KACEE
KANSAS ASSOCIATION FOR CONSERVATION & ENVIRONMENTAL EDUCATION

KANSAS GreenSchools
www.kansasgreenschools.org

Ignited with Energy Investigation

Eco-Schools

PLT GreenSchools!

KACEE- Kansas Association for Conservation and Environmental Education

Kansas Green Schools Program

www.kansasgreenschools.org

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Table of Contents

Ignited with Energy Investigation

Part 1: Introduction

- **KACEE has been promoting and providing conservation and environmental education for all Kansans since 1969.**
- **KACEE supports community education, outreach and engagement programs statewide to advance the mission of our natural resource agency, higher education, and non-formal education partners.**
- **KACEE's environmental education curricula help teachers improve student achievement, engagement in STEM, critical thinking, problem solving, and 21st century job skills.**
- **KACEE's professional development programs give educators the confidence to take students outdoors to learn with hands-on activities that are fun and meaningful for students.**
- **Environmental Education connects kids to nature, supports healthier, active lifestyles, and encourages students to take action to improve their school and environment.**
- **KACEE encourages and recognizes outstanding achievement through Excellence in Conservation and Environmental Education Awards and Kansas Green Schools Recognition programs.**
- **Kansas is the only state to have a unique, collaborative partnership with KACEE, Project Learning Tree and the National Wildlife Federation to coordinate Green School certification and recognition between state and national programs.**

- **Since 1998, the KS Green Schools Program has connected students to their community and the world, while growing problem-solving and leadership skills through service learning projects.**
- **KS Green Schools investigations engage students in exploring their school's energy, water, school grounds, waste management and creating a greener and healthier learning environment.**
- **The KS Green Schools Network supports teachers in creating greener and healthier schools through training, networking, grant funding, curriculum resources, and more!**
- **The KS Green Schools program celebrates and recognizes schools across the state for their green achievements through the KS Green Schools recognition program.**
- **The KS Green Schools Network connects and inspires teachers in over 500 Kansas Green Schools through an annual Green Schools Conference, Online Forum, Green Schools Updates, Professional Development Workshops, Facebook, and more!**

Fan us on Facebook at www.facebook.com/groups/kansasgreenschools

Here you can connect with KACEE and to hundreds of Kansas Educators!

Part 2: Leadership Resources

STEAM Education and the Energy Investigation

The Kansas Green School Investigations are designed to be interdisciplinary incorporating Science, Technology, Engineering, Art and Math (STEAM) into the activities and research. The investigations are designed to develop critical thinking and problem solving skills to solve environmental problems in the future.

Correlations to Academic Standards

The Kansas Green School Investigations are designed to support your efforts in the classroom with many national education standards. To keep up to date with the correlations, visit **http://www.plt.org/correlations**.

Career and Technical Education for Kansas Kids

Tying Kansas kids to real world applications is a great way to engage your students in the investigations. We encourage you to introduce to real world professionals throughout the investigations to increase the direct learning opportunities and to increase the depth of experiences. Here are a few of the fields that students may discover throughout the investigations:

- Environmental Scientist
- Alternative Energy System Designer and Installer (solar, wind, geothermal)
- Builder or Designer of Energy Efficient Buildings
- Energy Policy Analyst
- Energy Law Specialist
- Energy Use Statistician
- Biotechnology (Biofuels) Scientist
- Civil, Electrical, Mechanical, Petroleum Engineer
- Economist
- Green Architect
- Heating, Ventilation and Air Conditioning (HVAC) Technician
- Weatherization Specialist
- Power Plant Operator
- Utility Line Worker
- Substation Technician
- Corporate Communicator/Public Energy Educator

Did you know Green Jobs are growing in the State of Kansas? The highest areas of growth are in renewable energy area. Other areas of growth include increasing energy conservation, clean transportation and fuels, agriculture and natural resource conservation and pollution prevention/ environmental cleanup. https://www.cleanjobsmidwest.com/state/kansas

Why Should Students Study Energy?

Energy is related to many of our nation's biggest environmental issues. Nearly every environmental issue we face- water or air quality, transportation, land use and waste management to name a few, are related to energy.

We use energy in everything we do from getting ready in the mornings, keeping our homes heated or cooled, traveling from place to place, powering our technology and communications and keeping our food fresh and safe to eat. Energy is not just an environmental issue; it's a quality of life issue.

Energy management challenges bring together fields such as economics, sociology, environmental science, political science and engineering. The vision of the Kansas Association for Conservation and Environmental Education (KACEE) is to develop an informed and environmentally literate Kansas citizenry who is knowledgeable to make decisions for the future and come up with solutions with our pressing energy issues. The role of educators is fundamental to this process. The students in your classroom will be the policy makers, scientists, and voters of tomorrow. It is critical to help students realize that they can make decisions and take responsible action, which in turn can have positive effects on their community.

This investigation will help students become more aware of the energy they use every day. They will see the connections among the energy they use, natural resources and pollution. The results of the investigation will help students develop action plans for reducing energy use at their school.

What are the Benefits of Saving Energy?

- Daylighting is lighting indoor spaces using natural light from windows, skylights, etc. Daylighting can reduce energy use in schools and in return, save money. Daylighting also benefits students test scores and health. A report from Plympton, Conway and Epstein stated the following: **"Recent studies show that daylighting in schools may significantly increase students' test scores and promote better health and physical development.** Studies have also shown that this (improvement) can be attained without an increase in school construction or maintenance costs." (Source: National Renewable Energy Laboratory, "Daylighting in Schools" June 16, 2000.) www.nrel.gov/docs/fy00osti/28049.pdf.

- Although electricity itself is a clean source of energy, most electricity in the United States is generated from power plants that burn fossil fuels (coal, oil and natural gas). Those power plants emit large amounts of carbon dioxide, carbon monoxide, nitrogen oxides, sulfur dioxide and other emissions that affect air quality.
- Consuming less energy reduces the amount of carbon dioxide and other pollutants released into the atmosphere, thereby providing healthier air to breathe, also reducing allergy and asthma triggers and creating a healthier environment.
- Reducing energy costs saves money.

Kansas Case Study

Travis Hammond, 7th-8th-grade technology teacher from Horace Good Middle School in Garden City, utilizes energy education to supplement technology learning in his classroom. "Energy Education is an easy STEAM (Science, Technology, Engineering, Art and Math) tie in that I am incorporating into my classroom." Mr. Hammond's students study a variety of renewable, nonrenewable and perpetual resources. The students hypothesize, design, build and test many different types of energy. For wind energy, the students design their own wind generators and test variables such as the angles of the blades to determine what angle is the most efficient in producing electrical energy. For solar energy, students use solar energy kits which contain a solar panel, motor, buzzer and music box. The students design and wire their own solar creation and test it on a sunny day. One example the students created was a dancing monkey! The students made a monkey and attached it to the motor and completed the circuit to include the music box. The brighter the sun, the faster the music played and the faster the monkey danced.

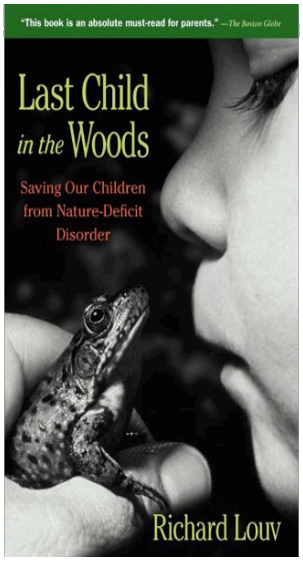
His students also took a field trip to the Sunflower Electric Coal Fired Power Plant. The students are taken on a tour throughout the plant and learn the process of where coal comes from, how we use it and how the energy reaches their homes. After the tour, students discuss the best forms of energy and the pros and cons of using each type of energy. The students also do an activity from the Project Learning Tree guide about acid rain and discuss the importance of clean energy and how our air becomes polluted. Students also make their own recycled paper and discuss how paper is made from a renewable resource. Students learn how using recycled paper reduces and saves the amount of energy required to produce new paper from new trees. The challenges of recycling are also explored. While recycling is a step in the right direction it requires energy and often creates its own waste.

Why is Connecting Our Kids to Nature and Environmental Education Important?

Here are some statistics about the average child in the United States.

- In 2004, American children spent less than half as much time outdoors as their parents. (Kaiser Family Foundation, 2005).
- Kids are reported to spend 7.5 hours per day on electronic equipment during their free time. (Kaiser Family Foundation, 2010).
- A longitudinal study found that children under 13 living in the United States spend on average only about half an hour of unstructured time outdoors each week (Hofferth & Sadberg, 2001).

In 2005, **Richard Louv** coined the term, "Nature Deficit Disorder" in his book, ***"Last Child in the Woods."*** In 2005, Richard Louv coined the term "Nature Deficit Disorder" to define the potential impacts on children of spending less time outdoors.



Louv states, "Nature-deficit disorder is not an official diagnosis but a way of viewing the problem, and describes the human costs of alienation from nature, among them: diminished use of the senses, attention difficulties, and higher rates of physical and emotional illnesses. The disorder can be detected in individuals, families, and communities" (Louv, 2005).

The reduced contact children are having with nature is leading to a rise in many emotional, mental and physical health risks. Some examples in his book are a rise in childhood ADHD, correlation with rises in childhood obesity and negative impacts on cognitive and conceptual development.

How Does Nature and Environmental Education Help Our Students?

Numerous studies have shown that environmental education has many benefits to children.

