigan

INTRODUCTION:

As people continue to rely on increased use of technology in their lives, they are also likely to continue using more electricity. In order to be good environmental stewards, it's important we don't forget about the potential environmental impacts of using electricity.

Energy Conservation means using less energy. Examples of conservation include turning off the water while you brush your teeth or drying your clothes on a clothes line rather than using a dryer.

Energy Efficiency means using technology and innovation to develop products that use less energy to do the same work. Examples of energy efficiency include driving a smaller car rather than an SUV or purchasing a toilet that uses less water.

Using less energy will impact our lives in several ways. Using less energy provides a personal benefit because you (or your parents) will have to pay less money each month on your electric bill. When people use less electricity, it also means we can rely less on fossil fuels that make up the majority of our energy production. This results in lower emissions and toxins being released into the air, which benefits air quality and issues related to climate change.

ACTIVITIES:

Activity 1:

Either through brainstorming or use of websites like energy.gov and energystar.gov, have the students develop a list of ways they can conserve energy or become more energy efficient. Fill out a copy of the following chart together (blank version found in Appendix M)

Way to Save Energy	Is this Conservation or Energy Efficiency?	Easiness Rating	Effectiveness Rating
Turn off lights	Conservation	1	4
Using power strips and turning them off	Conservation	2	3
Turning thermostats down	Conservation	3	2
Installing insulation	Energy Efficiency	4	1

Either in groups or as a class, have the students rate their suggestions from easiest to hardest. For example, is it easier to turn off the lights when you leave a room or install new installation in your home? Next, have the student's rate from least impact to most impact.

Activity 2

Following the activity, have the students use the chart located on the *Light Bulb Worksheet,* found in Appendix N, to help them answer the questions.

LIGHT BULB WORKSHEET (APPENDIX N) ANSWERS:

1. **Which lightbulb cost the most to purchase?**

LED

2. **Ten (10) incandescent lightbulbs cost about the same as 1 LED lightbulb. If you could buy 10 incandescent lightbulbs or 1 LED lightbulb to go into your lamp, which would last longer?**

   LED

3. **A 60 watt incandescent bulb running for 1 hour uses 60 watt-hours (watts x hours). Electric bills measure electric use through the kilowatt hour, which is equal to 1000 watt hours. So, a 60 watt incandescent bulb running for 1 hour uses .06 kilowatt hours (watt-hours/1,000). How many kilowatt hours would the Compact Fluorescent and the LED bulb use?**

   Compact Fluorescent: 14 watts x 1 hour = 14 watt-hours
   14 watt-hours/1,000= 0.014 Kilowatt-hours

   LED: 9.5 watts x 1 hour = 9.5 watt-hours
   9.5 watt-hours/1,000= 0.0095 Kilowatt-hours

4. **The average price of electricity in the United States per kilowatt hour is 12 cents. How much would each of these bulbs cost to run for 1 hour?**

   Incandescent: .06 kilowatt-hours x 12 cents =.72 cents

   Compact Fluorescent: 0.014 kilowatt-hours x 12 cents = 0.168 cents

   LED: 0.0095 kilowatt-hours x 12 cents = 0.114 cents

5. **Based on your analysis above, which type of bulb uses the least amount of electricity?**

   LED

6. **The number of lumens is an indication of the brightness of the bulb. Which bulb is the brightest? Which bulb is the least bright?**
   CFL is the brightest and LED is the least bright

ACTIVITY 3:

Note: Discuss this information with students and print off *Electric Meters Worksheet*, found in Appendix O, for students to answer questions.

Electric utilities provide electricity to their customers across electric lines from the power plants where the electricity is generated. Huge magnets spin within large copper coils inside electric generators, causing electrons to flow from the generators to homes, businesses, factories and schools. The movement of electrons constitutes electricity, which needs to be measured at its final destination so electric companies cover the cost of the production and transmission. Utilities are taking advantage of new meter technologies to measure electricity and accurately transmit data from the meters to the utilities, providing benefits to customers. They are smarter than older technology meters, so they are called "Smart Meters." Consumers Energy provides electricity to 1.8 million Michigan customers in the Lower Peninsula of Michigan.

Three types of meters are commonly used to measure electricity: electromechanical meters (analogue technology – similar to analogue clocks), digital technology meters, and digital meters with communication capabilities -- also known as smart meters.

