
# Going Green! Middle Schoolers Out to Save the World (MSOSW)

## Standby Power Conservation Project

# Curriculum Guide 2018

**Revised 2018**


# Going Green! Middle Schoolers Out to Save the World Project

## Credits

*Project Leadership*

| | |
|---|---|
| Gerald Knezek | Lead Principal Investigator, UNT |
| Rhonda Christensen | Co-Principal Investigator, UNT |

*Project Advisory Board*

| | |
|---|---|
| Cindy Barnes | Good Shepherd Episcopal School, Dallas TX |
| Jim Bower | Numedeon, Inc. (Whyville) |
| Troy Cline | NASA Goddard Space Flight Center |
| Chris Dede | Harvard Graduate School of Education |
| Lynn Farrin | Maine Mathematics and Science Alliance |
| David Gibson | Global Challenge |
| Lisa Grable | The Science House, NC State University |
| Bob Hirshon | American Association for the Advancement of Science (AAAS) |
| Theresa Overall | University of Maine Farmington |
| John Park | Pres. - School Science and Mathematics Assoc. |
| Miki Tomita | University Lab School, Hawaii |

*Project Evaluators*

| | |
|---|---|
| Penny Nolte | Lesley Leach |

*Project Staff*

| | |
|---|---|
| Fred Hobbs | Project Administrator |
| Dana Arrowood | Site Coordinator |
| Samson den Lepcha | Graduate Research Assistant |

Development of these materials was supported, in part, by National Science Foundation Innovative Technology Experiences for Students and Teachers (ITEST) (University of North Texas) Grant #1312168


# Table of Contents

# Curriculum Overview

## Unit Goal

Students will understand how electrical energy is produced and why it is important to conserve energy in their homes. Students will be able to identify sources of "standby" power that will enable them to be more efficient consumers. They will also educate their family as well as others about the benefits of saving "standby" power.

## Unit Question: How can we conserve stand-by power in our homes?

## Lesson Objectives

The student will be able to:

- Define standby power.
- Demonstrate safety when using electricity.
- Define energy and understand that it comes in many forms, including electrical energy.
- Understand that atoms cannot be broken down by natural processes and are made of neutrons, protons, and electrons, each with their own specific charge.
- Understand that electrical energy is the energy of moving electrons.
- Explain the difference between an insulator and a conductor.
- Explain how energy usage is measured in watts.
- Calculate basic kilowatt-hours use for a given appliance.
- Label the major parts of a generator and understand how a turbine spins.
- Compare renewable with nonrenewable energy.
- Describe the major methods of energy production, including coal, natural gas, nuclear, water, wind, and solar.
- Compare the risks and benefits of different energy production methods.
- Identify devices in his/her home that use electrical energy.
- Explain how to determine if a device likely uses standby power.
- State the percentage of standby power in an average home.
- Calculate the total standby power used by a device over time.
- Understand the cost of standby power in devices.
- Use a metering device to measure the amount of energy used by various devices in the home.
- Define carbon footprint.
- Define global climate change.
- Explain how the greenhouse effect warms our planet.
- Identify evidences for global climate change.
- Understand possible causes of global climate change.
- Identify possible future affects of global climate change.
- Read charts and graphs related to data collected by students
- Analyze basic standby power data for basic trends
- Calculate kilowatt-hours (kWh) spent on standby power, daily, yearly, in the home, country, etc.
- Generate realistic methods for conserving power in his or her daily life.
- Identify methods for conserving standby power.
- Use a monitoring device to monitor energy use for specific appliances.
- Analyze time vs power use graphs for trends.
- Calculate average standby power use for a specific appliance.
- Produce a blog, video (skit, song, report, etc), or poster informing others about standby power consumption. (OPTIONAL EXTENSION ACTIVITY)
- Explore careers related to energy conservation.
- Explore careers related to Science, Technology, Engineering and Mathematics (STEM).

# Project Timeline

This project is designed to be completed over a three to four week period of time. Extension lessons and projects can be used to create a longer, more in depth unit if time allows. Pre-test data should have been collected at the beginning of the school year. Post test data should be collected after the project activities are completed.

| | |
|---|---|
| **Just before start:** | Make sure you have already created a *Whyville* teacher account. |
| **Day 1:** | Introduce Project – Define standby power and discuss electricity safety; send home consent forms (this can be done in 10-15 minutes). |
| **Day 2:** | Safety Quiz<br>Introduce *Whyville* to class including STEM career activities. |
| **Day 3:** | Students will log into *Whyville* accounts and explore careers in *WhyPower.* |
| **Day 4:** | Electricity Basics – What it is and how it's measured; Assign Plug-In Inventory Worksheet. |
| **Day 5:** | Electricity Basics – how it's produced and transmitted |
| **Day 6:** | Return Inventory; finish electricity basics (production presentations). |
| **Day 7:** | Define and discuss standby power and how to determine appliances that use it. |
| **Day 8:** | Using the Belkin device – students learn how to use the device at school. |
| **Day 9:** | Why should we conserve electricity? Students will learn what their "carbon footprint" is, how carbon output affects our planet, and why we need to reduce our carbon output. |
| **Day 10:** | Why should we conserve electricity? |
| **Day 11:** | Why should we conserve electricity? |
| **Day 12:** | Why should we conserve electricity? (All data should be in.) |
| **Day 13:** | Using the Belkin device – students learn how to use the device; send devices home |
| **Day 14:** | ******You may wish to give them an extra day to get their devices measured. You might choose to have students work on their career component in preparation for the Career Fair. |
| **Day 15:** | Analyze data. |
| **Day 16:** | How can we conserve power? Students will brainstorm ways to conserve power and create a small poster with their idea. |
| **Day 17:** | Educating Others and Career Fair |

*** Teachers may choose to continue the project's extension activities until data is completed. **In the Final Phase of the project, the Educating Others segment can be removed if time is not available, but is an excellent culminating assessment tool for the project.**

**Final Phase: Days 1-4 days**

Educating others – students individually, or in groups, will produce a video (skit, song, etc), blog, or poster to educate others about standby power conservation

**After Project Ends** Collect Post-Test Data – this will take 1-2 class periods in a computer lab or, if necessary, can be assigned as homework over a few days.

# Project Teacher Tasks

**All teachers participating in the MSOSW project need to complete the following tasks to complete the project successfully.**

1. Collect Pre-Test data (both students and teachers) at the beginning of the school year (mid Sept. – mid Oct.).
2. Set up teacher account in *Whyville* at whyville.net.
3. Join the wikispaces site at msosw.wikispaces.com.
4. Introduce Unit – Send students home with project information and permission forms.
5. Teach the safety lesson.
6. Have students do the Plug-in Appliance Inventory using the worksheet provided.
7. Have students return inventory. Discuss with class and narrow down which 15 - 20 items you will have the students select to measure their 5 appliances with the Belkin devices. The teacher will use the electronic version of the provided worksheet (spreadsheet) to fill in the appliances their students will be measuring based on the inventory returned. Select 15 and have the students measure the ones they have at home. It may be only 5 of those listed but that is okay.
8. Look at returned lists and based on what students have at home, assign them in groups of 4 to use the Belkin devices to measure for a 24-hour period at 1-minute intervals.
9. Students will measure the assigned appliances (parent will sign off on this). The students will return data collection worksheets.
10. After all students have finished monitoring with the Belkin device, compile the data into the provided spreadsheet and upload to the project wiki (msosw.wikispaces.com).
11. Discuss “what if” projections and how students can make a difference.
12. Have students create a public service announcement to educate others.
13. Have students share their career exploration findings.
14. Collect post test data (both students and teachers)

Be sure to video segments of the project and/or interviews of students telling what they learned. Upload those on project wiki site (msosw.wikispaces.com).