- **Science Scores-** Numerous studies have shown that environmental education boosts science scores.
- **Physical Health-** Physical activity is shown to improve children's health, and a growing body of evidence suggests that exposure to natural environments can improve attention & decrease stress in children. (McCurdy et. Al, 2010)
- **Increased Focus/Improved Cognition -** Wells observed that proximity to nature, access to views of nature, and daily exposure to natural settings increases the ability of children to focus and improves cognitive abilities. (Wells, 2000)

- **Behavioral Management-** Taylor and her colleagues found that children with attention-deficit disorder (ADD) benefited from more exposure to nature –the greener a child's everyday environment, the **more manageable are the symptoms of ADD.** (Taylor, 2001)
- **Emotional Health-** Taylor also observed that access to green spaces for learning and play, and even having views of green settings, **enhances peace, self-control, and self-discipline** among inner-city youth, especially among girls.
- **Group Cohesion/Increased Creativity-** At the school environment level Bell and Dyment observed that children who experience school grounds or play areas with diverse natural settings are **more physically active, more aware of good nutrition, more creative, and more civil to one another.** (Bell & Dyment, 2006)
- **Community Involvement-** Getting students involved in recycling projects, composting, community swap days and waste education can promote stronger social ties to the community.

Energy Education Resources

Many organizations provide educational resources related to energy. See the **Resources** section in Part 5 for a list of organizations that provide curricula, professional development and more.

Educational Opportunities for Teachers

KACEE provides professional learning opportunities for educators across the state with the option to attain one hour of college credit for participating courses. For a current opportunity schedule and learn about the eeCredential Program, visit https://www.kacee.org/eecredentials.

Home Connection

The results of this investigation will show students how they can make a variety of improvements to reduce their school's energy consumption. Many of the ideas they generate can also be used at home. See page 46-47 for a **Home Connection** chart that can be distributed or made available on school websites for families to download and use.

Part 3: Energy Investigation Materials

Directions for Green Team Leaders

There are five areas you might want to investigate as a part of becoming a Kansas Green School of Excellence. These areas include:

1) **Energy-** This investigation will help your team identify current energy management practices and will help in thinking of ways to modify these practices to make your school greener and healthier! Your results will inform school staff and students where they can make improvements and also to generate an action plan to reduce school energy use.
2) **Waste and Recycling-** This investigation will help your team identify current waste management practices and will help in thinking of ways to modify these practices to make your school greener and healthier! Your results will inform school staff and students where they can make improvements and also to generate an action plan to reduce school waste.
3) **Water-** This investigation will help your team identify water practices and will help to identify ways in which your school can conserve water! Your results will inform school staff and students where they can make improvements and also to generate an action plan to improve water efficiency, improve water quality and create conservation ideas for students and staff.
4) **Healthy School Environments-** This investigation will help your team identify air quality and transportation management practices and will help in thinking of ways to modify these practices to make your school greener and healthier! Your results will inform school staff and students where they can make improvements and also to generate an action plan to improve school health for students and staff.
5) **The Learning Community-** This investigation will help your team identify improvements for your school grounds, and ideas to help local wildlife, flora and fauna, the school community, and your neighborhood, city, state, country and world. Your results will inform school staff and students where they can make improvements and to also generate an action plan.

Getting Ready to Begin the Investigation

Step 1. Identify Leaders- Identify one or more Green Team Leaders to be in charge of the Energy Investigation.

Step 2. Obtain Permissions- Leaders will want to obtain the necessary permissions from schools administrators before starting the investigation. They should decide how and when the investigation will be conducted to avoid conflicts with school classes and activities.

Step 3. Form Your Green Team- Leaders should decide who will be conducting the investigation. A team approach is recommended. The more diverse the representation on your Green Team, including students and their grade levels, members of the community, etc. the higher the Globe Level you can apply for. Consider including the following representatives:

- Teachers
- Students
- Administrative staff members
- Custodial and maintenance staff members
- Cafeteria staff members
- Parent/Grandparent volunteers
- Resource Professionals in the community

Step 4. Develop Questions for Discussion - Before you begin, gather your KGS Green Team and come up with a list of items and/or questions you have regarding your school's energy use, waste practices, water quality and usage, school grounds and overall environmental quality. Be sure to add on any items/questions you have that are not included in the KGS's Investigations.

Step 5. Develop a Schedule and Assign Roles- Discuss how team members are going to conduct the investigation. Will the team always work together, or will the team split into groups and assign sections to each group? Are specific school staff members (custodial, maintenance, administrative) needed during certain parts of the investigation? If so, contact them to schedule a time for that part of the investigation. Develop a schedule for how the team will conduct the investigation.

Step 6. Print the Investigation- Provide a printed copy of the entire investigation to the Green Team members who will be conducting the investigation. Then, they can record information as they walk around the school and complete the investigation. Encourage team members to answer the questions to the best of their ability according to time allotted and documents and materials available to them. The "**Teacher Print Out Packet"** contains the **Individual Classroom and School wide Charts** to record information on and are available for distribution throughout

your school faculty. The "Teacher Print Out Packet" is available on the KGS Website under the Investigation you are completing.

Add any questions that your Green Team discussed that were not covered in the investigation.

Step 7. Gather Documents and Supplies- If possible; gather the following documents and supplies before the team begins the Investigation:

- Monthly and/or Annual Billing Statements from your school's energy providers (you may need to gather from the school district office).
- Any written policies your school has related to energy use.
- Optional Equipment: Thermometer/infrared temperature gauge, watt meter, light meter, ballast tester and a vending machine miser(s). **See below for information on these tools and suggestions on how to borrow or purchase them.**
- Copies from the **"Teacher Print Out Packet"** for the investigation that's on the KGS Website under the Energy Investigation.

Step 8. Conduct the Investigation- Green Team should answer the questions to the best of their ability within the time allotted, and with the information and equipment available.

Step 9. Develop and Implement an Action Plan- Based on the information and data collected, the Green Team will prioritize their ideas for action projects and implement one or more of their plans.

Step 10. Apply for Recognition- Once your investigation and action plans are complete, you will apply for a Silver, Gold, or Gold Globe Level of Recognition. Rubrics on how each level will be scored along with the applications are available on the KGS website. Visit http://www.kansasgreenschools.org/apply-recognition for more information.

Step 11. Celebrate Your School's Success- Communicate your school's findings and action plans with the school, school administrators, families, the community and your representatives!

Energy Investigations Instrument Fact Sheet

Light Meter- A light meter measures the amount of light in an area and can determine the optimal level of lighting. Light meters are available from photography stores and internet stores. If your school offers a photography course, check if you can borrow a light meter. The typical cost for light meters is $50 and up.

Watt Meter- A watt meter measures the energy used by individual appliances plugged into the meter. It can display how much energy is being used and how much the appliance plugged in costs. Public utility companies and public libraries may have wattmeters available for loan. They can be purchased from home improvement stores or internet stores. The typical cost for wattmeters is $25 and up. When searching on the web, use the keywords Kill-A-Watt Meter or wattmeter. Note: KACEE as a few watt and light meters available for loan.

Thermometer/Infrared Temperature Gauge- A regular thermometer or an infrared temperature gauge can be used to take measurements in the classroom. The advantage of the infrared temperature gauge is that you can point it at an object and get a quick readout of the surface temperature of that object. The typical cost for an infrared temperature gauge is $25 and up. When searching on the web for sites that sell these items, use the keywords thermometers and Infrared temperature gauges.

Vending Machine Miser- A Vending Miser is an energy efficiency tool for vending machines. It saves money and power by turning off lighting and managing compressor cooling cycles when they are not needed. Public utility companies may provide free vending machine misers, offer rebates, or offer them for loan. They can be purchased from Internet stores using the keyword as "vending miser" or "vending machine miser."

Smart Strips- Smart power strips work to reduce power usage by shutting down power to products that go into standby mode saving energy and money for schools and homes. You can purchase them online for around $30 using the keyword as "smart strips."

Ballast Tester- Much like the rest of the tools, there are a variety of ballast testers. One example is a simple "point and shoot" device will indicate if the ballast on a light fixture is magnetic or electronic. A ballast regulates the amount of electricity that flows into a florescent light. Magnetic ballasts have been around since the beginning of fluorescent lighting. Magnetic ballasts may cost less initially, but they weigh more and are less efficient than the modern electronic ballast. The EPA is requiring that magnetic ballasts be replaced with electronic ballasts over the next several years. Ballast testers may be purchased online or some may be available through energy offices.

Part 4: Energy Investigation

Ignited with Energy Investigation!

Introduction

IGNITE your school as your team assesses how much energy your school uses and its main sources of energy consumption.

This investigation will help your team identify current energy management practices and will help in thinking of ways to modify these practices to make your school greener and healthier! Your results will inform school staff and students where they can make improvements and also to generate an action plan to reduce school energy use.

Objectives

- Students will investigate energy usage at their school.
- Students will use monitoring equipment, such as thermometers, watt meters, light meters, to take various measurements and record results.
- Students will develop an understanding of how individual and collective student actions can affect energy usage.
- Students will discover the connection between energy use and the depletion of natural resources.
- Students will learn about sustainable approaches to energy management and why it is important to adopt sustainable practices.
- Students will generate a plan to reduce their school's energy use and improve the school's overall environmental performance.
- As approval, time and funding permit, students will implement one or more of their energy improvement strategies.

Time Requirement

The Energy Survey will take several 45 minutes sessions to complete, depending on the documentation available, equipment being used, and help from supporting school staff. Be sure to gather all of the needed supplies and documents ahead of time.