Consumers Energy has upgraded meter technology for residtential customers and small businesses from electromechancial meters (left) to digital meters (middle) over the past 10 years, as the older meters have required replacement. Digital communicating meters (right),also known as smart meters, have upgraded functions and will be installed across the state through 2017.

Currently, the only way Consumers Energy knows how much electricity a customer has used in a month is when a meter reader drives to the customer's home, walks into the yard, looks at the meter and records the numbers from the meter that reflect how much electricity has been used since the last meter reading, typically a month. Smart meters send text-type messages to the company to record how much energy has been used each day. The information is sent in the middle of the night and no personal information is included. There is no customer name or address; it is simply an encrypted meter identification code and the amount of energy used.

Energy companies are usually unaware of individual customer power outages that occur when severe storms knock down trees and power lines. Unless customers are home to report the outages, repairs may not be made until customers return. The new meters will have the ability to contact Consumers Energy when power outages occur –a real benefit to customers, especially those who travel.

Those are the primary reasons energy companies are using the latest meter technology, but there are more customer benefits. The new meters will support greater billing accuracy through the elimination of estimated meter reads – which occur more frequently when severe weather makes reaching meters difficult. Overall, the new meters will help control costs and contribute to more efficient use of power outage repair resources.

The new meter technology also supports the ability to provide energy use data to customers through an online web portal where customers can create their own passwords and follow their home energy use. Two days after receiving a smart meter, they can go online and see their energy consumption by the hour. So, if a customer installs a new refrigerator on a Monday, and moves the old one into the garage or basement for extra freezer space, plugging it in on the following Tuesday, she will be able to see what sort of additional energy consumption she is experiencing with both plugged in. Energy companies have no way of knowing how the customer is using electricity; in other words, they can't see how much energy a toaster or television is using, but the customer will have a tool to see an energy spike and identify additional energy consumption by the hour. She will also have access to the web portal's tips and tools to help predict what the additional cost is for running the two appliances, which may help her decide if using both fits into her budget or if the expense of just one appliance is preferred. The access to online energy use information is a tool available to customers for their benefit at **ConsumersEnergy.com/smartenergy**.

Note: Use Consumers Energy Electric Meters Installation Map below to project in front of the class to show the rollout of the smart meters.

ELECTRIC METERS WORKSHEET (APPENDIX O) ANSWERS:

1. **List the things a smart phone can do that a standard telephone can't do?**

   Access the internet and use applications

2. **Knowing that old electric meter technology only measures the amount of energy a home or business is using, what do you think the new smart meter might be able to do?**

   Provide energy use data and see energy consumption hourly vs. monthly

3. **Has Consumers Energy upgraded electric meters in your area?**

   Answers will vary

4. **Have you gone online to look at your own home energy use information?**

   Answers will vary

5. **Each new electric meter has a yellow label on its face – do you have one?**

   Answers will vary

6. **What problems might occur when a meter reader is sent to read meters outside or insides people's homes?**