# Going Green! MSOSW
# Lesson One: Introduction
**Basic information and Electricity Safety**

**Overview:** Students will get a basic introduction to standby power and learn how to use electrical devices safely in their own homes.

**Objectives:**

**The student will:**

- Define standby power.
- Demonstrate safety when using electricity.

**Standards Addressed (Grades 5-8)**

- Life Science: Structure and Function in Living Systems
- Science in Personal and Social Perspectives: Personal Health; Natural Hazards; Risks and Benefits

**Suggested Grade Levels:** Middle School ($6^{th}$- $8^{th}$)

**Timeline:** 1 – 2 class periods ($2^{nd}$ day will take only a few minutes; continue to Lesson Two)

**Materials:**

| | | |
|---|---|---|
| **Day 1:** | Student Project Folders | Student Consent Form |
| | Parent Consent Form | Electrical Safety Presentation |
| **Day 2:** | Safety Quiz | Computer Lab Access |
| | Safety Certificates | |

**Procedure:**

**Day 1:** **Introduction and Electricity Safety**

- Introduce the project to students, giving them a basic outline of what they'll be doing. Define standby power and discuss briefly.
- If desired, hand out student project folders (simple braded folders). The students will be keeping track of several different handouts and worksheets during the project and it will be helpful to keep them all in one place. Also, the folder can be turned in periodically during the project for grading purposes. Alternatively, students can just keep all materials with their normal science materials.

- Explain to students that since the materials used in this project will be used in an actual scientific study, we need their consent and the consent of their parent or guardian to use the information they gather.
- Show *Electrical Safety Presentation*, including the video clips at the end:
  - What If...A New Global Option Part 1 (~8 min)
    - http://www.youtube.com/watch?v=PH2NHRtpZ1M
  - There Is No Energy Crisis, There is a Crisis of Ignorance (~6 min)
    - http://www.youtube.com/watch?v=-fVI3BRBC6o
  - After each clip, discuss the topics included as a class.
- Go over *Safety First* sheet and let students know there will be a short quiz tomorrow over the guidelines.
- Homework: Send home *Student* and *Parental Consent Forms*.

**Day 2:** **Safety Assessment**

- Take *Safety Quiz*.
- Hand out Safety Certificates to all students who scored a 90% or better on the Safety Quiz. Students who scored lower will need to retake the quiz or discuss the ones they missed with their teacher one-on-one to earn their certificate and begin using the devices at home.

**Assessment Options for this Lesson:**

- Safety Quiz
- The Safety Quiz can also be completed in *Whyville*. The students will be able to earn clams for completing the quiz in *Whyville*. While *Whyville* is not introduced formally until Lesson 4, you may wish to get the students started there if you wish to use the Safety Quiz in *Whyville*.


# Lesson One: Introduction

## Resources

# Student Participant Assent Form

You are being asked to be part of a research project being conducted by the University of North Texas, Department of Learning Technologies.

This study involves participating in a new science curriculum that will allow you to use energy monitoring equipment in diverse home and community settings to build accurate, scientifically important models of energy consumption in homes and communities, under the guidance of your teachers.

In addition to the science project that will be part of your science curriculum for the year, you will also be asked to complete a brief, 25-item questionnaire about what you think makes a great science class. This questionnaire will be administered twice, once at the beginning of the program and once at the end. It will take approximately 15 minutes to complete the survey each time, but it will be administered in the classroom and will require no time commitment outside of class. You will also be asked to complete a brief, 12-item questionnaire about whether or not a career in science would be interesting to you. This questionnaire will also be administered twice, once at the beginning of the program and once at the end. It will take approximately 10 minutes to complete the survey each time with no time commitment required outside of the class. As part of instruction involved with the unit, you will be asked to complete a quiz which assesses how much information you know about energy consumption.

If you decide to be part of this study, please remember you can stop participating any time you want to.

If you would like to be part of this study, please sign your name below.

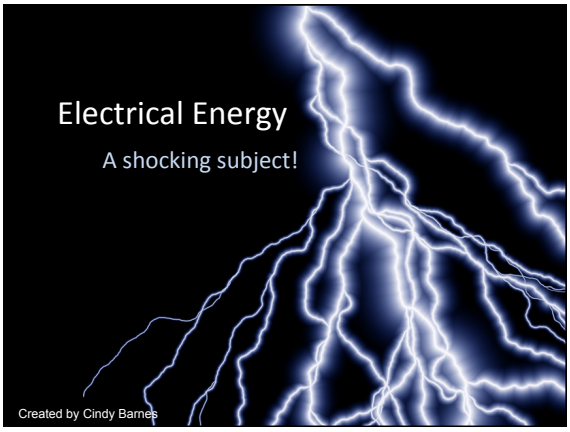
_____
Printed Name of Student

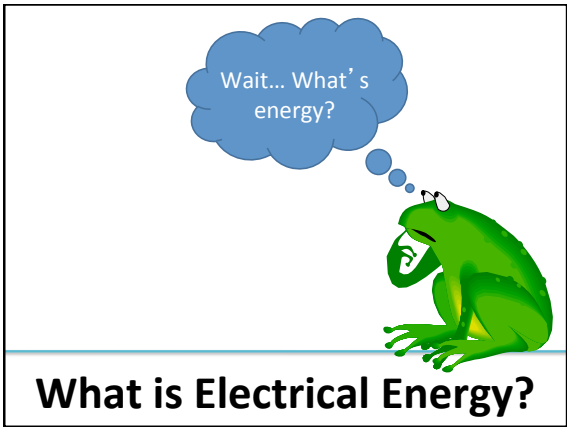
_____ _____
Signature of Student Date

_____ _____
Signature of Investigator Date

## Safety First

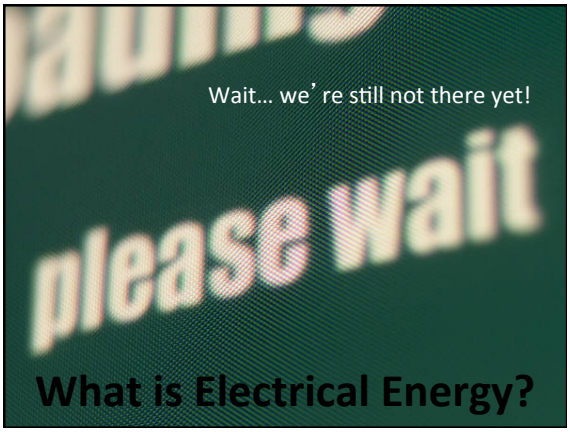
1. Never plug device in near water. (Machines aren't waterproof and this can cause severe bodily damage.)
2. Don't plug in a damaged (ripped, torn, broken) cord to a device.
3. When you unplug the device, don't unplug by pulling on the cord; hold on gently to the plug and pull it out of the outlet.
4. Don't let your best friends (pets) use cord as a chew toy. ☺
5. Don't touch your home's fuse box.
6. Never put anything besides a plug into an outlet.
7. Don't overload an outlet – limit the number of things that are plugged into each one.
8. Never use a plug that is damaged. Look for bent or broken prongs.
9. Never place heavy objects on top of electrical cords.
10. If in doubt ask an adult for help, or if in an emergency (fire, you or someone else is hurt) call 911 immediately.