Kansas Green School Energy Investigation:
Green Team Sign Up

Part 1: Energy in our School

Reducing energy use saves natural resources and can save your school money. This investigation will help you find out what uses the most energy at your school and ways that energy is wasted. It will help you find ways to save energy to make your school more environmentally friendly and sustainable. Sustainable practices are those which meet the needs of the present without compromising the ability of future generations to meet their needs.

School Name: _____ Date: _____
Conducted By: (Please include administrators, teachers, school staff, students, and parents involved in this investigation.)
Name Title/Role

_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____
_____ _____

School Population
Students: _____
Staff: _____

SCHOOL BUILDING INFORMATION AND ENERGY USAGE:

1. Who provides energy to your school? _____

2. What are the main sources of energy for your school?
To find this out, you can contact the electricity provider for your school (try the communications or media relations department). You can also review the Energy Resource section to learn how to calculate your fuel mix or try the following U.S. EPA website to find out your region's energy sources: http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html. You can also refer to **page 53** of this investigation on **"How to Find the Fuel Mix for Your School."**

Coal ____% Wood ____%
Nuclear ____% Solar ____%
Hydroelectric ____% Windpower ____%
Oil ____% Geothermal ____%
Natural Gas/Propane ____% Other _____%

3. Does your school have any renewable energy systems?
- ☐ Solar Photovoltaic
- ☐ Wind
- ☐ Geothermal
- ☐ Solar Thermal
- ☐ Other_____

Where and for what purpose? _____

4. What facilities other than the school building use electricity on school grounds?
- ☐ Athletic Fields
- ☐ Outdoor lighting
- ☐ Pool
- ☐ Other_____

5. Can you determine where the electricity enters the school building?
_____
Note: Depending on your community, electric lines may be above ground or underground, but students should be able to see where the lines enter the building. ***Caution:*** *Students should not enter any maintenance areas of the school. You might also ask custodial staff or the building engineer for this information.*
6. Where is the electric meter(s) for your school building?
_____
Caution: *Students should not enter any maintenance areas of the school. You might also ask custodial staff or the building engineer for this information.*

7. If the electric meter is located in an area that is safe for students, take a reading and record the time and date. Then take another reading 24 hours later. *Most electric meters are digital. If your school has an older meter, please refer to page 52* ***"Reading an Electric Meter."*** *If your school has more than one meter, it may be interesting to compare electricity consumption data for different areas of the school.*

Reading # 1	Reading #2	Difference (*This will tell you how many kilowatt hours (kWh) were used during the time period)*	Difference multiplied by cost of 1 kilowatt hour = Energy cost for 24 hours
Meter Location 1: Date and Time:	Meter Location 1: Date and Time:		
Meter Location 2: Date and Time:	Meter Location 2: Date and Time:		

By looking at an electric bill for your area, you can find out how much one kilowatt hour costs. The cost per kWh of electricity will be used in the Lighting and Appliance Investigations. An example of how to read an electric bill may be found at: http://www.evergy.com Visit the Manage Account section, then Billing then Understand My Bill section.

8. Does the School Utility Bill indicate how much is charged per kilowatt-hour (kWh) for energy?

_____

Note: If your school energy bills are not available, you can estimate your schools energy costs using Westar Energy's Commercial Energy Calculator at:
http://westarenergy.apogee.net/comsuite/bizframe.aspx?url=/comcalc

9. Using your school's energy bills, how much does your school pay for energy? (The British Thermal Unit, or BTU, is an energy unit. It is approximately the energy needed to heat one pound of water for 1 Fahrenheit. 1 BTU = 1,055 joules. 1BTU/hour = 0.293 watt.)

Energy Source	**Cost Monthly**	**Cost per Year**	**BTU's used Monthly**	**BTU's used Annually**
Electricity				
Natural Gas/Oil/Propane				
Other:				

10. Optional: Based on the answers to question #9, try to calculate how much money your school spent on energy-related utilities per student last year (Total cost of energy divided by the number of students):

_____ Total Energy Cost per Student

11. Optional: The U.S. EPA has an online tool called Portfolio Manager. This tool allows schools to track and assess their energy consumption. It also allows schools to benchmark their energy use and compare their school to others across the country. For more information, visit http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

Part 2: Heating and Cooling Our School

Building Information

1. When was the school building built?
   - ☐ Prior to 1950
   - ☐ Between 1950 and 1975
   - ☐ Between 1975 and 1990
   - ☐ After 1990

2. Has the school been renovated?
   - ☐ Yes
   - ☐ No

If yes, when? _____

3. What is the size of your building (in square feet):_____

4. Walking around the perimeter of the school building, note any visible obvious cracks or leaks in windows, doors, or foundations. (Do you see light or feel any warm/cold air coming from inside?)_____
_____
_____
_____

5. How old is the school's heating, ventilation and air conditioning (HVAC) equipment? _____
NOTE: The Kansas Energy Office offers a Facility Conservation Improvement Program (FCIP) for schools and school districts that provides assistance with in depth energy auditing and financing for energy saving improvements. If your school is interested in more ways to save energy, explore options at:
http://www.kcc.state.ks.us/energy/fcip/index.htm

6. Does your school follow a schedule for servicing HVAC equipment?
   - ☐ Yes
   - ☐ No

7. How often are furnace and ventilation filters cleaned or replaced?_____

8. If your school has central air conditioning, is the outside unit in the shade to increase efficiency?

- ☐ Yes
- ☐ No

9. Are there trees on the south side of the school building to provide shade during the hotter months?

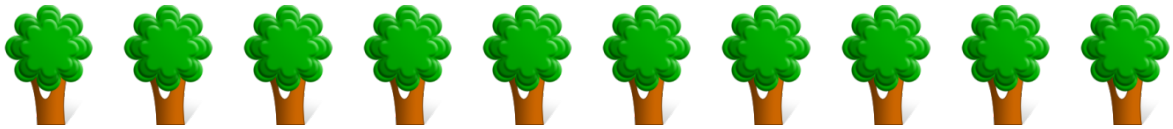
- ☐ Yes
- ☐ No

10. Are trees placed on the north and west sides of the school to provide a wind break in the colder months?

- ☐ Yes
- ☐ No

Landscape for Energy Efficiency (www.energy.gov)

- Plant trees or shrubs to shade air conditioning units, but do not block the airflow. A unit operating in the shade uses less electricity—this can save up to 10% of your energy costs.
- Grown on trellises, vines such as ivy or grapevines can shade windows or the whole side of a house.
- Avoid landscaping with lots of unshaded rock, cement or asphalt on the south or west sides -- it increases the temperature around the house and radiates heat to the house after the sun has set.
- Trees whose leaves fall off in the winter, planted on the south and west sides, will keep your house cool in the summer and let the sun warm your home in the winter.
- Just three trees, properly placed around a house, can save between $100 and $250 annually in cooling and heating costs. Daytime air temperatures can be 3 to 6 degrees cooler in tree-shaded neighborhoods.



Operational Definitions: Taking a Temperature Reading

In the *Individual Room Heating and Air Conditioning Investigation*, the Green Team and/or classrooms are asked to take a temperature reading at different locations within the room. For instance, classrooms are asked to take temperature readings near the outside walls/windows, at the middle of the room, at an open doorway, far away from the windows, and at or near an air output vent. While at first this might seem pretty straight forward, as your classrooms begin to take the temperature readings, there are lots of opportunities for data to be collected in different ways. This is why scientists use operational definitions. Operational definitions describe the way in which a measurement is taken so that no matter who is collecting the data, there is a consistency.

In order to write an operational definition, you must first identify the variables involved in the data measurement you're taking. The variables include those which are ***controlled variables, manipulated variable (independent variable)*** and the ***responding variable (dependent variable)***. So for instance, in taking temperature reading in a classroom near the outside wall or window (independent or manipulated variable), your team would get the most consistent data (responding or dependent variable) if they all take the temperature reading in the same way (controlled variables). For example, to control the variables you would all use the same type temperature measurement tool (a traditional thermometer or a temperature gun), gathered the data at the same time during the day and on the same day, identified the temperature reading locations in the same way (e.g. at the center of the wall/window taken at 4 feet from the ground), etc. These are some of the variables you will need to control in order to have consistent data that may be compared across classrooms. These variables are the controlled or dependent variables. The manipulated variable would be the location within the classroom the temperature is taken (e.g. wall/window area) and the responding variable or data would be the actual temperature reading. And again, to have reliable data, scientists will often repeat the data collection and average the results. In this case, you may want each classroom to take the temperature reading at each location three times and average the results in that location to record.

You may want your Green Team to develop these operational definitions. Or you might ask upper grade classrooms to submit suggestions for operational definitions of taking a temperature reading and then have the Green Team finalize the standardized operational definition so that temperature readings may be taken with consistency. Remember, there should be enough detail in your operational definition that anyone could read the definition and take the temperature reading in the same way. Be sure to provide your operational definitions with the *Individual Room Heating and Air Conditioning Investigation*.
Write your operational definition(s) in the space at the top of this page and duplicate the pages. Then distribute the *Individual Room Heating and Air Conditioning Investigation* with the *operational definitions* to classrooms that are willing to complete portions of this Energy Investigation for you. You can then pool all the results together in the end to make any recommendations or notice any trends in energy use in your school. Be sure to let classrooms know when and where to turn the results back in.

Individual Room Heating and Air Conditioning Investigation:

Record the room data using the following operational definition(s) for *taking a temperature reading*:

Please turn into _____ by _____.

