



Energy & Agriculture

Middle School Unit

EDUCATOR'S GUIDE



**Food and Agriculture
Center for
Science Education**

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OVERVIEW

LESSON 1: ENERGY AROUND US

Standards

Next Generation Science Standards

PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

PS1-3.A Structure and Properties of Matter

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

PS1-3.B Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

ESS3.A Natural Resources

- Humans depend on Earth's land, ocean, atmosphere and biosphere for many different resources. Minerals, fresh water and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

ESS3.C Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural

habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.

- Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

English Language Arts Common Core Standards

CCSS.ELA-LITERACY.SL.6-8.1

Engage effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grade 6-8 topics, texts and issues, building on others' ideas and expressing their own clearly.

Learning Objectives

At the conclusion of this lesson, students will be able to:

- Define energy.
- Describe how energy is generated.

Time

50 minutes

Materials

- "Energy Connections" images (1 set per class)
- Energy Generation Cards (1 set per group)
- Tape
- Whiteboard and markers



INTRODUCTION

Energy Connections

Prior to class, cut out the “Energy Connections” images. Create two boxes on a white board and tape the images in the boxes as follows.



- Ask students to identify a common relationship between each item in the left box, with an item in the right box. Students can use scratch paper to work through the scenario.
- After students have tested individually, ask a volunteer to come forward, move images out of the box and position in pairs on an open space on the board. Ask the students to explain the common relationship.
- Look for the following solution: sun grows apple tree, gas can fuels car, banana fuels person, electrical outlet powers TV, wind moves windmill. *Note: Students may

find different combinations. If the combination they find does not lead to the concept of energy, redirect them by appreciating the unique connection they found, while letting them know you are still looking for a different relationship.

- Ask students what all of the items have in common. Listen for responses indicating they “do work” or “create change.”
- Share with students that all of these items are connected by energy. This lesson will explore the definition of energy and how it is generated.



OBJECTIVE 1

Define Energy:

- Share with students the following definition of energy: Energy is the power used to do work. It is the power that comes from heat, electricity, natural resources, mechanical reactions or chemical reactions.
- Ask students to identify additional examples of energy use in life. Capture responses on the whiteboard.
- Emphasize that energy is required, in some form, for almost every interaction in life, yet we often take this amazing science for granted. When we turn on a light switch, we rarely stop to think about the person working at that moment to generate light for our home.
- Have students quickly brainstorm things they have done that day that require energy. Have students differentiate between items requiring human energy (i.e., running in PE) with those requiring external energy sources (i.e., using a blow dryer) by starring those items that require external sources of energy.

OBJECTIVE 2

Describe how energy is generated:

- Create a KWL chart in the front of the room (What I KNOW, WANT to know, and LEARNED).
- Ask students to share what they know about how energy is generated. Capture responses.
- Ask students to share what they want to *know* about energy. Capture responses.
- Inform students that energy is generated, or harnessed, many different ways. All forms of generation play an important role in our society.
- Energy Generation Activity (This activity may be done independently if a set of cards are available for each student.):
 - Each group will get a set of cards that show

a variety of ways energy is generated, a set describing the energy source and a set with a pro and con of using this source. Their goal is to match all three for each energy source.

- Divide students into groups of 2-3 students.
- Give each group a set of Energy Generation Cards.
- Challenge students to match the cards within their group.
- Have groups share matches, correct errors and discuss pairings.
- Revisit the KWL chart and ask students to revise “What I KNOW” statements based on this new information. Capture this in the “LEARNED” column.

CONCLUSION

KWL Update:

- Refer students back to the KWL chart.
- Add to, and/or check off items in the L column for what students learned today.
- Add to the W column what students now want to know.

Quick Write:

- Ask students to take 30 seconds to respond to the following prompt: How do we get energy for our bodies?
- Have students share. Anticipate responses related to nutritious food sources.
- Affirm student observations that food provides energy for our bodies. Help students make the connection that energy is also needed to produce the food we eat.
- Preview the next lesson by challenging students to think about how energy is used to make the food they eat throughout the rest of the day.

Sources

<http://www.need.org/files/curriculum/guides/Intermediate%20Energy%20Infobook.pdf>

<http://www.need.org/files/curriculum/infobook/CoalS.pdf>



Energy Connections





Energy Generation Cards

Solar

**Oil and
Natural
Gas**

Wind

Coal

Nuclear

Hydropower



Energy Generation Cards

Energy from the sun

**A gas mixture
trapped in
sedimentary rocks**

**Energy from
moving air**

**A rock formed from
plant remains
millions of years
ago that is primarily
used for fuel**

**Energy in the
nucleus of an
atom released using
fusion or fission**

**Energy that comes
from moving water**



Energy Generation Cards

Pro: renewable energy source used to heat water and buildings; can also generate electricity

Con: amount available varies depending on time of day, season of year, closeness to Equator, sky's cloud cover

Pro: used for heat, to generate electricity, for fuel, and as an ingredient in fertilizer, glue, laundry detergent and paint

Con: Can be hard to find since it's trapped in sedimentary rocks deep in the ground

Pro: a renewable energy source that is clean and does not pollute the air

Con: farms can only produce electricity when the wind is blowing at a particular speed

Pro: The ashes are used to build roads and make cement

Con: Surface mining, the less expensive mining technique than underground mining, can only extract about 1/3 of the nation's coal supply

Pro: No fuel is burned in these plants so there is no air pollution or carbon dioxide released into the environment

Con: The release of radiation and radioactive material in the incident of an accident at a plant is a concern

Pro: Because water is free to use and does not have to be transported, this is the cheapest source of energy generation