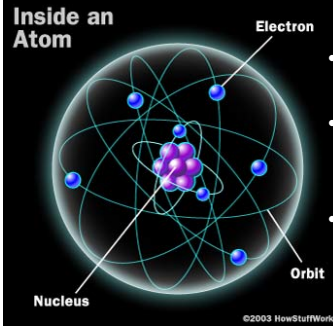




## What is energy?

- Energy is the ability to do work.
- Energy is a constant part of our lives.
- Energy comes in many forms.
- Energy cannot be destroyed.



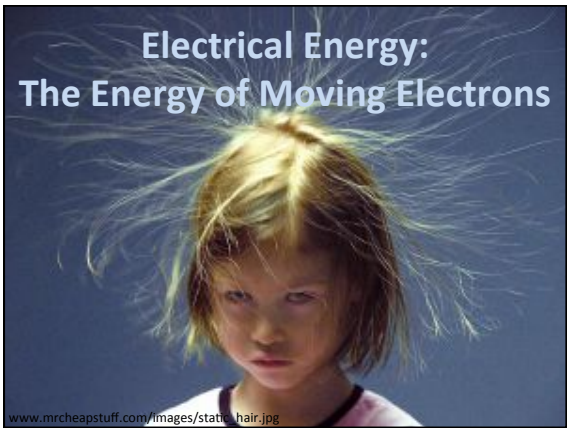

## What is an Atom?




- The basic unit of matter.
- Made of neutrons, protons, and electrons.
- Each particle carries a specific charge.

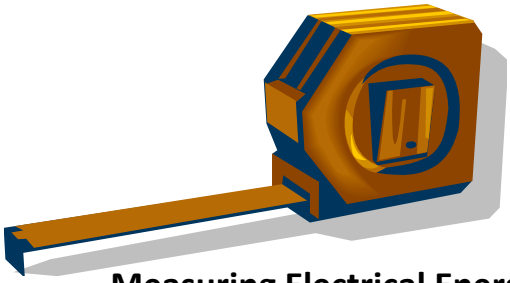
## So… What is Electrical Energy?

We're finally ready! ☺




## How Does That Work?

- Insulators versus Conductors
  - Some atoms are stable, others aren't
  - Unstable atoms like to share their electrons
- With enough conductor atoms together, you can move electrons over a long distance
- Electrical energy is the movement of these electrons from one atom to another.



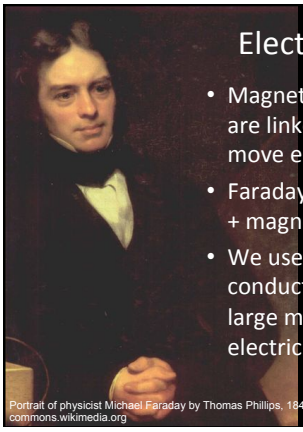
## Measuring Electrical Energy

## What's a Watt?

- Watts
  - Measure the amount of energy actually being used or converted by the circuit (measurement of power)
  - Can also be described in kilowatts (1 kilowatt=1000 watts)
- Measuring energy in our homes
  - Kilowatt-hours (kWh)
  - Example: A heater may be rated to use 1000 watts, or 1 kilowatt. It will use 1 kilowatt-hour if used for an hour.

## How Do We Create Electrical Energy?

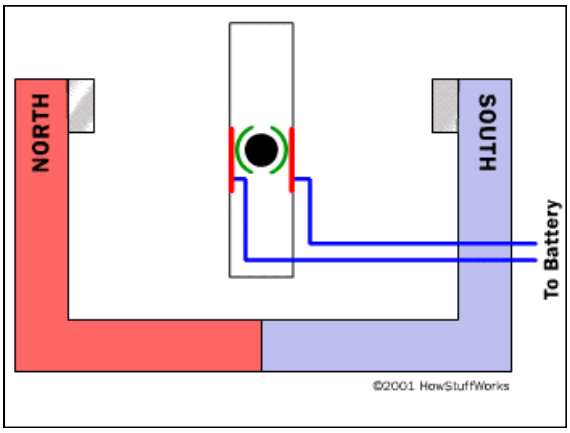
Generating a Flow of Electrons

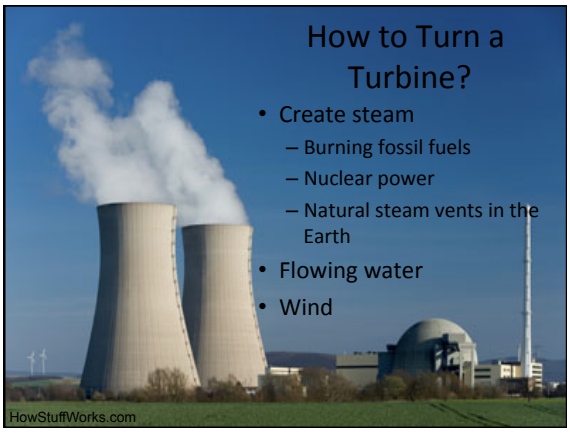


## Electrical Generators

- Magnets and electrical energy are linked because magnets move electrons
- Faraday's discovery – conductor + magnet = moving electrons!
- We use a turbine to spin a conducting wire inside very large magnets to produce electricity!

Portrait of physicist Michael Faraday by Thomas Phillips, 1842; commons.wikimedia.org




## Review

- What is energy?
- What is electrical energy?
- What is a conductor versus an insulator?
- What is a watt? What is kilowatt-hours?
- How do we create electrical energy?

## References


- Brain, Marshall, and Robert Lamb. "How Electricity Works" *HowStuffWorks*. HowStuffWorks, Inc., 28 May 2004. Web. 11 June 2010. <http:/science.howstuffworks.com/electricity.htm>.
- Brain, Marshall, and Robert Lamb. "How Nuclear Power Works." 09 October 2000. HowStuffWorks.com. < http://science.howstuffworks.com/nuclear-power.htm> 28 July 2010.
- "The Energy Story." *Energy Quest*. Ed. Suzanne Garfield. California Energy Commission, 22 Apr. 2002. Web. 11 June 2010. < http://energyquest.ca.gov/story/index.html>.
- All images not otherwise cited are Microsoft Clip Art images.

Name: _____ Grade-Period: _____

# Electricity Safety Quiz

1. If your hands are wet, you should always dry them off before touching any electrical device.

   **TRUE FALSE**

2. If an appliance has a frayed cord, it's okay to use it as long as you put duct tape over the frayed area.

   **TRUE FALSE**

3. If an appliance is plugged into an area where the plug is difficult to reach, simply grasp the cord and pull the plug out that way.