Individual Room Name/Number: **Teacher's Name:**	**Date of Investigation:** **Times of Investigation:**
Do you see any blocked air vents or ducts?	☐ Yes Comments: ☐ No
Are the seals of the windows between the frame and the pane tight?	☐ Yes Comments: ☐ No
Windows: How many windows does the room have? Which direction do the windows face? (N, S, E, or W). Can the windows be opened and closed?	Number of Windows: _____ Direction Windows Face: _____ ☐ Yes Comments: ☐ No
Are there window coverings that could be used to control the room's temperature?	☐ Yes Comments: ☐ No
Does your classroom have a programmable thermostat?	☐ No ☐ Yes –Current Temperature Setting ____
Can the thermostat be adjusted by the teacher?	☐ No ☐ Yes –Current Temperature Setting ____
After the room has been occupied for a couple of hours (per operational definition), **use a thermometer (regular or infrared temperature gauge)** to measure and record the room temperature in the following locations. **To more accurately take a temperature reading, take the temperature at each location three times, add those readings together and divide by 3 and record the average for each location. To find the room average, add the five room readings together and divide by 5.**	Near outside wall/windows: _____ Middle of the room: _____ Open doorway: _____ Far away from the windows: _____ At or near an air-output vent: _____ Average Room Temperature: _____ In the hallway outside the room: _____ Outside Temperature: _____ Other Location: _____ Time: _____
During the afternoon at time designated by operational definition, **use a thermometer (regular or infrared temperature gauge)** to measure and record the room temperature in the following locations. **To more accurately take a temperature reading, take the temperature at each location three times, add those readings together and divide by 3 and record the average for each location. To find the room average, add the five room readings together and divide by 5.**	Near outside wall/windows: _____ Middle of the room: _____ Open doorway: _____ Far away from the windows: _____ At or near an air-output vent: _____ Average Room Temperature: _____ In the hallway outside the room: _____ Outside Temperature: _____ Other Location: _____ Time: _____

Do the indoor room temperatures vary depending on the location of the temperature reading?	☐ Yes Explain: ☐ No
Does the room temperature vary based on the time of day the temperature is taken?	☐ Yes Explain: ☐ No
Where is the warmest temperature in the room?	
Where is the coldest temperature in the room?	
What is the average temperature in the room?	
Are most students comfortable with the temperature in the room? (Consider developing a survey)	☐ Yes Comments: ☐ No
Recommendations: Given this information, what recommendations, changes or improvements should be made to conserve energy in your classroom?	

School-Wide Heating and Air Conditioning Investigation:

1. How is the temperature in your building controlled?
   - ☐ Whole school is set at same temperature
   - ☐ Individual thermostats for each room or group of rooms

2. Who sets the thermostats?
   - ☐ Individual teacher controls the thermostat
   - ☐ Thermostat is set by administration/maintenance staff

3. Does your school use programmable thermostats?
   - ☐ Yes
   - ☐ No

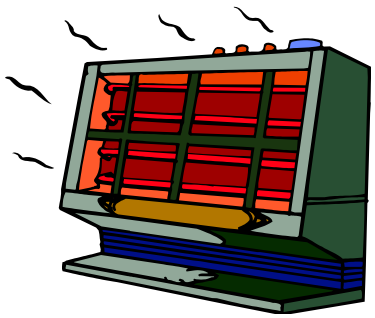
4. Can the school's HVAC be controlled remotely, allowing the heating and cooling system to be turned off when the building is not occupied?
   - ☐ Yes
   - ☐ No

5. Does your school (or school district) have standards or guidelines for thermostat temperature settings?
   - ☐ Yes
   - ☐ No

   If yes, what are the thermostat temperatures setting for the following?

   Heating Season:
   Occupied_____
   Unoccupied_____

   Cooling Season:
   Occupied_____
   Unoccupied_____



Did you know? That over 50% of your school's energy usage is spent in heating and cooling your building?

School Wide Heating and Air Conditioning Investigation Summary

Use this chart (duplicate as necessary) to summarize the school's heating and air conditioning data, including non-classroom spaces such as the gymnasium, cafeteria, library, auditorium, office, etc. For each space, summarize the data and note your findings/recommendations. Share your findings.

Room	Findings
Room: Gym Findings/Recommendations: This room is too hot for its use. Recommend: lower thermostat, use ceiling vent system more, get coverings for skylights	Outside Temperature Average Temperature Reading AM: 78 AM: 76 degrees PM: 84 PM: 83 degrees What's the highest temperature reading in this room and where was it located?________________________ What's the lowest temperature reading in this room and where was it located?________________________ Comfort Level: too hot (circled) too cold comfortable Any window coverings? No Can windows open? No Any fans/ventilation systems? Ceiling fan
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?________________________ What's the lowest temperature reading in this room and where was it located?________________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?________________________ What's the lowest temperature reading in this room and where was it located?________________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?________________________ What's the lowest temperature reading in this room and where was it located?________________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?

Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?_______________________ What's the lowest temperature reading in this room and where was it located?_______________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?_______________________ What's the lowest temperature reading in this room and where was it located?_______________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?_______________________ What's the lowest temperature reading in this room and where was it located?_______________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?
Room: Findings/Recommendations:	Outside Temperature Average Temperature Reading AM: AM: PM: PM: What's the highest temperature reading in this room and where was it located?_______________________ What's the lowest temperature reading in this room and where was it located?_______________________ Comfort Level: too hot too cold comfortable Any window coverings? Can windows open? Any fans/ventilation systems?

***Develop a heating and cooling profile report for your school. Summarize the data your school's Green Team collected from classrooms, other areas of the school and the cafeteria. Include graphics, pictures and other visuals when appropriate. Highlight potential recommendations (including cost estimations and savings estimations) from classrooms and from the whole school analysis and develop a strategy to communicate this information to the school, parents and community, including school boards or district personnel.**

Part 3: Lighting Our School

See pg. 51 of the investigation, ***"Fact Sheet on Fluorescent Lights"*** *for more information on lighting types. Another good resource may be found at www.energystar.gov, search for "Lighting Technologies Fact Sheet."* ***Below are pictures of some commonly found light bulbs:***

	Compact Fluorescent Bulbs	CFL'S can save more than $40 in electricity costs over its lifetime. CFL's use about 75% less energy than standard incandescent bulbs and last up to 10 times longer. They also produce about 75% less heat, so it's safer to operate and can cut energy costs associated with cooling.
	Incandescent Bulbs	Incandescent bulbs typically have short life spans and use significantly more watts than CFLs. Incandescent technology produces light by heating up a metal filament enclosed within the lamp's glass. More than ninety percent of the energy used by an incandescent light bulb escapes as heat, with less than 10% producing light.
	T5 and T8 Fluorescent Tubes	Using an energy-efficient lighting technology, such as T8 or T5 fluorescent lamps and electronic ballasts, is a critical step to improving the energy efficiency of your facility and saving money. T5 are 5/8ths of an inch and T8 are on inch in diameter.
	T12 Fluorescent Tubes	T12's are one of the most common fluorescent lamps, but least efficient fluorescent systems. T12 lamps can be identified by their 1.5-inch diameter.
	Halogen Bulbs	Halogen bulbs are somewhat more efficient than incandescent lamps, but operate at an even higher temperature. These high operating temperatures can present a safety concern in some fixtures.
	LED Fluorescent Tubes	LED lighting uses at least 75% less energy, lasts 25 times longer than incandescent lighting and provides optimal light color.
	HiDischarge (HID)	Due to their intensity, HID lighting systems are useful for lighting large areas like stadiums, and range from 50 to 2,000 watts each. Older HID installations are often mercury vapor lamps, an extremely inefficient design.

Artificial Lighting Investigation (Individual Rooms):

Distribute to classrooms that are willing to complete this Energy Investigation for you. Use this chart for other spaces such as the gym, library, etc. You can then pool all the results together in the end to make any recommendations or notice any trends in energy use in your school. In the average school, about 14% of the energy costs are spent in lighting (*Managing Energy Costs in Schools*, www.mge.com). So exploring the lighting in your school is a good place to look for potential savings. **Please turn into _____ by _____.**

(Bulb type will be written on bulbs or you can measure bulb diameters to determine bulb types. See the Lighting Information Sheet above for more lighting details).

Teacher Name (if applicable):		**Room Number:**		**Date of Investigation:**		
Type of Bulbs	Number of Fixtures	Number of Bulbs per Fixture	Average Wattage of the Bulb	Average Hours "On" per Day	Energy Consumed per Day (kWh)	Daily Cost for Electricity ($) (use average of .10 or actual cost, see p. 16)
	A	**B**	**C**	**D**	**E=AxBxCxD/1,000**	**F = E x $0.10**
 Compact Fluorescent:						
 T12 Fluorescent Tubes:						
 T8 Fluorescent Tubes:						
 LED Fluorescent Tubes:						
 Incandescent:						
Totals:						

For Column D: Collect "on time" data each day for one week (Monday-Friday), and then divide the total hours by 5 to get the "Average Hours "On" per Day."

For Column E: Calculate the kWh used per day by multiplying the number of light fixtures of each type by the number of bulbs per fixture, the average bulb wattage, and the average time in use per day, and then dividing by 1,000 to obtain the correct units.

For Column F: Calculate the daily cost for using each bulb type in your classroom by multiplying the daily energy use (column E) by cost/kWh (use the National average of .10 or actual cost, see p. 16 of this packet).

1. Is this space lit by any natural lighting?
   - ☐ Artificial Only
   - ☐ Primarily Artificial and some Natural
   - ☐ Primarily Natural w/ Artificial as needed
   - ☐ Natural Only

Did You Know??? Establishing a habit for classrooms to shut off their lights, even for a few minutes, helps conserve energy! The most efficient light is a light not used.