The meter may not be accessible

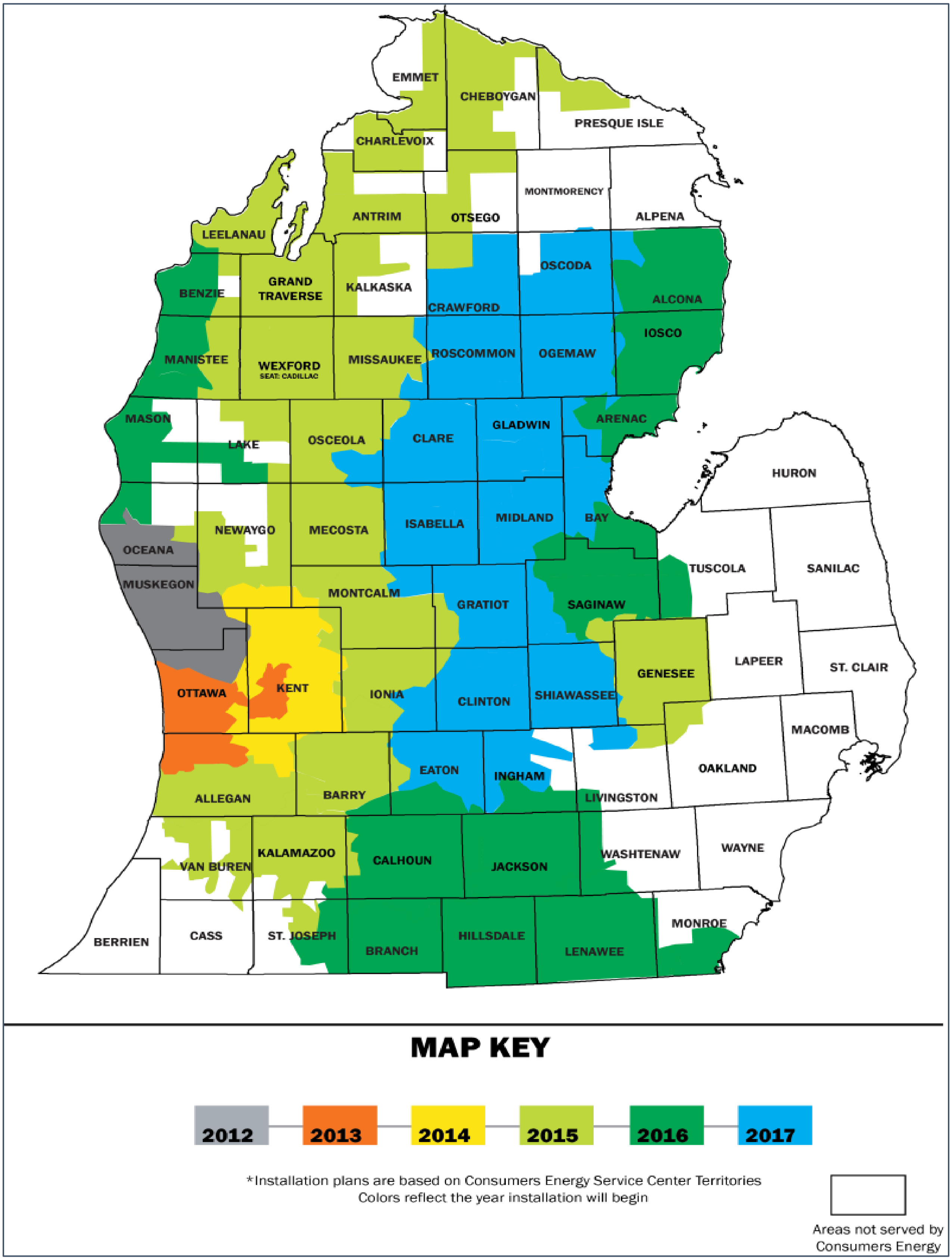
CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs, or whole group.

- **If you were to change out the light bulbs in your house, what lightbulbs would you end up using now? Why?**
  LED, because they use less energy and last longer

- **What would be the impact on the environment and your energy bill by changing out your light bulbs?**
  We would be using less energy and our bill would be lower

Consumers Energy Electric Meters Installation Map



Lesson 11

Exploring Energy Careers

OBJECTIVES:

- Students will be exposed to various careers in the energy industry.
- Students will research what types of jobs are available or in high demand in the energy industry.
- Students will explore programs at local schools focusing on energy related careers (trade or vocational school, two year programs, four year colleges).

ESSENTIAL QUESTION(S):

- What types of jobs are available in the energy industry?

MATERIALS NEEDED/TIME (TWO OR THREE, 55 MINUTE CLASS PERIODS):

- Copies of *Careers Worksheet* (found in Appendix P)
- Copies of *Careers Project Worksheet* (found in Appendix Q)
- Need access to computer with internet
- Need materials to make a visual aid (Ex: PowerPoint software, poster board, etc.)

INTRODUCTION:

The energy industry is more than just power lines and generators. In this lesson, we will explore different types of jobs in the energy industry. In the energy industry, we need people who help generate power at the plant, map out the path electricity will take to get to customers safely and reliably and people who fix downed power lines. There also are workers who install new natural gas pipes, people who take calls from customers all day and help answer their questions and people who develop communication materials (like brochures, commercials and other documents) to share with customers.

The *Careers Worksheet* provides some examples of jobs and the work involved with that position. You may use these as a starting point for your research.

ACTIVITIES:

<u>Class Period 1</u>

Review with students the list of jobs on the *Careers Worksheet*, found in Appendix P. These are just some of the jobs available in the energy industry. Give students copies of Careers Project Outline, found in Appendix Q. Assign students to choose one job to research. (Students may choose a career in the energy industry that is not listed.)