   **TRUE FALSE**

4. You should never put anything besides a plug into an outlet.

   **TRUE FALSE**

5. Plugging too many appliances into one outlet (by using multiple power cords, etc) can be dangerous.

   **TRUE FALSE**

6. If the prongs on a plug are bent, you should bend them back before plugging the device in.

   **TRUE FALSE**

7. You never want to move a heavy object, such as a chair or a cabinet, on top of an electrical cord.

   **TRUE FALSE**

8. If the power is out in your home, it's okay for you to open the fuse box and try to fix it.

   **TRUE FALSE**

9. If you're unsure how to safely use a device, you should ask an adult for help.

   **TRUE FALSE**

10. If you experience an electrical emergency and someone is hurt or a fire starts, you should call 911 immediately.

    **TRUE FALSE**

**TEACHER KEY**

# Electricity Safety Quiz

1. If your hands are wet, you should always dry them off before touching any electrical device.

   **TRUE**

2. If an appliance has a frayed cord, it's okay to use it as long as you put duct tape over the frayed area.

   **FALSE**

3. If an appliance is plugged into an area where the plug is difficult to reach, simply grasp the cord and pull the plug out that way.

   **FALSE**

4. You should never put anything besides a plug into an outlet.

   **TRUE**

5. Plugging too many appliances into one outlet (by using multiple power cords, etc) can be dangerous.

   **TRUE**

6. If the prongs on a plug are bent, you should bend them back before plugging the device in.

   **FALSE**

7. You never want to move a heavy object, such as a chair or a cabinet, on top of an electrical cord.

   **TRUE**

8. If the power is out in your home, it's okay for you to open the fuse box and try to fix it.

   **FALSE**

9. If you're unsure how to safely use a device, you should ask an adult for help.

   **TRUE**

10. If you experience an electrical emergency and someone is hurt or a fire starts, you should call 911 immediately.

    **TRUE**

# MSOSW Curriculum
# Lesson Two: Why Should We Conserve Power?

**Why does saving energy matter?**

**Overview:** In this lesson, students will learn about how energy use affects our planet, including the science of global climate change.

**Objectives:**

**The student will:**

- Define carbon footprint.
- Define global climate change.
- Explain how the greenhouse effect warms our planet.
- Identify evidences for global climate change.
- Understand possible causes of global climate change.
- Identify possible future effects of global climate change.

**Standards Addressed:**

- Science as Inquiry: Think critically and logically to make the relationships between evidence and explanations; Recognize and analyze alternative explanations and predictions; Understandings about scientific inquiry
- Physical Science: Transfer of energy
- Life Science: Populations and ecosystems; Diversity and adaptations of organisms Earth Science: Structure of the Earth system; Earth's history; Earth in the solar system
- Science and Technology: Design a solution or product; Understandings about science and technology
- Science in Personal and Social Perspectives: Natural hazards; Risks and benefits; Science and technology in society
- History and Nature of Science: Science as a human endeavor; Nature of science

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 3.5 class periods

**Materials:**

| | | |
|---|---|---|
| **Day 1:** | Global Climate Change Presentation and Notes (GCC) | |
| | 3 small tanks or large jars | plastic wrap |
| | 3 thermometers | 1-3 heat lamps |
| | Vinegar | baking soda |
| **Day 2:** | Computer access | Student Definition Worksheet |
| | GCC presentation | Getting to the Core activity sheets |
| **Day 3:** | GCC Presentation | |
| **Day 4:** | GCC presentation | |

**Procedure:**

**Day 1: The Greenhouse Effect**

- Ask students if they have heard of or know about the greenhouse effect. Ask them to describe it or relate it to their lives. At this point, all answers are fair, just get them talking.
- Set up the greenhouse effect model (you could also have students do this in groups if you have the materials available and the time):
    - Tape a thermometer to the side of each tank (if you put them on the bottom of the tank, the third thermometer needs to be elevated)
    - Cut two pieces of plastic wrap for the second and third tank.
    - In the bottom of Tank 3, pour 200mL of vinegar and 2 Tbsp. of baking soda (the amounts may vary if you're using a smaller or larger tank size – you want to produce a fair amount of $CO_2$ to fill at least half the container).
    - After combining the baking soda and vinegar, wait 1-2 minutes – the $CO_2$ produced is denser than the air in the tank and so will push it out. During this time, discuss the lab set up with the students and have them start discussing what they think will happen.
    - Cover the second and third tanks with plastic wrap.
    - Place a heat lamp above the tanks, positioned high enough to be more or less equally spaced from all three tanks.
    - Record the initial temperatures and turn on the heat lamp.
    - Ask students to predict what will happen over the next 15 minutes.
- Teach the mini-lesson on the greenhouse effect (first section of the Global Climate Change presentation). You may choose to stop every few minutes and record the temperature or wait a full 15 minutes and then observe the temperature in each tank.
- Assessment: Each student should sketch the lab set up and explain how the different parts of the lab relate to Earth's atmosphere. (See Resources for an example and the grading rubric.) You could choose to have students draw or write for the assessments, or explain in a short video.

**Day 2: What is Global Climate Change?**

- Defining carbon footprint and climate change:
    - Hand out the Student Definitions Worksheet and, in pairs, have students spend 10 minutes researching and creating their own definitions for carbon footprint and global climate changes. They need at least two sources and should focus on having a complete definition.

    - Have pairs share their answers to create a class definition of each on the board.
- Begin next section of the Global Climate Change presentation (What is It section, then stop on the "Well, What Do the Data Say?" slide.)
- Begin the "Getting to the Core: The Link Between Temperature and Carbon Dioxide" activity from the EPA. See document included in this unit. The archived site is (https://19january2017snapshot.epa.gov/climatechange_.html)
- You may choose to introduce it and complete it tomorrow or introduce it, have students start working, and then complete the graphs for homework.

**Day 3: What is Global Climate Change?**

- Complete the "Getting to the Core" graphing activity from yesterday.
- Explore "The Greenhouse Gases webpage" (https://goo.gl/XYwPYs)
- Watch "Climate Change – A Report from Antarctica: WAIS Divide Ice Core – (10 minutes – a good feature on polar scientists) https://www.youtube.com/watch?v=TDOQIkiIL9Q&feature=related (The link is also in the presentation on the "Well, What Do The Data Say slide in the "Meet an Ice Core Scientist" and in the notes)
- Additional updated video segments "Causes and Effects of Climate Change/National Geographic (https://www.youtube.com/watch?v=G4H1N_yXBIA)
- Updated video about Antarctica: "Showing Troubling signs of Climate Change" (https://www.youtube.com/watch?v=YzcFZLxOUHU)
- Ask students to compare what they learned from the modeling activity two days ago to the information they have now on CO2 levels on Earth.
- Complete the section on Well, What Do the Data Say in the GCC presentation.

**Day 4: The Future of Climate Change**

- Go over the possible future effects of climate change (final two sections), and then lead into the "What Can We Do About It?" section)
- Ask students to brainstorm some things that could be done to reduce our greenhouse gas emissions, after looking at the slide with information on where our emissions come from.
- Lead into the section on electrical energy production.