Con: Dams built to generate hydropower have altered the water patterns and flow



Energy Generation Card Answer Key

Solar	Energy from the sun	<p>Pro: renewable energy source used to heat water and buildings; can also generate electricity</p> <p>Con: amount available varies depending on time of day, season of year, closeness to Equator, sky's cloud cover</p>
Oil and Natural Gas	A gas mixture trapped in sedimentary rocks	<p>Pro: used for heat, to generate electricity, for fuel, and as an ingredient in fertilizer, glue, laundry detergent and paint.</p> <p>Con: can be hard to find since it's trapped in sedimentary rocks deep in the ground.</p>
Wind	Energy from moving air	<p>Pro: a renewable energy source that is clean and does not pollute the air.</p> <p>Con: farms can only produce electricity when the wind is blowing at a particular speed.</p>
Coal	A rock formed from plant remains millions of year ago that is primarily used for fuel	<p>Pro: the ashes are used to build roads and make cement.</p> <p>Con: surface mining, the less expensive mining technique than underground mining, can only extract about 1/3 of the nation's coal supply.</p>
Nuclear	Energy in the nucleus of an atom released using fusion or fission	<p>Pro: no fuel is burned in these plants so there is no air pollution or carbon dioxide released into the environment.</p> <p>Con: the release of radiation and radioactive material in the incident of an accident at a plant is a concern.</p>
Hydropower	Energy that comes from moving water	<p>Pro: Because water is free to use and does not have to be transported, this is the cheapest source of energy generation.</p> <p>Con: Dams built to generate hydropower have altered the water patterns and flow.</p>



OVERVIEW

LESSON 2: ENERGY INPUT & FOOD PRODUCTION

Standards

Next Generation Science Standards

PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

PS3.A Definitions of Energy

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states and amounts of matter present.

PS3.B Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

English Language Arts Common Core Standards

CCSS.ELA-LITERACY.RST.6-8.3

Follow precisely a multistep procedure when carrying out experiments, taking measurements or performing technical tasks.

CCSS.ELA-LITERACY.SL.6-8.1

Engage effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grade 6-8 topics, texts and issues, building on others' ideas and expressing their own clearly.

Learning Objectives

At the conclusion of this lesson, students will be able to:

- Describe at least five points of energy consumption in food production.
- Describe at least five points of energy consumption in food processing.

Time

2 hours

Materials

- 1 apple
- Whiteboard and markers
- Scratch paper (1 per group)
- Large poster paper (1 per group)
- Markers (1 set per group)
- Computer paper (1 page per student)
- Small sticky notes (1 per student)
- Granny smith apples (4 per group)
- Golden delicious apples (4 per group)
- Small containers of cinnamon (1 per group)
- Water
- Sugar (3 T per group)
- Microwave safe bowls (1 per group)
- Measuring cups (1 per group)
- Tablespoon measuring spoon (1 per group)
- Microwave (in class)
- Canning jars, with lids (1 per group)
- Large forks or potato mashers (2 per group)



INTRODUCTION

Think – Write – Pair – Share:

- Present students with an apple and ask the students to think about where the apple came from. Ask students to write down what they think of as the “correct” answer and share it with a partner.
 - Some responses may be that the teacher obtained the apple from the grocery store, by bringing it from home, from a tree in the back yard, a farm, from a tree that sprouted from an apple seed or even from a flower (which turned into the fruit), etc.
- Ask a few students to share their responses with the class.
- To wrap up discussion, share with students that today they'll be exploring the role energy plays in food production and processing.

OBJECTIVE 1

Describe at least five points of energy consumption in food production.

Apple Chart:

- Ask students to create a flow chart depicting the steps to growing and apple:
 - Divide the class into groups of three or four.
 - Instruct groups to brainstorm what they would need to grow this apple in their backyard. Come up with a list of at least five steps they would need to grow the fruit and get it delivered to their grandma.
 - While students are thinking of these things, have them determine what steps they would have to use energy to accomplish. Hint for students: Think of this as any time they have to DO something.
 - Instruct students to create a flow chart of these steps on the top part of the construction paper. (A sample of the flow chart is at the end of this lesson. This can be shown on a whiteboard if students need to see a sample.)
- After students have completed their flow charts, each group will share their results.
- During the share-out, students should identify one step from another group's poster that they liked.
- Create a flow chart on the whiteboard like the students' depicting these five steps: 1) Clear Land (pull weeds), 2) Plant the Seed, 3) Water the Tree, 4) Pick the Fruit and 5) Take Apples to Grandma.

- Facilitate a discussion about what is used in each step. Steer students in a discussion toward the idea that each of these steps requires energy in order to complete.
- Transition discussion and thinking to commercial agriculture by describing differences and similarities to large-scale agriculture. Transition questions could include:
 - Why is growing food in your backyard different from what a farmer does?
 - How is this process similar to what you would do on a larger scale operation such as a farm?
 - What would need to be different on a farm?
 - How is energy consumed when producing food?
- Instruct students to relate their five steps to an agricultural model and create a flow chart on the bottom half of their poster. This will be a model of the steps of agriculture that require energy.
 - Have each group reveal their new flow charts.
 - Underneath or near the flow chart drawn on the whiteboard, draw a flow chart with these steps: 1) Agricultural Process, 2) Ground Preparation, 3) Planting, 4) Irrigation, 5) Harvest and 6) Transportation.
- Facilitate a discussion about what is good and what is missing from the flow chart.
- Turn students' attention to the second flow chart they created. Considering the discussion they just had and the agriculture production flow chart just revealed, have students add in any missing pieces they left off from their agriculture model.

OBJECTIVE 2

Describe at least five points of energy consumption in food processing.