<u>Class Period 2/3</u>
Give students time to research their project in class (or assign it as homework).
Provide the rubric for the research project and presentation.

CLOSURE/DISCUSSION QUESTIONS:
Discuss the following questions with students individually, in pairs or as a whole group.

- **Which career did you chose to focus on? Why?**
  Answers will vary.
- **Was there a job you thought was interesting from your peers' presentation?**
  Answers will vary.
- **After hearing about different careers in energy, which was your favorite? Why?**
  Answers will vary.

Lesson 12

Safety

OBJECTIVES:

- Students will learn about different safety topics related to energy and underground wires.

ESSENTIAL QUESTION(S):

- Think about the safety message: Safety 24/7: Home, Work or Play; what does the message mean to you and how would you implement it?

MATERIALS NEEDED/TIME:

- Copies of *Electric Safety Awareness* (found in Appendix R)
- Copies of *BINGO worksheet* (found in Appendix S)
- Internet access
- Poster making supplies (poster board, crayons, markers, pencils, etc.)
- Tablet and an app that allows you to record

INTRODUCTION:

Safety is the #1 priority at Consumers Energy. We are committed to providing safe and reliable energy to our customers in the Lower Peninsula. We also instill this message in our employees through our safety first slogan. In addition, we promote the use of MISS DIG 811, a free service that marks underground utilities when you are going to be digging.

Visit the website: http://www.consumersenergy.com/safety to learn more about safety based on three topics; Natural Gas, Downed Power Lines and Calling Miss Dig before you Dig. View the videos below to get some ideas you can focus on:

Natural Gas:
https://www.youtube.com/watch?v=GzJUP5YYe0I&feature=player_embedded#t=2

Downed Power Lines
https://www.youtube.com/watch?v=vqL9SQyXuAk&feature=player_embedded#t=0

Calling Before You Dig.
https://youtu.be/rn828gZq26Y

ACTIVITY:

- Print off and assign students the *Electric Safety Awareness Project*, found in Appendix R.

CLOSURE/DISCUSSION QUESTIONS:

Discuss the following questions with students individually, in pairs or as a whole group.

- **What do you feel is the most important message you learned today about safety? Why?**

  Common Responses: Call 811 before you dig, be aware of your surroundings, etc.

- **What can you do to focus on safety at home or at school?**

  Answers will vary

- **Why should safety be so important to you?**

  It keeps us alive and prevents injuries

BINGO ACTIVITY:

- Print off one copy of the Bingo Worksheet, found in Appendix S, for each student.
- Have the students write one word from the bingo list of words in each blank space.
- Read the definition from the glossary and if they have the word on their sheet, they can cover the space with an X or an M&M (optional).
- Once they cover all of the spaces in a diagonal, vertical, or horizontal line, they call out, “BINGO.”
- Make sure to have the student call back their words to verify it is a good BINGO.
- Candy or extra credit points can be offered as a reward for the winner(s).

Note: The BINGO activity, found in Appendix S, can be used as a culminating activity for the whole unit.

Glossary

All of the definitions below were taken from www.merriam-webster.com/dictionary except for the ones with an asterisk (*) next to them. The (*) next to a vocabulary word indicates a definition provided by the Consumers Energy Education Team.

Beaufort Scale (Bow-fert) a scale where the force of wind is indicated by numbers from 0 to 12. *Example: The hurricane received a 12 on the Beaufort scale*.

Biogas: a mixture of methane and carbon dioxide produced by the bacterial decomposition of organic wastes and used as a fuel. *Example: When the microbes digested the food scraps, a byproduct was methane gas, a biogas.*

Biomass Energy: plant materials and animal waste used as a source of fuel. *Example: The scouts used biomass energy by cooking hotdogs over a fire.*

***Chemical Energy:** energy stored in atoms and molecules until released. *Example: When the vinegar was mixed with the baking soda, the foam was proof that chemical energy was released.*

Coal: a black or brownish-black hard substance within the earth that is used as a fuel. *Example: I toasted a marshmallow over the coals of the campfire.*

Coalification: a process in which vegetable matter becomes converted into coal. *Example: It takes a long time for coalification to occur, so coal is non-renewable.*

***Consumers Energy:** Michigan's largest utility, is the principal subsidiary of CMS Energy (NYSE: CMS), providing natural gas and electricity to 6.6 million of the state's 10 million residents in all 68 Lower Peninsula counties. *Example: When I saw a downed power line, I called Consumers Energy and they took care of it.*