**Assessment Options for this Lesson:**

- Student Definition Worksheet
- Modeling the Greenhouse Effect Rubric

**Extension Options for this Lesson:**

- Modeling the Greenhouse Effect – this is a simple demonstration that models the greenhouse effect a little more interactively than simply showing a diagram. You'll need objects to represent the Earth, the sun, a light particle, a heat wave, oxygen, nitrogen, and carbon dioxide.
    - Model a light wave traveling at relatively high frequency from the sun to Earth. In a wavelike motion, walk the light wave (e.g., a yellow balloon) from the sun to Earth. Do not include any effects of atmospheric gases.
    - Model absorption of the light energy, its conversion to heat and its departure from Earth to outer space. For example, exchange the yellow balloon for a red balloon. Walk the heat wave away from planet Earth, again using a wavelike motion but this time of a lower frequency (fewer up and down motions; longer wavelength). Do not include any effects of atmospheric gases.
    - Describe what you have done as modeling the flow of energy into and out of the Earth system.
    - Now include the atmospheric gases nitrogen, oxygen and carbon dioxide. Model a light wave traveling from the sun and show that it does not interact with any of the atmospheric molecules. Model the heat wave leaving Earth and that it interacts with carbon dioxide but not with oxygen or nitrogen.
    - Model the interaction of the heat wave with a carbon dioxide molecule as an absorption of energy and a re-radiation of that heat energy back to planet Earth where it is absorbed and re-radiated back out. This can be repeated several times.
    - Describe the greenhouse effect as a natural phenomenon that currently helps keep Earth at a comfortable temperature. Describe the effects of human actions in increasing the current greenhouse effect, thereby threatening to change the global climate.

Updated 6.22.2018rc


# Lesson Two:

# Resources


# MSOSW Curriculum
# Lesson Three: Electricity Basics
**What is electricity and where does it come from?**

**Overview:** In this lesson, the student will get a basic understanding of electricity, its production, and how it is used in his/her home.

**Objectives:**

**The student will:**

- Define energy and understand that it comes in many forms, including electrical energy.
- Understand that atoms cannot be broken down by natural processes and are made of neutrons, protons, and electrons, each with their own specific charge.
- Understand that electrical energy is the energy of moving electrons.
- Explain the difference between an insulator and a conductor.
- Explain how energy usage is measured in watts.
- Calculate basic kilowatt-hours use for a given appliance.
- Label the major parts of a generator and understand how a turbine spins.
- Compare renewable with nonrenewable resource.
- Describe the major methods of energy production, including coal, natural gas, nuclear, water, wind, and solar.
- Compare the risks and benefits of different energy production methods.
- Identify devices in his/her home that use electrical energy.

**Standards Addressed (Grades 5-8)**

- Science as Inquiry: Use of Mathematics in All Aspects of Scientific Inquiry
- Physical Science: Properties and Changes of Properties in Matter; Transfer of Energy
- Science and Technology: Understanding About Science and Technology
- Science in Personal and Social Perspectives: Populations, Resources, and Environments; Natural Hazards; Risks and Benefits; Science and Technology in the World

**Suggested Grade Levels:** Middle School ($6^{th}$- $8^{th}$)

**Timeline:** 3.5 class periods

**Materials:**

| | | |
|---|---|---|
| **Day 1:** | Electrical Energy Presentation | Plug-In Appliance Inventory |
| **Day 2:** | Energy Production Worksheet | Computer Access |
| **Day 3:** | Vocabulary Jeopardy file | |
| **Day 4:** | Energy Quiz | |

**Procedure:**

**Day 1:** **Electricity: What it is and how it's measured**

- Ask students to define energy and electricity to gauge current knowledge and/or misconceptions. Guide the discussion and refine the definitions so that the students understand that **energy is the ability to do work** and comes in many forms. **Electricity is one form of energy and is energy in the form of moving electrons.**
- Give the Electrical Energy Presentation (see notes for each slide)
    - For this presentation, you may have the students take their own notes (they'll need the information for the quiz) and provide paper for that purpose in their project packet.
    - Alternatively, you can print the presentation in Handout Format (a handy feature: on the Print menu, under Print what, choose "Handouts" and then choose "3 per page" in the section on the right) this will leave area on the printed page for students to take their own notes and allow you to go through the presentation a bit faster.
- Ask students to estimate how many items in their homes are plugged in right now. Discuss the importance of electricity in the modern world. Handout and go over the instructions for the Plug-In Appliance Inventory.
- Homework: Plug-In Appliance Inventory – Rather than having each student do a whole house inventory which may take a great deal of time for some students, you may wish to have students form teams and determine which room they will inventory (living area, kitchen, bedroom, etc.) and return to class and combine their inventory.

**Day 2:** **Energy Production methods**

- Show Energy 101:Electricity Generation (~5 min) https://www.youtube.com/watch?v=20Vb6hlLQSg
- Discuss some of the types of energy production presented in the video and hand out Energy Production Worksheet.
- Define the terms *renewable* and *nonrenewable* resources for the students. Using the Energy Production Worksheet, have the students classify each form of energy production on the sheet as a renewable or nonrenewable source.
- Watch a video about wind energy (~3 min) such as https://video.nationalgeographic.com/video/ge-energyconservation?_ga=2.135358258.2041900002.1529684341-282219038.1529684341 and/or Renewable Energy: Wind Power (~ 1 min.) https://www.youtube.com/watch?v=mtlvjo5nSqo
    - Discuss video and fill in wind energy section
- Assign students to small groups, one for each remaining type of energy production.
- Each group will define the form of energy production they're assigned and research the benefits and drawbacks of each form of energy

during the remainder of Day 4. Encourage students to use the Energy Quest website (http://www.energyarchive.ca.gov/energyquest/) as well as others toget their information. (Students can work separately to research and then compile their information in the final 10 minutes of class or can have one computer per group and research together.)

- Homework: Continue working on Plug-In Appliance Inventory.

**Day 3: Student Energy Production Presentations**

- Students should turn in their Plug-In Appliance Inventory worksheets
- Give students 10 minutes to create a short presentation (2-3 minutes) about their assigned form of energy production.
- Groups present their findings.
    - Each group will educate their classmates about the different forms of energy production.
    - When one group is presenting, the other group members in the audience should be recording notes on their Energy Production Worksheets and asking questions of the presenters.
    - At the end, fill in any missing information the students didn't cover.
- Review material with Vocabulary Jeopardy.
- Homework: Study for quiz (Energy Production Worksheet will be turned in at the beginning of quiz).

**Day 4: (Partial Day) Energy Quiz**

- Students should turn in Energy Production Worksheet.
- Have students take the Energy Quiz.
- Continue on to Whyville introduction Lesson.

**Assessment Options for this Lesson:**

- Plug-In Appliance Inventory
- Energy Production Presentation
- Energy Production Worksheet
- Energy Quiz

**Extension Options for this Lesson:**

- Lab Activity – Charge and Carry Science Snack activity
    - From the Exploratorium (https://www.exploratorium.edu/snacks/charge-carry)
    - Demonstrates a static electrical charge
- Math/Data Analysis – Light it Up!
    - Have students record the number and wattage of the lights in their homes and, with parent or guardian, estimate how many hours a day those lights are on.
    - Create data tools:
        - Enter collected data into a spreadsheet program (Excel)

        - Each student can create a graph showing the number of each type of bulb they have in their homes.
        - Calculate the average amount of time a light bulb is on in the house.
- Analyze data:
    - Calculate the kilowatt-hours (kWh) generated by each type of bulb.
    - Calculate the total kilowatt-hours spent on lighting (multiply by average electrical cost to get actual cost estimate for the month and year).
    - Calculate the kWh and money saved by switching to lower wattages or to CFL bulbs.