2. Are lights turned off when the room is not in use?
   - ☐ Yes
   - ☐ No
   - ☐ Sometimes

3. Are lights controlled by motion and/or photo sensors?
   - ☐ Yes
   - ☐ No

If yes, what type? _____
(Photo sensors automatically turn lights on /off depending on the amount of natural light in the room. Motion sensors automatically turn lights on/off based on movement in the room.)

4. If fluorescent tube light fixtures are present, are the ballasts the newer electronic type?
   - ☐ Yes
   - ☐ No

(Older light fixtures may still be using the magnetic-type ballasts. A ballast tester can be used to determine the type, or ask a member of your school's maintenance staff. Electronic ballasts increase energy efficiency.)

How to identify fluorescent bulbs: The letter T is used in front of the number to show the fluorescent bulb is a tube type. Following the letter is a number representing the diameter of the bulb measured in fractions of an inch. Fluroscent bulb widths are measured in eights of an inch. For example, a T5 bulb is five-eighths of an inch wide, a T8 bulb is one inch wide (eight-eighths) and a T12 is 1-1/2 inches (12/8ths) in diameter. Installing T8's in place of T12's can reduce lighting energy consumption by 35%! Read more: What is T5, T8 and T12 Lighting? eHow.com http://www.ehow.com/about_6464110_t5_-t8-t12lighting.html#ixzz1MuRu8DR7

Daylighting Investigation (Individual Rooms):

Distribute to classrooms that are willing to complete this investigation for you. Use this chart for other spaces such as the gym, library, etc. You can then pool all the results together in the end to make any recommendations or notice any trends in energy use in your school. Daylighting is the illumination of indoor spaces by natural light from windows or skylights. A light meter measures the amount of light falling on a surface. Measurements are typically made in units called a foot-candle (fc), which is a unit for measuring illumination. You may be able to borrow a light meter from a photographer or purchase one online. If you have access to a light meter, take the following measurements and record data on this chart. If you do not have a light meter, record "adequate" or "inadequate" on the chart. Standards for adequate lighting in classrooms have been established.

Turn into _____ by _____.

Using Light Meter: **Time of Day:**				**Natural light adequate with…**	
Teacher Name: **Room #_____**	**Light Quantity with All Lights On (foot candle-fc)**	**Light Quantity with Half of Lights Off (foot candle- fc)**	**Light Quantity with All Lights Off (foot candle-fc)**	**Half of Lights Off (Yes or No)**	**All Lights Off (Yes or No)**
On a desk near the windows					
On a desk in the middle of the room					
On a desk away from the windows					
In the hallway outside the room					
Conclusions:	Average fc with All Lights On	Average fc with Half Lights Off	Average fc with All Lights Off		

Note: Assuming that 50 foot candles (fc) provides adequate lighting for the students, it may be possible to use fewer lights and ultimately less energy. To test if 50 foot candles provide enough light, students can try reading at different light levels and determine what level of lighting is most comfortable for them.

The Illuminating Engineering Society of North America has set standards for indoor lighting. The typical classroom should be in the range of 30 to 50 foot candles, depending on the task being performed. *For example, reading very small print will require more light than reading large print or viewing a computer screen.* ***Hallways and lower-use areas can be approximately 25 fc.*** *With daylighting, it may be possible to use fewer lights and ultimately less energy. (Source: www.iesna.org)*

1. Type of weather on the day measurements were taken: circle one
   Sunny Partly Cloudy Cloudy

2. If the weather was cloudy, try repeating the measurements on a brighter day. Do the readings change?
   - ☐ Yes
   - ☐ No
   - ☐ Explain _____

3. Do the light meter readings vary depending on the location of the reading?
   - ☐ Yes
   - ☐ No
   - ☐ Explain _____

4. Are any rooms or areas of the room over lit or under lit for the tasks being performed?
   - ☐ Yes
   - ☐ No

   Explain: _____

5. Are all light bulbs on when the space is in use or can lighting be adjusted to take advantage of natural light when available?

☐ Yes
☐ No

6. How could this information be used to help conserve energy in the room?_____
   _____
   _____

Disposing of fluorescent bulbs: You may have heard that fluorescent light bulbs shouldn't be thrown in the regular trash. This is because they contain small traces of mercury. For more information on how to properly dispose of fluorescent bulbs, go to http://www.epa.gov/wastes/wycd/howdoirecyclemy.htm

Did You Know??? "LED" Exit Lights are as much as 75% more visible than traditional exit lights; cuts energy costs by 90%, and can last up to 10 years!

Whole School Lighting Investigation:

Compile the data on lighting that was gathered in Artificial Lighting and Daylighting Investigations. Record the results and do the calculations. See the instructions after the chart.

Whole School Building Lighting Assessment						Number of rooms with adequate lighting throughout the room with ……		Number of rooms with "cloudy" conditions during light reading
Type of bulbs	Number of fixtures within the school	Average total hours "on" per day	Total energy consumed per day (kWH)	Daily Cost for Electricity (use average of .10 or actual cost, see p. 16)	Number of rooms with this bulb type as its main source	Half of lights off	All lights off	
	A	**B**	**C**	**D=C x$.10**	**E**	**F**	**G**	**H**
CFL's								
Fluorescent tubes								
Incandescent								
LED								
Other:								

Instructions:

A — Using the completed Lighting Section of the Individual Room Energy Survey forms for all rooms evaluated in the school, tally all of the individual fixtures of each bulb type, and enter the numbers in the appropriate rows.

B — Using the completed forms, develop and record an overall average hours "on" value for each bulb type. This overall average value can be based on the typical or most common value found on the completed forms. Or you can use the completed forms to calculate a simple or weighted average value.

C — Add up and enter the energy usage figures from the completed Individual Room Energy Survey forms for each bulb type.

D — Calculate the daily cost for using each bulb type schoolwide by multiplying the daily energy use (column C) by cost/kWh, (use the National average of .10 or actual cost, see p. 16 of this packet).

E — Using the completed forms, tally and enter the number of rooms in your school that use fixtures with a particular bulb type as the main lighting source for each bulb type.

F — Review the completed forms. For each bulb type supplying the main artificial lighting, count the number of rooms in which natural light was adequate at all points inside the room with half of the lights off. Enter the values for each bulb type in the appropriate rows.

G — Using the same approach as for instruction F, count and enter the number of rooms for which natural light was adequate at all points inside the room with all of the lights off.

H — Review the completed forms and for each bulb type that supplies the main artificial lighting. Count the number of rooms for which weather conditions during measurement of natural light adequacy were "cloudy."

Observations and Conclusions:

1. Looking at column A (Number of Fixtures), which fixture was the most common?
   Least common?
2. Looking at column D (Daily Cost for Electricity), which fixture has the highest daily electricity cost?
   The lowest cost? Are these the same answers as in question #1?
   What can you conclude from this result?
3. What observations and conclusions/recommendations can you make based on these data?

Outdoor Lighting School Investigation

What type of lighting is used outside of the school? Use this chart to investigate types, quantity and ways in which lighting is used outside your school.

Space and Light Bulb Type Used	Number of Fixtures	Number of Bulbs per Fixture	Average Wattage of the Bulb	Average Hours "On" per Day	Energy Consumed per Day (kWh)	Daily Cost for Electricity ($) (use average of .10 or actual cost, see p. 16)	Lights Controls: Timers, Motion &/ or photo sensors?
	A	**B**	**C**	**D**	**E=AxBxCxD /1,000**	**F = E x $0.10**	
Building Exterior							
Parking Lot							
Stadium							
Concessions							
Other:							
Totals:							

For Column D: Collect "on time" data each day for one week (Monday-Friday), and then divide the total hours by 5 to get the "Average Hours "On" per Day."

For Column E: Calculate the kWh used per day by multiplying the number of light fixtures of each type by the number of bulbs per fixture, the average bulb wattage, and the average time in use per day, and then dividing by 1,000 to obtain the correct units.

For Column F: Calculate the daily cost for using each bulb type in your classroom by multiplying the daily energy use (column E) by $0.10/kWh, the average nationwide cost of electricity.

1. Based on your Outdoor Lighting Investigation, what recommendations, can you make for outdoor lighting of your school?

Summary of Schoolwide Lighting

Use this chart to summarize the ways lighting is controlled for quantity and quality inside and outside and explore recommendations for increasing energy efficiency throughout your school.

Lighting Summary Questions	Number of Classrooms	Number of Other Rooms	Number of Outdoor Fixtures	Comments/ Recommendations
Lighting Control: Are the lights controlled by one switch or multiple switches?	**1 Switch:** **Multiple Switches:**	**1 Switch:** **Multiple Switches:**	**1 Switch:** **Multiple Switches:**	
Are lights controlled by timers or motion, photo or infrared sensors?	**Timers:** **Sensors:**	**Timers:** **Sensors:**	**Timers:** **Sensors:**	
Natural Lighting: Is there adequate lighting with half the off?	**Yes:** **No:**	**Yes:** **No:**	**Yes:** **No:**	
Is there adequate lighting with all the lights off?	**Yes:** **No:**	**Yes:** **No:**	**Yes:** **No:**	
What are some more energy efficient options for these spaces?				