***Electrical Energy:** energy created through the movement of electrons. *Example: A plug outlet uses electrical energy to power my appliances.*

Energy: the ability to be active. *Example: They devoted all of their energy to the completion of the project.*

***Energy Conservation:** using less energy. *Example: In order to conserve energy, the kids turned off the light after they left the room.*

***Energy Efficiency:** using technology and innovation to develop products that use less energy to do the same work. *Example: My family bought a new car that is more energy efficient.*

Energy Star: a labeling program that helps identify appliances that have superior energy efficiency. *Example: An Energy Star appliance will help us save money.*

Fossil Fuels: a fuel (such as coal, oil, or natural gas) that is formed in the earth from dead plants or animals. *Example: Coal is the most prevalent fossil fuel we use to make electricity.*

Geothermal Energy: of, relating to, or using the natural heat produced inside the Earth. *Example: An example of humans utilizing geothermal energy would be swimming in a natural hot spring.*

***Gravitational Energy:** energy caused by the position of an object and influenced by gravity. *Example: Water flowing downhill is an example of gravitational energy.*

Hydroelectricity: of or relating to the production of electricity by using machines that are powered by moving water. *Example: Ludington Pumped Storage utilizes water to generate hydroelectricity.*

***Kinetic Energy:** energy made through motion. *Example: When the students played soccer, they were full of kinetic energy.*

Microbes: an extremely small living thing that can only be seen with a microscope. *Example: The soil was full of microbes.*

Mining: the process or business of digging in mines to obtain minerals, metals, jewels, etc. *Example: While mining, the miners found enough coal to heat a home!*

***811 MISS DIG:** the number/organization to call before doing any digging projects. *Example: Excavators and anyone planning to dig should always call 811 MISS DIG at least three full working days before breaking ground for free staking of underground utility lines.*

***Motion Energy:** energy created when objects move after a force is applied. *Example: When the pitcher threw the softball, it was full of motion energy.*

Natural Gas: gas that is taken from under the ground and used as fuel. *Example: Consumers Energy stores their natural gas in porous rocks underground.*

***Non-Renewable Resources:** comes from sources that cannot be replenished within a short period of time. *Example: If we use up all of our non-renewable resources, we will have to find alternate sources of energy.*

***Nuclear Energy:** energy stored in the nucleus of an atom until split apart through nuclear fission. *Example: Uranium is the main element used for nuclear energy.*

Petroleum: a kind of oil that comes from below the ground and that is the source of gasoline and other products. *Example: Petroleum accounts for approximately 37 percent of the world's energy consumption.*

Pollution: the action or process of making land, water, air, etc., dirty and not safe or suitable to use. *Example: Over the past few years, politicians have attempted to pass legislation that will decrease pollution.*

Potential Energy: the energy that something has because of its position or the way its parts are arranged. *Example: The stone at the top of the mountain had a lot of potential energy.*

***Radiant Energy (light energy):** electromagnetic energy that travels in waves. *Example: Sun rays are full of radiant energy.*

***Renewable Resources:** comes from sources that do not run out or can be replenished within a short period of time. *Example: Solar energy is a renewable resource because the sun continues to shine.*

Safety: the condition of being safe from undergoing or causing hurt, injury, or loss. *Example: Always put safety first!*

Smart Meters: new meter technology to measure electricity and accurately transmit data from the meters to the utilities, providing benefits to customers. *Example: A smart meter was installed at our house last week to measure our energy usage.*

Solar Energy: produced by or using the sun's light or heat. *Example: Solar panels are used to collect solar energy.*

Substation: a place where the strength of electricity is changed as the electricity passes through on its way from the power plant to homes and businesses. *Example: Don't go near a substation, it could be very dangerous because of all the electricity going through it.*

Sustainable Energy: able to last or continue for a long time. *Example: If we invest in sustainable energy now, we'll have plenty of resources in the future.*

***Thermal Energy:** energy created through the movement of atoms. *Example: The hand-warmers and my hands exchanged thermal energy.*

Transformer: a device that changes the voltage of an electric current. *Example: Electricity passes through a transformer on its way to your home.*

Transmission: the act or process of sending electrical signals to a radio, television, computer, etc. *Example: The music was transmitted through the radio waves.*

Voltage: the force of an electrical current that is measured in volts. *Example: The voltage is decreased when it passes through the transformer.*