Apple Energy:

- Recall the apple discussion from earlier, and facilitate a discussion about what we do with apples once they're produced. Discussion should lead students to the topic of food processing.
- Discuss what we can make when apples are processed.
- Present an apple and a jar of applesauce. Ask students if they think it also requires energy to turn apples into applesauce. The answer should be yes!



Applesauce Activity

(could be substituted with making orange juice or ice cream):

- Divide students into small groups and make applesauce by following the instructions below (<http://www.food.com/recipe/microwave-applesauce-72365>). (If classroom supplies are limited, one group at a time can make applesauce while the others work on the comic strip activity.)

1. Peel apples.
2. Cut apples into slices and remove seeds.
3. Combine apples, $\frac{1}{4}$ cup of water and $\frac{1}{2}$ teaspoon cinnamon in a microwave-safe bowl.
4. Microwave on high for 5-10 minutes until apples are soft.
5. Using a fork or potato masher, coarsely mash apples to desired texture.
6. Add sugar while still hot.
7. Put in a jar.

- After applesauce is finished, ask students to describe where energy was used to prepare their applesauce. Brainstorm as a class the various points of energy consumption.

- Create a flow chart from student-generated ideas. An example of an energy consumption flow chart can be found at the end of this lesson.

CONCLUSION

Comic Draw!

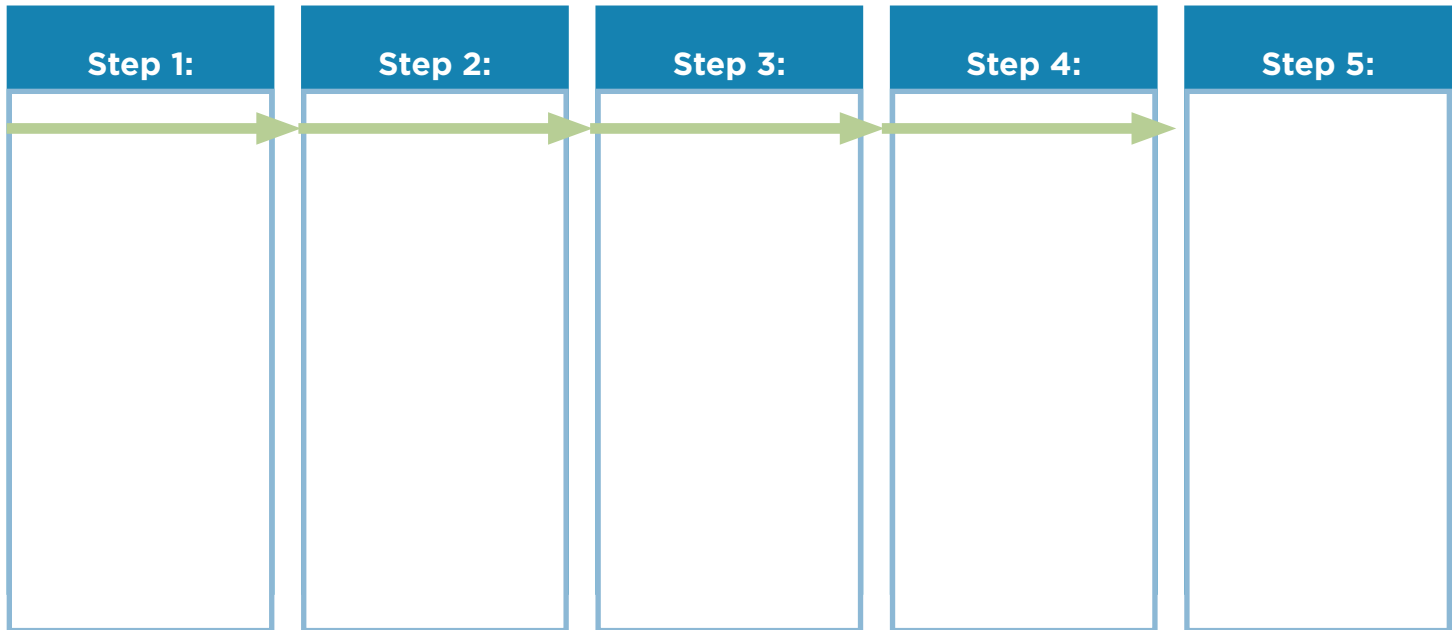
- Students will create a minimum six-pane comic depicting the start to finish process of creating another processed food item.
 - The comic should include elements starting at ground preparation and ending in transportation to the store.
 - Students can choose any food, but should be encouraged to choose foods not made from multiple items. Suggested items may include: bagged and ready-to-eat lettuce, French fries, a bag of chips and dried fruit (like banana chips).
- As students finish their comics, tape them around the room.
- Conduct a gallery walk where students walk around the room to see other students' comic strips. As they are exploring, students should record five key items they liked from others' comic strips.
- Following the gallery walk, have students share their findings and discuss where energy is used in the production of their food.