Observations and Conclusions of Schoolwide Lighting:

1. How common are electronic ballasts in your school?

2. Does your school have a plan for properly disposing/recycling of light bulbs such as compact fluorescents that contain mercury?
   - ☐ Yes
   - ☐ No

The following U.S. EPA website has information on proper disposal/recycling of mercury containing light bulbs:
http://www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm

3. What other observations and conclusions can you make on the basis of these data?

4. Brainstorm and develop a lighting profile report for your school. Summarize the data your school's Green Team collected from classrooms, other areas of the school and outdoors. Include graphics, pictures and other visuals when appropriate. Highlight potential recommendations (including cost estimations and savings estimations) from classrooms and from the whole school analysis and develop a strategy to communicate this information to the school, parents and community, including school boards or district personnel.

Part 4: Equipment and Appliances in Our School

Items we plug in and school equipment account for the remainder of energy use in the school or about 20% of overall energy usage. Explore ways that your classrooms and school are using equipment and look for ways to conserve energy. Print off the Equipment and Appliance Investigation and distribute to classrooms to collect data for school wide investigation.

Classroom Equipment and Appliance Investigation

Turn into_____by _____. Date of Investigation:_____

If you have access to watt meters, they can calculate the kWh used per hour, day, month, year and the estimated costs per hour, day, month and year.

Teacher Name:			**Room #:**					
Equipment or Appliance	**Quantity** (Number of devices in the room)	**Average Watts Used:**	**Estimated Hours Used per Day** (Consider whether it is turned off at night and/or when not in use)	**Energy Used Per Day (kWh)**	**Number of School Days per Year** (consider if the appliances are unplugged during breaks and holidays)	**Total kWh Used per Year**	**Estimated Cost per Year** (use average of .10 or actual cost, see p. 16)	**How Many of these Devices have an Energy Star Label?**
	A	**B**	**C**	**D= B x C**	**E**	**F= D x E**	**G= A x F x $0.10**	**H**
Computers		Unit On: Unit Off:						
Printers		Unit On: Unit Off:						
Radio		Unit On: Unit Off:						
Television		Unit On: Unit Off:						
DVD/VCR Players		Unit On: Unit Off:						
Smart Boards		Unit On: Unit Off:						
Coffee Pot		Unit On: Unit Off:						
Microwave		Unit On: Unit Off:						
Mini Fridge		Unit On: Unit Off:						
Clock		Unit On: Unit Off:						
Fans		Unit On: Unit Off:						
Overhead Projector		Unit On: Unit Off:						

LCD Projector		Unit On: Unit Off:						
Other:		Unit On: Unit Off:						
Totals:								

Energy Investigation Appliance Instructions

Note: 1. Average electricity cost of $0.10 per kWh (nationwide average in 2009) or the actual electricity cost (see p. 16 of this packet).

A—Total quantity: Add up and record the number of devices of each type.
B—Average watts used: Record an overall average watts used for each device type when it's on and off if possible. This overall average value can be based on the typical or most common value found.
C—Hours used per day: Add up the hours used per day for each device type and record the result.
D—Energy used per day: Multiply average watts used (column B) by hours used per day (column C). Then divide by 1,000 to get power used per day in kilowatt hours (kWh). Record the result.
E—Number of school days per year: Record the number of days per year that your school is in session.
F—Total kWh per year: Multiply energy used per day (column D) by number of school days per year (column E) to get the total electricity use while school is in session for each device type in kWh.
G—Total cost per year: Multiply the number of devices (column A) by total kWh per year (column F) by the U.S. average of electricity cost to get the electricity cost of operating the devices while school is in session.
H- ENERGY STAR: Many devices have an ENERGY STAR label indicating that they have been certified as energy conserving. Look for the ENERGY STAR label on each device. Count and record the number with labels.

1. Are any of the above equipment or appliances turned on in the morning and left on all day? If yes, list them:
   _____
   _____
   _____

2. Look at column A, Number of devices in school.
   Which device was the most common? _____
   The least common? _____

3. Look at column B, Average watts used.
   Which device had the highest average watts used? _____
   The lowest average watts used? _____

4. Look at column G, Total cost per year.
   Which device type had the highest total electricity cost? _____
   The lowest total electricity cost? _____

5. Are computer monitors turned off after use?
   - ☐ Yes
   - ☐ No

6. Do classroom computers have a sleep function or sleep mode software that allows them to “sleep” when not in use?
   - ☐ Yes
   - ☐ No

7. Are power strips or smart strips used with appliances or electronics to turn off multiple devices at once?
   - ☐ Yes
   - ☐ No

8. Do any of the appliances or devices have a phantom load?
   (A phantom load is the amount of energy that a device uses while in standby mode or when switched off. Some appliances, such as TV’s or DVD players with remote controls, use energy even when they are turned off, because they are in standby mode and not actually turned off. Devices with an internal clock, such as a microwave, also carry a phantom load. You can use a watt meter to check for and measure phantom loads.)
   - ☐ Yes
   - ☐ No
   - ☐ If yes, list the devices:

     _____

     _____

Did you know? Your appliances are using electricity even when they are turned off? This is called “phantom energy.” To help save energy in your classroom or school, unplug appliances when they are not in use or plug them into a power strip or another option is a smart strip. When you turn the strips off, the appliances no longer draw phantom energy and save energy and money.

Did you know? Sensors or vending machine misers can save nearly 50% of the $170-$250 in annual electricity costs to operate.

School-Wide Equipment and Appliance Investigation

Gather the information on the table below for any appliances or equipment not found in a classroom (i.e. offices, library, cafeteria, gymnasium, auditorium, etc.) and then combine your data with the classroom investigations that have been completed.

Date of Investigation:								
Equipment or Appliance	**Number of devices in the room**	**Average Watts Used:**	**Estimated Hours Used per Day** (Consider whether it is turned off at night and/or when not in use)	**Energy Used Per Day (kWh)**	**Number of School Days per Year** (consider if the appliances are unplugged during breaks and holidays)	**Total kWh Used per Year**	**Estimated Cost per Year** (use average of .10 or actual cost, see p. 16)	**How Many of these Devices have an Energy Star Label?**
	A	**B**	**C**	**D= B x C**	**E**	**F= D x E**	**G= A x F x $0.10**	**H**
Computers		Unit On: Unit Off:						
Printers		Unit On: Unit Off:						
Radio		Unit On: Unit Off:						
Television		Unit On: Unit Off:						
DVD/VCR Players		Unit On: Unit Off:						
Smart Boards		Unit On: Unit Off:						
Coffee Pot		Unit On: Unit Off:						
Microwave		Unit On: Unit Off:						
Mini Fridge		Unit On: Unit Off:						
Clock		Unit On: Unit Off:						
Fans		Unit On: Unit Off:						
Overhead Projector		Unit On: Unit Off:						
LCD Projector		Unit On: Unit Off:						
Ice Makers		Unit On: Unit Off:						
Large Refrigerator		Unit On: Unit Off:						

Dishwashers		Unit On: Unit Off:						
Stoves/ Ranges		Unit On: Unit Off:						
Ovens		Unit On: Unit Off:						
Vending Machines		Unit On: Unit Off:						
Other:		Unit On: Unit Off:						
Totals:								

Energy Investigation Appliance Instructions

School Wide Energy Investigation Appliance Instructions
Note: 1. Average electricity cost of $0.10 per kWh (nationwide average in 2009) or the actual electricity cost (see p. 16 of this packet).

A—Total quantity: Add up and record the number of devices of each type from the completed Individual Room Energy Survey forms and add on any additional devices you found to each category throughout the school.
B—Average watts used: Review the completed Individual Room Energy Survey forms. Then develop and record an overall average watts used for each device type. This overall average value can be based on the typical or most common value found on the completed forms. Or you can use the completed forms to calculate a simple or weighted average value.
C—Hours used per day: Add up the hours used per day for each device type from the completed Individual Room Energy Survey forms, and record the result.
D—Energy used per day: Multiply average watts used (column B) by hours used per day (column C). Then divide by 1,000 to get power used per day in kilowatt hours (kWh). Record the result.
E—Number of school days per year: Record the number of days per year that your school is in session.
F—Total kWh per year: Multiply energy used per day (column D) by number of school days per year (column E) to get the total electricity use while school is in session for each device type in kWh.
G—Total cost per year: Multiply the number of devices in school (column A) by total kWh per year (column F) by the U.S. average of electricity cost to get the electricity cost of operating each device school wide while school is in session.
H- ENERGY STAR: Many devices have an ENERGY STAR label indicating that they have been certified as energy conserving. Look for the ENERGY STAR label on each device. Count and record the number with labels.

9. Look at column A, Number of devices in school.
   Which device was the most common? _____
   The least common? _____

10. Look at column B, Average watts used.
    Which device had the highest average watts used? _____
    The lowest average watts used? _____

11. Look at column G, Total cost per year.
    Which device type had the highest total electricity cost? _____
    The lowest total electricity cost? _____

12. If your school has vending machines, does your school use vending machine misers or timers to control vending machine lighting and compressor use so the machine can use less power when it is not in use?
    - ☐ Yes
    - ☐ No

13. How can this information be used to help reduce energy use at the school?

_____
_____
_____
_____
_____
_____
_____

Question Tally for Equipment and Appliances Individual and School Wide Survey

Tally the answers to the Equipment and Appliance Investigations here.

Question	Number of Responses				Comments or Observations
	Classrooms		Other Rooms		
	Yes	No	Yes	No	
Do the computers in the room have a sleep mode that allows them to conserve energy when not in use?					
Do the monitors in the room have a sleep mode that allows them to conserve energy when not in use?					
Are computers turned off when not in use?					
Are monitors turned off when not in use?					

Are power strips/smart strips used with appliances or electronics to make it easy to turn off multiple devices at once?					
Do any of the appliances or electronic devices in the room have a Phantom load?					