# Lesson Three:

# Resources

# MSOSW Curriculum
# Lesson Four: Introducing Whyville
### Welcome to Vampire Manor and WhyPower

**Overview:** In this lesson, the student will identify standby power usage through exploration of a virtual environment.

**Objectives:**

**The student will:**

- Identify devices found in a 3D environment that use standby power.
- Explore careers related to energy.
- Explore additional STEM careers.

**Standards Addressed:**

- ESS3.D Global Climate Change
- Technology Apps: 2(A) participate in personal learning networks to collaborate with peers, experts, or others using digital tools such as blogs, wikis, audio/video communication, or other emerging technologies

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 2 class periods

**Materials:**

**Day 1:** Access to teacher *Whyville* account
Active student email accounts
Access to computers/Internet if possible

**Day 2:** Access to 1 to 1 computers/Internet

**Procedure Day 1:**

- Log into teacher *Whyville* account to introduce students to the environment. Make sure you are familiar with *Whyville* prior to introducing it to the students.
- Tell students they will be getting a *Whyville* account that is linked to the classroom and the project. Tell them they will be able to create their own personal avatar that will represent them in *Whyville*.
- Show students how to navigate through *Whyville* using the bus menu. Go to *WhyPower*. You can point out that *Vampire Manor* is in the background and can be accessed from either the bus menu or from *WhyPower*. Explain that *WhyPower* is the power plant that runs all of

*Whyville*. There are multiple types of power sources to explore as well as purchase to place in *Whyville* to earn clams.

- Explain the *Whyville* economy –earning points, clams, pearl, badges and jobs. There are also contests in *Whyville* each week.
- Now go to *Vampire Manor* to explore activities related to the Going Green! Curriculum.
- Click on Count Ampula for a brief overview. Click on the tombstone, *Plugged and Forgotten*, for more information on vampire power. Click on the book near the sidewalk to get more information about how to measure standby power in *Vampire Manor*.
- Go into *Vampire Manor*. Explain that they may see other avatars there as well – anyone in *Whyville* can go into any room.
- Hover over a plugged in appliance to see how to measure the power usage in watts, kwh, dollars and $CO_2$. Look for the helpful hints to determine whether the item should be unplugged.
- Show students how to access their Vampire Power Journal. Students can see the results of their exploration.
- Have students access their "Real World Measurements" tab.
- Explain to students how they can search and contribute to the database of information. (Explain what a database is if students are not familiar with the term.)
- Show students there are multiple rooms in *Vampire Manor* to be explored. When the student has unplugged something to save energy, it is possible that the vampire will fly through and plug it back in. The students can earn points for unplugging again. Having the vampire plug it back in allows other participants in *Whyville* to have a chance to unplug appliances that are using standby power.
- If you have 1 to 1 access to computers, have the students sign up under your account for a *Whyville* student account. If there is not access, have the students sign up for an account for homework. Make sure you give the students the proper link that will put them in your teacher backpack. For homework the students can also create their avatar and explore *Whyville*.

**Procedure Day 2:**

- Students should come to class with their *Whyville* accounts activated.
- Tell students that the unit will also allow them to explore STEM-related careers and specifically energy-related ones in *WhyPower.*
- Have students log into their *Whyville* accounts. Guide them to *WhyPower*. Click on the badges hanging on the wall. It will lead to a list of energy-related careers – both technical and professional.
- Have students explore the careers to determine what is needed to earn the career they choose. Once they earn the job, they will earn clams in *Whyville*.

- Continue the career exploration by going into the *ACT Career Club*. Here students can apply for jobs or participate in a Career Quest. As in the real world, only a specific number of jobs are available in each career cluster. The number of available jobs will vary each day.
- Set an expected date, adjusting dates for students' learning level and needs, for students to earn their Engineer Level Vampire Power Badge and complete a career assignment. Consider having a career fair day at the end of the unit.
- Homework: Work on career challenges to be completed by dates determined by teacher.

**Follow up:**

- Looking at the dead line you have given students, being sure to provide some scheduled time for students to access *Whyville*. Be mindful of students who may not have computer access at home and allow them "school lab time" when possible.

**Extension Options for this Lesson:**

- To have students explore more about careers in earth and physical sciences, go to http://www.sciencebuddies.org/science-engineering-careers. Browse through detailed information on over 100 careers to discover what scientists really do and what it takes to prepare for these careers. Each career profile provides basic career information such as salary, job outlook, degree requirements, etc. The site also includes videos featuring interviews with real scientists or on the job profiles.
  - The following questions can be answered about specific careers by using the Science Buddies website:
  - What do they do?
  - What type of education is needed?
    What is projected job growth for next ten years?
  - What is the median salary?
  - What do you need to study in high school to pursue this career?
  - Ask an Expert forum to gather more information
- To have students explore more on their own, have them take the STEM Type Quiz to see what may an area of interest they many not have considered. Go to http://stemjobs.com and click on STEM Type Quiz.


# Lesson Five:

# Resources

# MSOSW Curriculum
# Lesson Five: Standby Power
**What is standby power and what devices use it?**

**Overview:** In this lesson, the student will learn what standby power is, how it affects our power consumption, and what devices are usually associated with it.

**Objectives:**

**The student will:**

- Define standby power.
- Identify devices in his/her home that use electrical energy.
- Explain how to determine if a device likely uses standby power.
- State the percentage of standby power in an average home.
- Calculate the total standby power used by a device over time.
- Understand the cost of standby power in devices.

**Standards Addressed:**

- Science as Inquiry: Use of Mathematics in All Aspects of Scientific Inquiry
- Science and Technology: Evaluate Completed Technological Designs or Products

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 1 class period

**Materials:**

**Day 1:**
Standby Power Notes sheets
Standby Power Worksheet
Completed plug in appliance inventory sheet
Belkin energy monitoring device
Appliance that uses standby power

**Procedure:**

**Day 1:** **Standby Power**

- Hand out Standby Power Notes worksheet (or have in project folders ahead of time).
- Have students define standby power. Be sure to discuss that there are many other terms for this type of energy use that students may have heard, including vampire power, leaking electricity, phantom power, or

phantom load. (These terms are all interchangeable, but in this curriculum we'll be referring to it as standby power.)

- In small groups or with partners, have students brainstorm for 5 minutes to create a list of devices they think might use standby power.
- On the board, post the following tips for identifying devices that use standby power:
    - Device has a clock display
    - Device has a light that stays on even when it's off
    - Device is warm to the touch after being off for a few hours
    - Device operates with a remote control
    - Device has an "instant-on" feature
    - Use a meter to find out for sure!
- Have students revisit their lists of standby power devices and cross off those that they don't meet the criteria.
- Calculating standby power usage:
    - Use a Belkin meter and a device that uses standby power to demonstrate how much standby power can be used at a particular time. Ask students if they think standby power drain constitutes an issue for people in terms of how much power they use and discuss.
    - Remind students what a kilowatt-hour (kWh) is and calculate how many kWh are used by this device daily, monthly, and yearly (if plugged in and not used all day). For instance, if a DVD player uses 4 watts of energy in standby mode, that means it uses 4 watts/hour = 0.004 kWh. Multiply that by 24 hours – 0.096 kWh in a day. Multiply that by 30 days – 2.88 kWh in a month. Multiply that by 12 – 34.56 kWh in a year.
    - Have students record the average electricity cost (per kWh) for your area and then calculate how much money that device can cost over a year's period. (Example – a DVD player that uses 34.56 kWh in a year in the previous example, at an energy cost of 18.1 cents per kWh means that DVD player, even though never used, costs $6.25.
    - On average, standby power consumption in most homes in the US is probably between 5-15%. The average energy bill in the US is $99.70. Have students calculate how much can be saved each month and each year by reducing standby power.
- Using the electronic version of the Belkin Measurement Worksheet, have the students use their individual plug-in appliance inventory worksheets. As a class, make a list on the electronic document, of 15-20 appliances they think may have standby power. This will be the list they will choose from to measure at home using their Belkin devices. Save the document and make a copy for each student to use for Lesson 6.