KWL Update

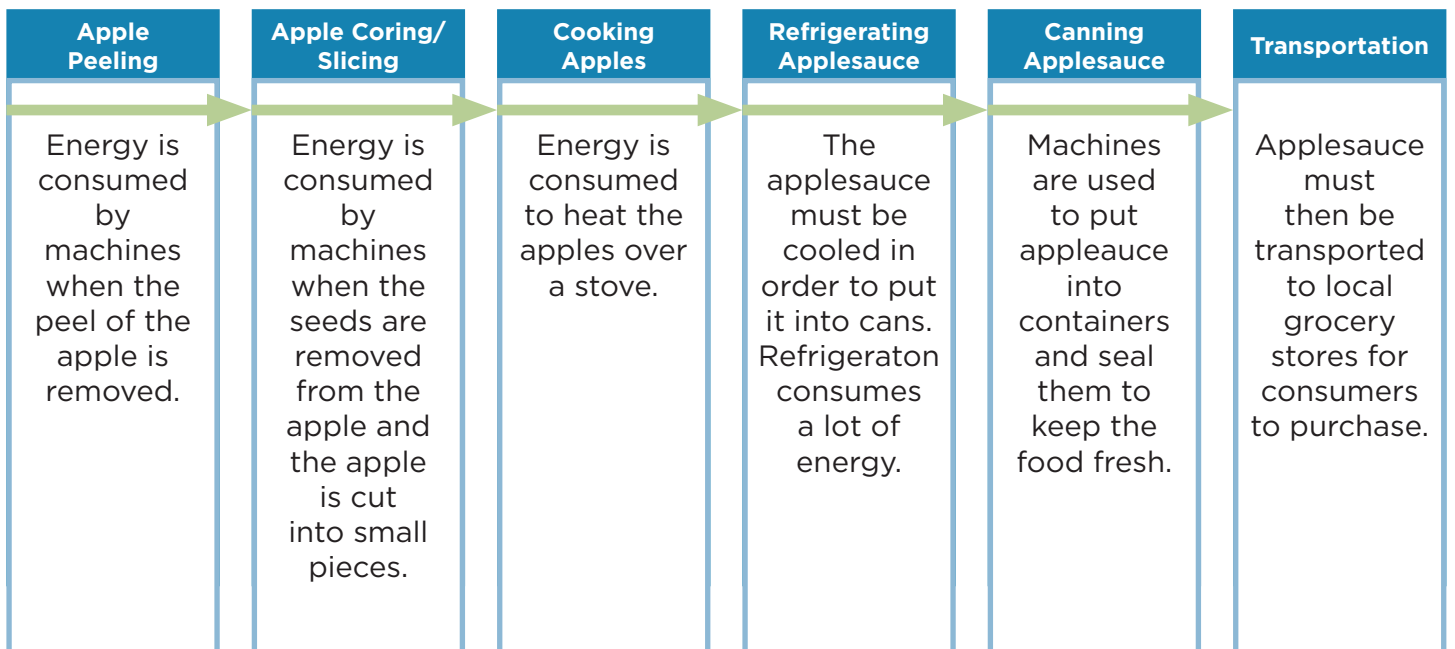
- Refer students back to the KWL chart created the first lesson.
- Add to and/or check off items in the L column for what students learned today.
- Add to the W column what students now want to know.



Sample Apple Production Flow Chart



Energy Consumption While Processing Apples Into Applesauce Answer Key





OVERVIEW

LESSON 3: ENERGY DISTRIBUTION

Standards

Next Generation Science Standards

PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

PS3.A Definitions of Energy

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.
- A system of objects may also contain stored (potential) energy, depending on their relative positions.
- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between then temperature and the total energy of a system depends on the types, states and amounts of matter present.

PS3.B Conservation of Energy and Energy Transfer

- When the motion energy of an object changes, there is inevitably some other change in energy at the same time.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample and the environment.
- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

English Language Arts Common Core Standards

CCSS.ELA-LITERACY.RST.6-8.3

Follow precisely a multistep procedure when carrying out experiments, taking measurements or performing technical tasks.

CCSS.ELA-LITERACY.WHST.6-8.2

Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments or technical processes.

CCSS.ELA-LITERACY.SL.6-8.1

Engage effectively in a range of collaborative discussions (one-on-one, in groups and teacher-led) with diverse partners on grade 6-8 topics, texts and issues, building on others' ideas and expressing their own clearly.

Learning Objectives

At the conclusion of this lesson, students will be able to:

- Demonstrate the GRID flow, constraints and demand of energy.
- Solve the limitations of the GRID in reference of a natural disaster situation.

Time

1.5 hours

Materials

- Masking tape
- Whiteboard and markers
- Scratch paper
- 72 Legos
- Yarn
- Non-carpeted floor



INTRODUCTION

The Grid:

- Prior to class, tape GRID to classroom floor (see GRID map at end of lesson).
- Have students circle around the diagram, look at the floor and share ideas of what they see.
- Record ideas on whiteboard near diagram.
- Reference KWL chart from Lesson 1, and review what was learned and talked about in the previous lesson.
- Share with students that today we will further energy and the generation of energy.

OBJECTIVE 1

Demonstrate the GRID flow, constraints and demand of energy.

Understanding the GRID:

- Share YouTube videos:
 - Energy 101: Energy Generation <https://www.youtube.com/watch?v=20Vb6hLQsG>
 - Where Energy Comes From https://www.youtube.com/watch?v=__zB80Saglk
- While watching videos, have students jot down 10 new things they discovered about energy generation.
- After the videos, refer back to the whiteboard where ideas were recorded about the diagram on the floor. Ask students to modify this list and the diagram based upon the information gleaned from the video. A leading question could be, "What can we add or take away that is true about the GRID?" (Labels should be added at this point.)
- Circle students up around the diagram. Identify each piece of the GRID and note that the Xs represent a person or a career in energy and agriculture. Discuss the different energy careers in agriculture. These may include, but are not limited to:
 - Account manager, engineer, gas welder, lineperson, troubleperson, accountant, business analyst, marketing, event planner, etc.
 - Let students know that these careers will be further discussed in Lesson 4.
- Have students identify where each of the jobs above fit into the GRID:
 - Generator- Plant Manager
 - Transmitter- Linemen/ women
 - Neighborhood Transmitter- Troublemens/women
 - Farm- Farmer

The GRID Game:

- Assign students an energy career in agriculture. (Plant Manager x2, Lineman/ woman x8, Troubleman/ woman x2, Farmer x6)
- Use prompts at the end of this lesson to guide students to distribute energy to the 6 farms.
- Repeat as time permits with different team groupings and different prompts and until teacher feels understanding is met. Make up your own as needed.