Observations and Conclusions about the Question Tally for Appliances and Electronic Devices

1. Based on the data, what recommendations would you make regarding computers, monitors, and printers?

2. Based on the data, what recommendations would you make regarding power strips and/or smart strips?

3. Based on the data, what recommendations would you make regarding reducing your school's phantom load?

4. What other observations and conclusions can you make on the basis of these data?

5. Brainstorm, and then record recommendations for ways to reduce the amount of energy consumed by appliances and other electronic devices at your school.

***Develop an appliance/equipment profile report for your school. Summarize the data your school's Green Team collected from classrooms, other areas of the school. Include graphics, pictures and other visuals when appropriate. Highlight potential recommendations from classrooms and from the whole school analysis and develop a strategy to communicate this information to the school, parents and community, including school boards or district personnel.**

Part 5: Energy Education in Our School

An important part of greening your school is making sure that the students, teachers, administrators, school personnel, parents and community have the knowledge and skills to make informed and responsible decisions. In this section, you will explore ways your school is engaging in education and outreach about energy and energy conservation.

Curriculum and Community Investigation

To answer the following questions, you may want to interview the personnel who manage the school's environmental policies and professional development. Information on academic standards may be available on school websites.

1. Do your school's academic standards include energy and energy conservation?
   - ☐ Yes
   - ☐ No

   If yes, in what grades/classes is this being taught?_____

2. Is renewable energy being taught in any grades/classes?
   - ☐ Yes
   - ☐ No

   If yes, in what grades/classes is this being taught?_____

3. Has your school staff participated in training programs/workshops that include energy education?
   - ☐ Yes
   - ☐ No

4. Does your school participate in energy projects that benefit the community?
   - ☐ Yes
   - ☐ No

   If yes, what are they?

_____

5. Some energy providers can be used as educational resources for field trips and guest speakers. Which facilities are found in your community?
   - ☐ Fossil Fuel Power Station; Location: _____
   - ☐ Hydropower Station; Location: _____
   - ☐ Geothermal Station; Location: _____
   - ☐ Wind Energy; Location: _____
   - ☐ Bio-Energy; Location: _____
   - ☐ Nuclear; Location: _____
   - ☐ Other: _____; Location: _____

6. Has your school/classroom ever taken a tour of any of these facilities?
   - ☐ Yes
   - ☐ No

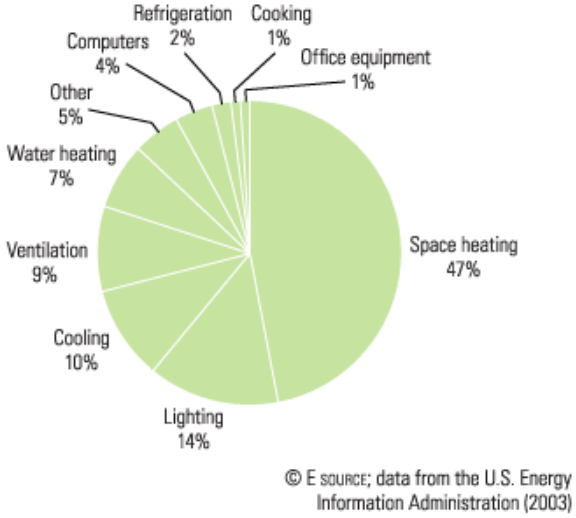
7. Does your school have an energy plan, rules or policies for students and staff that emphasize energy conservation and efficiency?
   - ☐ Yes
   - ☐ No

8. Are students and staff encouraged to conserve energy?
   - ☐ Yes
   - ☐ No

   If so, how?

_____
_____
_____
_____
_____

9. Does your school website, newsletter and/or other media outlets emphasize the school's energy conservation goals or programs?
   - ☐ Yes
   - ☐ No



As you continue in your Energy Investigation, review the pie chart to the left to see where most of the energy in schools goes and compare it to your investigation. As you move forward in the Action Planning process, you will be asked to make recommendations on how your school can lower its energy consumption. The chart will help you see where most of your energy is used and can help with making recommendations that will lower your school's energy usage and help both environmentally and financially.

Go Green Random Energy Classroom Audit

To encourage ongoing efforts, your KGS Green team may consider doing periodic random audits to determine how well classrooms are doing in being good energy conservationists. Your KGS Green team might also develop stickers, certificates or some other way of letting others know which classrooms are doing a great job!

GO GREEN RANDOM ENERGY CLASSROOM AUDIT **Room:** **Date:** **Time:**	
Room Purpose	
Side of Building	North South East West
We visited this room during the	AM PM
We found the room uncomfortably (circle only if one applies):	Hot Cold
We believe this is due to: (Please be as specific as possible.)	☐ temperature settings ☐ doors and/or windows open or leaking ☐ blinds not closed ☐ other: _____ ☐ other: _____
We found unnecessary:	☐ lights left on ☐ equipment left on ☐ water left on ☐ other: _____ ☐ other: _____
We found the following maintenance problems:	☐ broken windows ☐ cracks ☐ dripping faucets ☐ other: _____ ☐ other: _____
Comments:	Classroom Award for meeting standards? ☐ Good But We Can Do Better ☐ Doing Great! ☐ Outstanding!
Auditors Signatures:	

Part 6: Action Planning

Based on the information you found out from this investigation, what recommendations do you have for the school to improve its energy use and conservation programs?

Explore the data you have collected from the classrooms and the whole school. It may be helpful to combine data into over all totals to help your Green Team analyze your data.

Possible Calculations:

- Average cost for lighting a classroom (to calculate, find the total watts in a classroom, and multiply that number by the number of hours the lights are on in a day and the number of days in a school year. Then divide this number by 1000 to determine kilowatt hours. Multiply the total kilowatt hours by your regions rate) :

  _____
- Average cost per classroom on heating and cooling per year (The national school average of energy usage for heating, cooling and ventilation is 66% of total energy costs. Find the total energy costs for your school per year and multiply this amount by the national school average of 66%): _____
- Total number of watts for appliances and equipment in the school: _____
- Average cost for powering a classroom (to calculate, total the cost per year and divide by the number of classrooms) :

  _____
- Percentage of energy efficient/energy star appliances and equipment currently being utilized in the school: _____
- Appliances and equipment that use the most energy:

  _____
- Total numbers of different types of light bulbs currently used in the school:
  - CFLs: _____
  - T12s: _____
  - T8s: _____
  - Incandescent: _____
  - Halogen: _____
  - HIDs: _____
  - LEDs: _____

What additional information from your investigation did you find that might have implications for your action plan:

Use your tracking data to demonstrate your program's success to administration, staff, students, and the public. Take advantage of tools and resources to convert hard-to-understand measurements, such as kilowatt-hours or tons of waste, into vivid equivalents - numbers of cars removed from the road or numbers of trees saved. This can also be an excellent classroom project for math and science students. Check the following websites for conversion tools: http://www.nerc.org/documents/environmental_benefits_calculator.html and www.environmentaldefense.org/papercalculator/

To develop your action plan, consider the following questions:

- What are your school's goals to reduce energy usage?
- What are the potential economic benefits of reducing school energy usage? How much do you estimate the school might save for each action item?
- What are the environmental and/or health benefits of reducing energy usage?
- How can you engage the broader school and community in setting goals?
- What are some potential strategies you might use to address those areas where your Green Team would like to make improvements?
- What resources (including funding) will your school need to implement strategies and where might your school obtain these resources?
- How can you engage students, school personnel, parents and community in helping to develop and implement these strategies?
- How can you encourage students to support your school's energy conservation goals at home? See the Leader Resource Section for more ideas.
- How can you share and celebrate your school successes with your local and state representatives?

The following template may be helpful to create an action plan for success!

Energy Action Plan School Name: Energy Goal:				Date:
Strategies	Resources Needed	Persons Responsible	Timeline	How will you measure, communicate and celebrate success?

Home Connections

There are many simple ways that you can save energy and money at home, including adjusting the heating or air conditioning thermostat, using compact fluorescent bulbs, caulking doors and windows to minimize drafts, lowering the setting of the water heater, turning off lights and appliances that are not in use and many more ideas! This Home Connection helps your family analyze energy usage practices in your home.

Family Name:_____ Student:_____ Teacher:_____

Heating and Cooling	**Yes**	**No**
Can the temperature of your thermostat be adjusted to conserve energy?		
Is your thermostat programmable so it can automatically adjust to day and night setting?		
If you have an outdoor air conditioning unit, is it in shade most of the day to help save energy?		
Are trees planted around the south side of the house to provide shade and a cooling effect in the summer?		
Are evergreen trees planted on the north and west sides of the house to serve as a windbreak and to prevent heat loss from the house in cooler months?		

General Thermostat Operation- Energy.gov

You can easily save energy in the **winter by setting the thermostat to 68°F while you're awake** and setting it lower while you're asleep or away from home. By turning your thermostat back 10° to 15° for 8 hours, you can save 5% to 15% a year on your heating bill.

In the summer, you can follow the same strategy with central air conditioning by keeping your house warmer than normal when you are away, and lowering the thermostat setting to 78°F (26°C) only when you are at home and need cooling.

A common misconception associated with thermostats is that a furnace works harder than normal to warm the space back to a comfortable temperature after the thermostat has been set back, resulting in little or no savings. In fact, as soon as your house drops below its normal temperature, it will lose energy to the surrounding environment more slowly. The lower the interior temperature, the slower the heat loss. So the longer your house remains at the lower temperature, the more energy you save, because your house has lost less energy than it would have at the higher temperature. The same concept applies to raising your thermostat setting in the summer -- a higher interior temperature will slow the flow of heat into your house, saving energy on air conditioning.