- If time remains, discuss the devices that students will be testing with the Belkin meters.
- Homework: Standby Power Worksheet

**Assessment Options for this Lesson:**

- Standby Power Worksheet


# Lesson Six:

# Resources

# MSOSW Curriculum
# Lesson Six: Using the Belkin Meter
**How can we measure the amount of standby power a device uses?**

**Overview:** In this lesson, the student will learn how to use the Belkin meter to measure the standby power used by several different devices.

**Objectives:**

**The student will:**

- Use a metering device to measure the amount of energy used by various devices in the home.

**Standards Addressed:**

- Science as Inquiry (Content Standard A): Identify Questions That Can Be Answered Through Scientific Investigations (p145); Use Appropriate Tools and Techniques to Gather, Analyze, and Interpret Data (p145); Understandings About Scientific Inquiry (p148)
- Physical Science (Content Standard B): Transfer of Energy (p156)

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 1 class period

**Materials:**

**Day 1:**

- How-To Guide Belkin
- Extension cords (1/group)
- Belkin Meter Measurement WS (completed)
- Belkin devices (1/student)
- Assorted appliances/devices
- Class Belkin Meter spreadsheet

**Procedure:**

**Day 1:** **Using the Belkin meter**

- Ask students to answer the question, "What device in your home uses the most standby power?" Have students brainstorm answers as well as discuss how they could discover a scientifically accurate answer to this question.
- Hand out the How-To Guide (unless it's already in the packet).
- Hand out the Belkin meter devices and go over the buttons with the students so they're familiar with them.
- Using the device:
    - Have students plug the Belkin meter into a plug-in appliance.
    - Explain how to scroll through the different functions to find the measurement we're looking for – the watts being used,

the $CO_2$ and the amount of money used (per month and per year). Explain that the reading is in watts on the Belkin but will be multiplied by .001 to get kilowatts. To get kWh, they will need to multiple kilowatts by the number of hours (ex. 24 hours in a day).
    - Go over the protocol for how students will use the devices at home – read over basics (amount of time plugged in, measuring, and having an adult monitor).
    - Students should plug their device into the Belkin meter and observe if standby power is being used. The students can then turn their appliance on and measure how much power is used.
    - With each appliance, students should record on their own papers how much energy is being used when the device is on versus off and any questions they're generating while completing this activity.
    - Have groups trade devices, giving each student a chance to turn the Belkin meter on, plug in an appliance, and measure.
- Hand out the completed Belkin Measurement Worksheet class list created in Lesson 5. Have students determine which of the 5 items they are able to measure in their homes. Make sure each appliance has at least 2-3 students measuring it so they can compare their results.
- Hand out Belkin Energy Monitoring Worksheet and read over the instructions together so that students understand what they're doing. (Be sure to stress the importance of timing and adult supervision as well as reminding students that they'll only complete those devices listed that they have in their homes.)
- Check out the Belkin meters to the students. You may want to have student work in groups to measure different rooms, and then combine their measurements on one group sheet.
- Individual student data should be entered into a class spreadsheet. A blank template and an example spreadsheet are provided. When the spreadsheet is complete, upload it to your class page on the wiki.

**Assessment Options for this Lesson:**

- Have students demonstrate individually how to use the device correctly
- Belkin Meter Measurement Worksheet
- To ensure the students return the devices promptly (so you can stay on track with the curriculum timeline), you may choose to reward them with a "free" homework grade for turning the meters back in on time.

**Extension Options for this Lesson:**

- With permission from the administration, have small groups check power usage of appliances in and around the school for a class period and analyze the data.

- Examples of appliances to measure:
  - Microwave in a workroom or cafeteria
  - Printers, scanners, etc.
  - Copy machine
  - Lab computers
  - Laptops
- Each group should present to the class how much standby power their device used.
- With the teacher's assistance, have the class estimate how many hours per day the appliance is drawing that level of standby power
  - Ex: the lab computers are turned on when first used in the morning and turned off at 4pm each day. If most computers are turned on during 1st period (say 8:30) and used for 2-3 periods (1-1.5 hours) during the day, you might estimate that they are in standby mode for 6 hours each day.
  - The teacher can then provide data on the total number of each appliance that the school has (i.e., 3 copiers, 24 laptops, etc.).
- Analysis of Data
  - Using the above information, have students calculate the kilowatt-hours spent each day, each week, and each month on standby power at the school.
- Students can then brainstorm ways the school can conserve that standby power. Start with open-ended brainstorming, then have the students examine each idea to see if it is realistic to implement on a regular basis. (For example, turning off the computers between every class may not be realistic in a school that uses their computers regularly throughout the day, but making sure laptops are fully turned off before storing is a realistic solution.)
- Students can then calculate how much energy could be saved by each of the solutions.
- Further extension – have students create a report to send to the administration. The report can show the data they collected, the conclusions drawn from that data, and the proposals students generated to reduce energy costs along with the data as to how much energy/money would be saved.


# Lesson Six:

# Resources

# MSOSW Curriculum
# Lesson Seven: Analyzing Data
**What can we learn from our Data?**

**Overview:** In this lesson, the student will examine the data collected using the Belkin device and compare with data from other students to make conclusions.

**Objectives:**

**The student will:**

- Read a graph – x-axis vs y-axis, etc
- Analyze basic standby power data for trends
- Calculate kilowatt-hours (kWh) spent on standby power, daily, yearly, in the home, country, etc

**Standards Addressed:**

Science as Inquiry: Identify Questions That Can Be Answered Through Scientific Investigations;
Use Appropriate Tools and Techniques to Gather, Analyze, and Interpret Data;
Understandings About Scientific Inquiry
Physical Science (Content Standard B): Transfer of Energy

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 2 class periods

**Materials:**

**Day 1:** Completed Measurement Worksheets
Belkin Analysis Excel Spreadsheet Template
(as you change numbers in this file, it will change the resulting averages, graph, and charts for you)

**Day 2:** Returned homework assignment to discuss

**Procedure:**

**Day 1:** **Analyzing Data**

- Each student needs their completed Belkin Energy Monitoring worksheets on hand to answer questions.
- Briefly discuss what the students have learned after doing this section of the project. What were they surprised by? What new questions do they have? Encourage students to include data in their comments whenever possible. Get a basic discussion going on the raw data that the students currently have in front of them.
- Use the provided Excel spreadsheet template to compare class data.