The GRID Game Instructions:

Note: Depending upon age level and class size, modifications may need to be made (e.g., using fewer Legos, using just one color of Lego, etc.)

- Divide class into two teams of 9 students each.
- Teams will move energy from the generator to the farms like a relay race.
- Legos will represent the energy that is being distributed.
- Legos will travel from one station to the next using a piece of yarn. The only time a person's hands are allowed to touch the Legos is when they are being stacked or unstacked. All other times, only yarn and the floor may be used.
- One person from each team stands at the Generator representing the Plant Managers.
- Plant Managers walk the line between the Generator and Transformer, moving one Lego each at a time.
- Two more students at each Transformer will represent our Linemen/ women.
- Once the total number of Legos needed to run one farm (can choose to do more) are at the Transformer, the Lineman/ woman will connect them together and slide or roll the group along the ground to the Neighborhood Transformer. Connecting Legos represents how transformers increase voltage to help electricity travel a long distance.
- Each team has one Troubleman/ woman available to help if the group of Legos stops along the path from the transformer to the neighborhood transformer. This student is representing that there are people who are on call and ready to fix energy crises when they occur due to weather and other problems.
- Three students will be at each Neighborhood Transformer representing more Linemen/ women.
- Once the group of Legos gets to the Neighborhood Transformer, they will break them apart and each of the Linemen/ women will get one. Breaking apart Legos represents how neighborhood transformers decrease voltage so electricity can travel to one's home.



- The Lineman/woman will take the Lego to a Farm and the Farmer stationed there.
- Farmers will connect their Legos.
- The Farmer will hold their connected Lego group up until all three farmers on the team are holding their Legos up to symbolize they have enough energy to run their farm.
- The winning team will be the team that completes the teacher prompt first.

The GRID Game Discussion:

- What would a farmer use the energy he received from the neighborhood transformer toward on his farm?
- What would happen if a natural disaster occurred?
- Can the Legos (energy) stay at a transformer longer than the time it takes to connect or break them apart?

OBJECTIVE 2

Solve the limitations of the grid in reference of a natural disaster situation.

Disaster News:

- Divide students into pairs. One person will play the

role of a news reporter and the other an energy expert.

- Give students 10 minutes to respond to the following questions in a news report skit.
 - Describe how you would solve the GRID's limitations to a natural disaster. Natural disasters could include: tornado, thunder storm, flood, etc.
 - Where would the farm get its energy?
 - Who would fix the problem?
- Each group will share their news report.

CONCLUSION

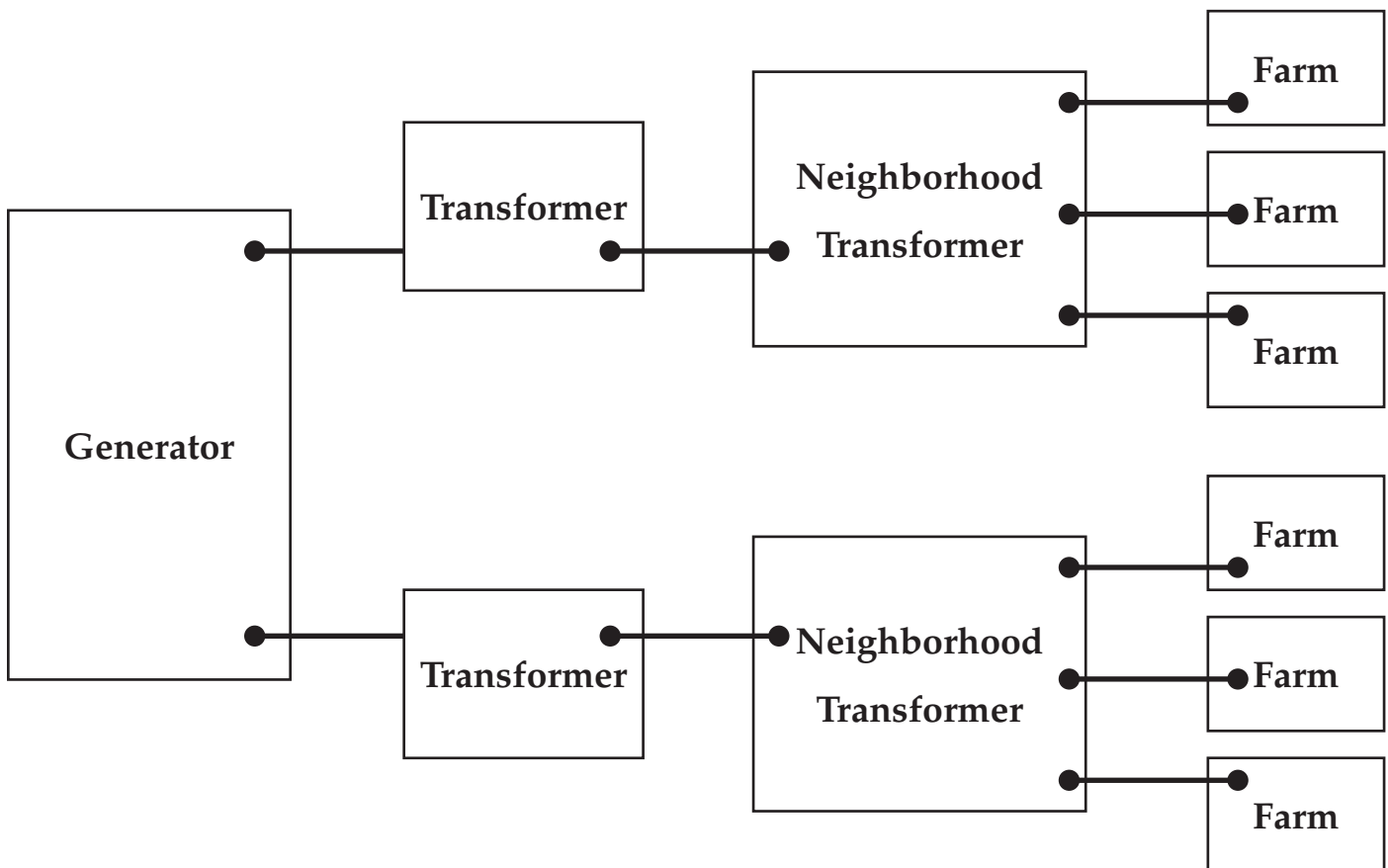
KWL Update:

- Refer students back to the KWL chart created in the first lesson.
- Add to and/or check off items in the L column for what students learned today.
- Add to the W column what students now want to know
- Have students complete attached crossword in class or take home.



GRID Map

Duplicate on classroom floor with tape and without labels initially. After watching the video, labels can be added.





Teacher Prompts

<p>Farm needs 5 energy to run their production.</p>	<p>Due to a spike in the temperature, the farms now need 8 energy to run production.</p>
<p>A storm hit a power line a few miles away. It's been a challenge to get the electricity back. Players must complete activity using only their non-dominant hand. Farm needs 7 energy to run production.</p>	<p>A severe drought is plaguing the region. The farm needs 12 energy to run production.</p>
<p>Your livestock buildings have a solar design, using the sun's heat to warm the building, air and water. It's a cloudy day, no verbal communication may be used to complete this activity.</p>	<p>You participate in an energy rewards program, and reduce energy use during peak demand events. The farm needs 3 energy to run production.</p>



Energy Crossword

ENERGY CROSSWORD
Across

- 3. The power used to do work or cause change
- 6. Energy from the sun
- 7. Energy in the nucleus of an atom released using fusion or fission
- 8. Solar energy and wind energy are both _____ sources of energy.

Down

- 1. Oil and natural gas are difficult to find because they are usually found trapped between layers of _____ rock.
- 2. This energy source is the cheapest because it comes from the movement of water
- 4. The process of _____ mining makes coal less expensive to mine, but limits extraction to 1/3 of the coal that is available.
- 5. A device that changes the voltage of electricity.

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



Answer Key: Energy Crossword

ENERGY CROSSWORD

Across

3. The power used to do work or cause change

6. Energy from the sun

7. Energy in the nucleus of an atom released using fusion or fission

8. Solar energy and wind energy are both _____ sources of energy.

Down

1. Oil and natural gas are difficult to find because they are usually found trapped between layers of _____ rock.

2. This energy source is the cheapest because it comes from the movement of water

4. The process of _____ mining makes coal less expensive to mine, but limits extraction to 1/3 of the coal that is available.

5. A device that changes the voltage of electricity.

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OVERVIEW

LESSON 4: CAREER SHOWCASE

Standards

English Language Arts Common Core Standards

CCSS.ELA-LITERACY.SL.8.4

Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning and well-chosen details; use appropriate eye contact, adequate volume and clear enunciation.

Learning Objectives

At the conclusion of this lesson, students will be able to:

- Describe three key pieces of information about a career in energy.
- Persuasively present information about a career in energy.

Time

1 hour and 10 minutes

Materials

- Computers (1 per student or pair)
- Computer paper (1 sheet per student)
- Energy Careers Grid
- Markers and coloring items (for manual brochure option)
- Whiteboard and markers

INTRODUCTION

Career Shout-Out:

- Summarize what students have learned in the unit thus far. Dialogue may sound like: Over the past few days, we've discovered what energy is, how it is generated, the flow of the GRID and energy involved in food production and processing.
- Facilitate a discussion about who is involved in each of these pieces. Translate that into careers in energy.
- Record these careers on the whiteboard.

OBJECTIVE 1

Describe five key pieces of information about a career in energy.

Careers in Energy:

- Distribute Energy Careers Grid to each student.
- Guide students to the website: <http://www.getintoenergy.com/careers.php>
 - There are five careers on the site. Students should select the four careers that are of most interest to them.
 - Click the name of the career to find necessary information to complete the worksheet.
- The worksheet outlines five key pieces of information: description, average salary, skills required, high school courses to take and future training options in their area.
- Identify the high school courses, by clicking "view courses."
- Identify future training options, by clicking on "find training," enter local address and investigate further.
 - Your local energy company may have a website that includes career information pertinent to your area.
 - Teachers may also choose to have students explore beyond the above website. Additional time can be spent researching careers by using other websites and adding more rows to the bottom or back of the chart. Be sure students realize there are more than five careers related to energy!



OBJECTIVE 2

Persuasively present information about a career in energy.

Career Brochure:

- Once grids are complete, have students select the one they found to be most interesting and create a tri-fold brochure advertising the career.
 - If computer access, time and skill are available, students can create a tri-fold brochure on the computer. Students can also prepare a brochure by hand using computer paper, markers and colored pencils.
 - Students should incorporate their research into an eye-catching, colorful and thorough brochure that highlights the major points of their research.
- Display brochures in one of the following manners:
 - Have a mini career expo by having students circulate throughout the room and share their brochures with one another, attempting to “recruit” others into their career field.
 - Set up the classroom to resemble a career fair (desks/tables in a circular form around the edge of a room) and have an 8 ½ X 11 poster for each “career booth” (desk/table) at each location with the title of each career at that location. Have students man a “booth” that corresponds with their career and have teachers or administrators come through there while students attempt to recruit or persuade them to join their career area.
- Following mini expo or career fair, facilitate a discussion about what students liked/saw, things that caught their interest, etc.