    - Enter each student's data into the spreadsheet template (this could be done also as students turn in their worksheets rather than take class time. The only benefit to taking class time is for the students to get a chance to really see how different their numbers are, discuss outliers and the reasons they may exist, and to cement that feeling of working together as a class to answer the question.)
    - Discuss the benefits of seeing data in a simple chart – then lead discussion to the importance of graphs.
    - Generate graph of data and discuss the axis (The graph is already generated when you enter the data. It is on the *What If (WI)* Graph tab in the spreadsheet. Tabs are accessible at the bottom of the spreadsheet.)
- Give each student a copy of the class data and graph, if possible.
- Homework: Write a conclusion statement (1 paragraph) about the trends discovered in class. They can also include a reflection paragraph about any new questions they have.

**Day 2: Reflection on Data Analysis**

- Discuss the paragraph written for homework as a class. Answer the following questions as a class to include on the Going Green! Wiki. Post answers to your class page on the Wiki.
- Using your combined class data, answer the following questions to share with other students in the project.

1. What were the biggest vampires you found?

2. How much money could your class save each month by unplugging vampires?

3. How much $CO_2$ would be reduced if your class unplugged the vampires each month?

4. What was the most surprising thing you found while studying this standby power unit?

**Assessment Options for this Lesson:**

- Conclusion statements rubric:

| 100 | 90 | 80 | 70 |
|---|---|---|---|
| Answer demonstrates a thorough understanding of the trends in the data and uses clear evidence from the investigation to support. | Answer demonstrates a good understanding of the trends and uses evidence from the investigation to support. | Answer demonstrates a limited understanding with some evidence OR a better understanding, but little to evidence used to support. | Answer is incomplete, but shows some attempt to understand trends OR use evidence. |
| *Below those guidelines, it is recommended that the student rewrite the assignment to be sure learning is taking place. | | | |


# Lesson Seven:

# Resources

# MSOSW Curriculum
# Lesson Eight: How Can We Conserve Power?
### Why do we focus on standby power?

**Overview:** In this lesson, students will examine ways to conserve power, specifically standby power and will understand that while it may not be a huge drain on their personal electricity bill, when taken on a national level, standby power is a large amount of wasted energy.

**Objectives:**

**The student will:**

- Measure standby power use for a specific appliance.
- Generate realistic methods for conserving power in his or her daily life.
- Identify methods for conserving standby power.

**Standards Addressed:**

Science as Inquiry: Think critically and logically to make the relationships between evidence and explanations; Recognize and analyze alternative explanations and predictions; Understandings about scientific inquiry
Physical Science: Transfer of energy
Earth Science: Structure of the Earth system; Earth's history; Earth in the solar system
Science and Technology: Design a solution or product; Understandings about science and technology
Science in Personal and Social Perspectives: Risks and benefits

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 1 class period

**Materials:**

**Day 1:** Analyzing Belkin data spreadsheet
Note cards (or other small pieces of paper)

**Procedure:**

**Day 1:** **Why should we conserve standby power?**

- Put the following problem on the board for the students to work out:
  - If a device, say your Playstation3, uses 2 watts of power when in standby mode and is in standby mode for about 20 hours each day…
    - How much standby power does it use in a day? (40 w/day)
    - In a week? (280 w/week)

        - In a year? (40x365) (Convert that to kilowatts - 14.6 kWh in a year)
    - Explain that the final number is actually in kWh since they're looking at energy use over time. You can then multiply that by the average energy cost for your area to see how much money would be spent in a year on that device.
    - The reality is that it won't be that much. The students end up thinking, "So what?" Ask students to think about why this still matters. You may get several answers, but can help lead the students by having them think about the phrase, "Think Globally, Act Locally."
    - Suppose your home's monthly use of electricity is 1200 kWh (about $144 at the common Texas rate of $ 0.12 per kWh). By unplugging devices, you might save 5% or 60 kWh per month. That may not sound like much, but since power generation puts into the air about 1.1 pounds of $CO_2$ for every kWh of electricity used, then the wasted KWHs put about 66 pounds of extra $CO_2$ in the air each month. How long would it take to put that 66 pounds back into the ground so that it doesn't fuel global climate change? The Environmental Protection Agency estimates "A medium growth coniferous tree, planted in an urban setting and allowed to grow for 10 years, sequesters 23.2 lbs. of carbon." So your choice is simple: For each month you use 60 kWh serving no useful function (standby power), you can remain carbon neutral on the wasted part by planting 3 trees and taking care of them for 10 years ... or else you can simply unplug the devices.
    - While individual standby power use is fairly small, as you can show the students in the Analyzing Belkin Data spreadsheet, the total cost, both in energy production and actual dollars is VERY high.
    - Standby power may be a relatively small percentage of our TOTAL energy use, but unlike heating/cooling, the VAST majority of it is completely unnecessary. That is why we focus on reducing standby power usage in this project.
- Ask the students if they know what a Public Service Announcement is – this is an open discussion that will lead them into the next activity. Briefly discuss their ideas on what these are and give them some specific examples so they understand.
- Give each student a note card and have them write their names at the top. Each student should then spend about 10 minutes coming up with 3 things they (personally) could do to reduce standby power use. Encourage them to think creatively and not just write – Unplug stuff, Turn stuff off, etc. (These responses will be used to assign the groups

for the Educating Others project.) They should turn this in before they leave.

**Assessment Options for this Lesson:**

- Note card Ideas

| 4 points | 3 points | 2 points | 1 point |
|---|---|---|---|
| Ideas all relate specifically to conserving standby power and show good thought. | Ideas all relate specifically to conserving standby power. | 2 of the ideas relate specifically to conserving standby power. | Only 1 idea relates specifically to conserving standby power. |

**Extension Options for this Lesson:**

- For a homework activity, students can involve their family members in completing the Personal Energy Meter (http://environment.nationalgeographic.com/environment/energy/great-energy-challenge/personal-energy-meter/) from National Geographic. The students will enter data to determine their energy use (in tons of CO2 per year) compared to their region as well as the nation.
- An additional extension activity could be having the students calculate the number of trees they could save based on their total energy savings. The EPA site calculator is located at http://homeenergysaver.lbl.gov/consumer/.


# Lesson Eight:

# Resources

# MSOSW Curriculum
# Lesson Nine: Educating Others
### Sharing What We Learned

**Overview:** In this lesson, students will create public announcements regarding standby power as well as share their career exploration activity with their classmates.

**Objectives:**

**The student will:**

- Share possible solutions to reduction in standby power
- Learn about more careers
- Communicate information to their peers about a STEM career

**Standards Addressed:**

**Suggested Grade Levels:** Middle School ($6^{th}$-$8^{th}$)

**Timeline:** 2 class periods

**Materials:**

**Day 1:** Solutions from previous lesson
Access to materials or technology to create a public service announcement

**Procedure:**

**Day 1:** Using the solutions cards created by the students, have them work in groups based on their common solutions. In their groups they will create a public service announcement intended to educate others in ways to save standby power. Students need to also determine who they will share the information once it is created (blog, newsletter, website, posters around school, etc.). Select one or two solutions to share on the MSOSW wiki.

**Day 2:** Each student should have their completed Career Exploration Worksheet. Students will share with one another what they learned about careers explored in *Whyville* or other places. Each student should prepare at least three facts about their career that others might wish to know. Spend 10 -15 minutes sharing these career explorations.

If there is not time for both of these activities, students may select one of the two to complete.


# Lesson Nine:

# Resources