CONCLUSION

Quick Call Review:

- Call out a specific career, and have all students who chose that career stand.
- Call on them for specific information (salary, skills, etc.).
- Repeat with other careers.
- Facilitate a class discussion about the benefits of energy careers.

KWL Update:

- Refer students back to the KWL chart created the first lesson.
- Add to and/or check off items in the L column for what students learned today.
- Add to the W column what students now want to know



Tri-Fold Brochure & Career Presentation Scoring Guide

- Brochure includes the following details: **25 points**
 - Career description
 - Average salary
 - Skills required (at least 5)
 - High School courses to take
 - Future training options in the area

- Brochure is: **20 points**
 - Easy to read
 - Well organized
 - Free of spelling errors
 - Free of punctuation errors

- Presentation
 - Student shows clear knowledge of career **10 points**
 - Student persuasively shares information about career to peers and/or teachers and administrators **10 points**

- Total:** **65 points**



Energy Careers Grid

Career	Description	Average Salary	Skills Required	High School Courses to Take	Future Training Options in the Area



OVERVIEW

LESSON 5: PUTTING IT ALL TOGETHER

Standards

Next Generation Science Standards

- PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- ETS1.B Developing Possible Solutions
- There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

English Language Arts Common Core Standards

CCSS.ELA-LITERACY.RST.6-8.8

Distinguish among facts, reasoned judgment based on research findings and speculation in a text.

CCSS.ELA-LITERACY.SL.8.4

Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning and well-chosen details; use appropriate eye contact, adequate volume and clear pronunciation.

Learning Objectives

- At the conclusion of this lesson, students will be able to:
 - Decide between multiple energy use options in an agricultural setting.
 - Validate the reasons behind the decisions for a particular energy use.

Time

50 minutes

Materials

- Guest evaluator (administrator, energy company official, farmer, etc.)
- Farm scenarios (1 per person)
- Farm Energy Flow Chart (1 per person)
- Writing utensils
- Scratch paper (1 per student)
- Whiteboard and markers



INTRODUCTION

Decisions, Decisions:

- Instruct students to think back to the day they made applesauce.
- Give students one minute to list the steps involved in the creation of the applesauce, from production to processing.
- Have each student list their steps on the whiteboard or a sheet of paper for all to see.
- Conduct a class contest to see who go the most correct sequence.
- The class lists will probably be different, or have different components. Facilitate a discussion on why this happened. Lead students to the conclusion that the lists are different because you, as the “farmer,” made different decisions than others.
- Wrap up the introduction by concluding that these decisions ultimately affect the product, bottom line and total energy use.

Note: Depending upon the age level and agriculture knowledge, teachers may need to first facilitate a discussion on choices kids made in order to understand pros/cons and then progress into talking about farmers and their choices.

OBJECTIVE 1

Decide between multiple energy use options in an agricultural setting.

Energy Decisions:

- After identifying some of the major decision points from production to processing, have students further examine the steps of energy use and identify all points of decisions (using a microwave instead of an oven, the kind of tractor used in the apple orchard, etc.)
- Distribute Farm Energy Flow Chart and walk students through what would theoretically go in each box (a choice and a rationale).
- Distribute the farm scenarios and read through the scenario situation and directions. Highlight the following information from the directions:
 - There is a maximum number of points allowed to be spent.
 - Each decision must have a clear “why” that is able to be explained.
 - Be prepared to make tradeoffs to get the most important things. For example, the energy efficient tractor will use less fuel and therefor contribute

fewer emissions to the atmosphere, however it will cost more points.

- A guest evaluator will judge each plan according to quality.
- Walk through the sample decision at the top of the page (this will come out of the possible total points). Ask students to make a decision and write it in the box. Ask three students to reveal their sample decision and why they made it.
- Give students 10 minutes to walk through the energy decisions they would make on their farm.
- Circulate throughout the room and help them walk through the development of their rationales for the purposes of explanation.

Note: Depending upon age level and agriculture knowledge, teachers may choose to do this example as an entire class and then have the class create another scenario, typical for your specific area/location, and then complete the activity as pairs. In some cases, teachers may need to facilitate a discussion about each of the choices noted on the flow chart, how they work, advantages, disadvantages, etc. Teachers can also choose to have students do the exercise below in pairs, and plan for additional time for students to research the decisions independently.

OBJECTIVE 2

Validate the reasons behind farm decisions.

Flow Chart Presentation:

- Introduce guest evaluator.
- In pairs, have students share their flow chart, citing the decisions they made and their reasoning behind the decisions.
- Suggest that students offer feedback to one another to strengthen their validation. Encourage them to particularly focus their validations on evidence or unit knowledge.
- Depending upon time, either have all students present their ideas to the guest evaluator or have students peer-select the best plan from within their pair.
 - When presenting, students will play the role of the farmer, describe their farm, identify the farm’s name, share what they are growing and finally share their series of decisions.
- During presentations, prompt students with probing questions to determine the rationale behind their evaluations, asking lots of, “Why this instead of this...” type of questions.
- Ask the guest evaluator to select the best plans according to their validations.



CONCLUSION

Celebration:

- Conduct a class celebration and reflection for the content learned and effort demonstrated. Reflection questions for discussion may include:
 - What are two a-ha moments you had during this unit regarding energy?
 - Describe three ways energy and agriculture are related.
 - How can agriculturalists alter their energy use?
 - What are two ideas you want to remember about this unit? Why?

KWL Update:

- Refer students back to the KWL chart created the first lesson.
- Add to and/or check off items in the L column for what students learned today.
- Add to the W column what students now want to know and plan to explore further.



Farm Scenario

A number of fruit farms in California are looking for ways to cut energy costs. A particular farmer (the guest evaluator) has 300 acres of orange trees and is committed to producing high quality fruit. He/she realizes their energy costs could easily get out of control in an effort to produce the best fruit possible. He/she does, however, have a limited budget and must make some important decisions when it comes to the farm's energy consumption and usage. The farmer has enlisted the assistance of energy experts (you and your classmates) to determine a plan for his/her farm. After examining all decisions and justifications from your class, he/she will hire one energy expert to consult with his farm.

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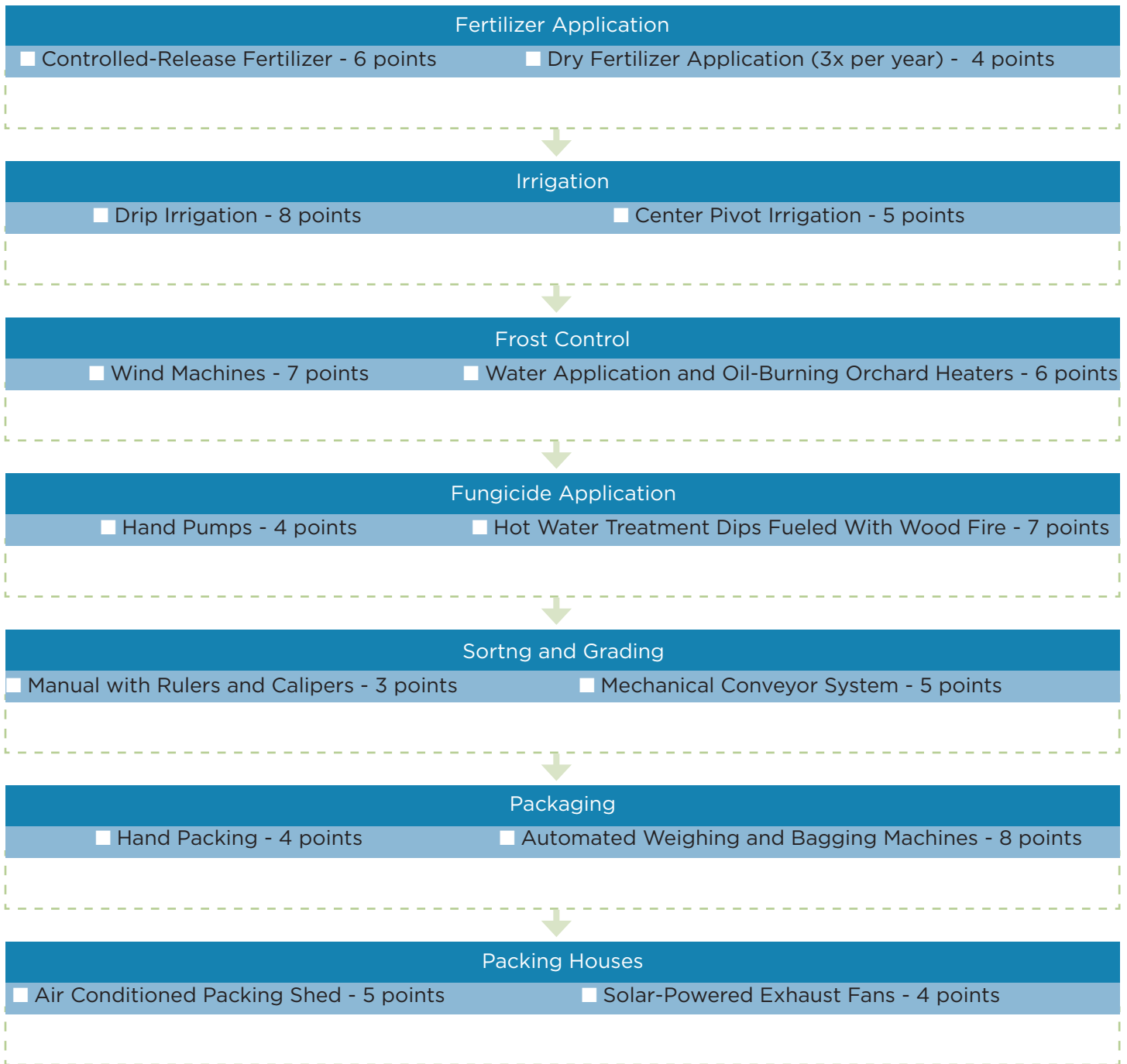
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Farm Energy Flow Chart

This farmer has 36 points to spend on energy expenses. Once an option is selected, provide justification in the box to the right of the chart. There are a number of things to consider when making a decision, including but not limited to, labor costs, timeliness, energy conservation, cost, etc. Be sure to take all of these into consideration when justifying your decisions.





My American Farm was built for educators, learners and their families with free downloadable resources and fun family activities to explore:

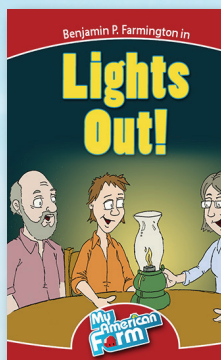
www.myamericanfarm.org

Lesson Extenders:



Power Up Game

- Playing Time: 7-10
- Grades 3-5
- Curriculum Areas Science
- Lesson plan: "Energy and Agriculture"
- Hands on Activities: "Making the Connection: Energy Lessons"



Lights Out! eComic

- Grades 3-5
- Curriculum Areas Science



Plugged In Activity Sheet

- Grades 3-5
- Curriculum Areas Science



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