Lights		
Are there light fixtures where you could install compact fluorescent light bulbs to save energy?		
Do you turn off lights when you leave a room?		

Compact fluorescent light bulbs can save more than $40 in electricity costs over its lifetime. CFL's use about 75% less energy than standard incandescent bulbs and last up to 10 times longer. They also produce about 75% less heat, so it's safer to operate and can cut energy costs associated with cooling.

*****Fluorescent light bulbs must be disposed of properly because they contain very small amounts of mercury. For more information go to http:// www.epa.gov/bulbrecycling.**

Appliances		
Are radios, TVs, DVD players, computers and so forth turned off when not in use?		
Many appliances, such as TVs and DVD players that use remote controls are not really turned off when they are standby mode. They continue to use energy in the standby mode. Are those appliances plugged into a power strip or smart strip so they can easily be turned off?		
Phantom Loads- Energy.gov Many appliances carry a "phantom load." **A phantom load is any appliance or electronic device that uses energy even when it is turned off.** The "off" button on many appliances may not really mean "off," instead, it means "standby." Appliances with phantom loads are appliances with remote controls, such as TVs, DVDs, and audio equipment. They may have a continuous digital display, such as a clock. Other appliances with phantom loads include computers and printers. **Phantom energy load loss can be minimized by using a power strip.** Plug all components of a computer, TV, and so forth into the strip. Turn off the power strip with a single switch. Anything plugged into the strip now is truly turned off. **Another option is using a Smart Strip.** Smart power strips work to reduce your power usage by shutting down power to products that go into standby mode. They are a convenient option because when you powered off your TV via remote, it would turn everything truly off instead of in standby mode and you don't have to go turn off a power strip. Using these practices saves money for your home. Statistics vary, but experts say standby power consumption in average homes ranges from 5 percent to 10 percent of your household energy consumption. It can also account for about 1 percent of worldwide carbon dioxide emissions [source: Lawrence Berkley Nation Laboratory]. You can also unplug rarely used appliances.		
Windows and Doors		
Do you use weather stripping and caulking to reduce drafts around windows and doors?		
Water		
Is the hot water heater seat at a temperature that is warm enough to provide hot water, but not set so high that it wastes energy or could burn a child? **(120 degrees is the recommended setting for home hot water heaters).**		
Does the hot water heater have an insulated cover to help save energy?		
Do you wash clothes in cold water to save energy?		
Other Energy Saving Practices		
Do you clean the lint trap on the clothes dryer before using it to help it run more efficiently and save energy?		
Do you run the drying cycle on the dishwasher or let dishes air dry?		
Do you wait for a full load before running the dishwasher?		
Do you regularly service the heating and cooling units so they run more efficiently and save energy?		
Do you routinely clean or replace furnace and ventilation filters to increase efficiency and to reduce allergens in the air?		

For more Home Energy Savings Tips, visit: energy.gov and search the **Energy Savers Guide**. (http://energy.gov/energysaver/articles/energy-savers-guide-tips-saving-money-and-energy-home).

Part 5: Resources

General Links

- Contact the Kansas Association for Conservation and Environmental Education (KACEE at www.kacee.org) for local resource contacts.
- Kansas Green Schools for resources and contacts with other schools in the state (www.kansasgreenschools.org)
- Small Grants are periodically available for Kansas Green Schools energy projects at www.kansasgreenschools.org

Energy Investigation Useful Links

- http://www.energystar.gov/ia/business/challenge/learn_more/Schools.pdf: An **Overview of School Energy Use and Energy Efficiency Opportunities**. This information is provided by Energy Star, a government-back program that focuses on energy efficiency.
- http://www.epa.gov/climatechange/kids/index.html: This U.S. EPA **climate change website for kids** provides information on how simple actions can help our environment.
- http://www.eia.doe.gov/kids/: This **Energy Information Administration's Kids' Site** provides an explanation of the different kinds of energy, in addition to a wealth of other resources like energy-related links.
- http://hes.lbl.gov: The **Home Energy Saver website** provides an online home energy audit with tips, ideas, and tools to calculate your energy usage and emissions levels.
- http://www.eere.energy.gov/kids/: This is the **website for Kids Saving Energy** by the U.S. Department of Energy. It includes games, tips, and facts on saving energy.
- http://www.eere.energy.gov/kids/pdfs/EnergyActionList.pdf: This **poster by the U.S. Department of Energy** provides simple tips for saving energy at home.
- http://apps1.eere.energy.gov/consumer/your_home/appliances/index.cfm/mytopic=10040: This **U.S. Department of Energy website** provides information on how to estimate appliance and home energy use.
- http://www.need.org/needpdf/PlugLoads.pdf: **National Energy Education Development Project** has developed a lesson plan that is for intermediate and secondary grade levels and that teaches students a) how to investigate electricity consumption of various devices at their school and b) how to use the data collected to determine ways to reduce that consumption.
- http://www.epa.gov/bulbrecycling: This **U.S. EPA** website provides information on proper disposal of fluorescent light bulbs. Fluorescent light bulbs must be properly disposed because they contain very small amounts of mercury.

Energy Guides for Schools

- **Guide to Operating and Maintaining Energy Smart Schools**- http://apps1.eere.energy.gov/buildings/publications/pdfs/energysmartschools/ess_o-and-m-guide.pdf

- **Energy Star for K-12 School Districts-**www.energystar.gov/schools
  This U.S. Department of Energy guide provides detailed information for developing and implementing a district or school wide operations and maintenance program that focuses on energy efficiency.

Energy-Saving Tips for Schools

Following are some energy-saving tips that you can share with students. Many of these tips apply to energy use at both school and home.

Trees Save Energy

- Planting trees can help to save energy at school and at home. The U.S. Department of Energy reports that carefully sited trees can cut the average household's energy consumption by 25 percent.
- Strategically placed trees can be as effective as other energy saving improvements, such as insulation and the installation of weather-tight windows and doors. Trees help reduce heating and cooling costs.
- Trees save energy through shading in the hotter months. They provide a wind break during winter. The result is burning less fossil fuels to generate electricity for cooling and heating.
- Deciduous trees provide shade and block heat during hotter months. By dropping their leaves in the fall they admit sunlight in the colder months. Place these trees on the south and west sides of buildings.
- Shade all hard surfaces such as driveways and sidewalks to minimize landscape heat load.
- Use evergreens as windbreaks to save from 10 to 50 percent in energy used for heating. Evergreens offer the best benefits when they are placed to intercept and slow winter winds, usually on the north side of buildings. Do not plant them on the south or west side of your home, because they will block warming sunlight during the winter. These trees also provide some shading benefits during summer.

Maintaining HVAC Saves Energy

- HVAC (Heating, Ventilation, and Air Conditioning) systems are among the largest energy consumers in schools. Regular maintenance of the heating and cooling systems will save energy and money.
- HVAC filters should be replaced or cleaned every month during peak cooling or heating season. Changing filters improves efficiency and helps to reduce allergens in the air.

Phantom Energy Loads

- A "phantom load" is any appliance or electronic device that uses energy even when it is turned off. The "off" button on many appliances may not really mean "off," instead, it means "standby."
- Appliances with phantom loads are appliances with remote controls, such as TVs, DVDs, and audio equipment. They may have a continuous digital display, such as a clock. Other appliances with phantom loads include computers and printers.

- Phantom energy load loss can be minimized by using a power strip. Plug all components of a computer, TV, and so forth into the power strip. Turn off the power strip with a single switch. Anything plugged into the strip now is truly turned off.
- You can also unplug rarely used appliances.
- To check how much energy is being lost through phantom energy use in the classroom, leave appliances in the standby mode, plug them into a power strip, then plug the power strip into a watt meter. Finally, the watt meter gets plugged into a wall outlet. Leave the items plugged in for the school day or for 24 hours, whichever is more convenient for you. The watt meter gives a readout of how much electricity the items used during that time period. If you get the cost per kilowatt hour of electricity in your area (from the electric bill), you can calculate the cost of keeping those appliances in standby mode for a specific amount of time.
- The Energy Investigation materials section provides information on where to get a watt meter.

Vending Machine Misers

- A vending machine miser reduces the energy use of running vending machines that cool drinks and food. Because they reduce energy use, they can save the school money.
- Vending machine misers use a passive infrared sensor to determine when the surrounding area is vacant. When the area is vacant, the device powers down the machine to conserve energy.
- Free vending machine misers may be available from local power companies. In addition, schools can ask the companies that provide the vending machines to install the misers or put in newer vending machines that are more energy efficient.
- For more information on energy efficient vending machines and case studies, visit the following U.S. EPA website: http://www.energystar.gov/index.cfm?c=vending_machines.pr_vending_machines

Additional Energy Saving Tips for Schools

- Form a student energy patrol to educate others about how students can save energy at school and at home. The Energy Patrol can make sure that lights are off when rooms are empty, computer monitors are off when not in use, and computers are turned off at the end of the day. All computer equipment should be turned off at the end of the day and on weekends, unless the school's computer staff instructs otherwise.
- Students can check their classrooms to make sure that the airflow around heating and cooling vents is kept clear. This will prevent items from blocking and absorbing the warm or cool air coming into the room.
- Keeping windows and doors closed will help conserve heat (energy) in the classroom. The same is true when the air conditioning is on. When there is little difference between the outside and inside temperatures, open windows and doors will not have much effect on energy consumption.

Fact Sheet on Fluorescent Lights

What is a Fluorescent Light?
A fluorescent light consists of a glass tube coated on the inside with a fluorescent material. Mercury vapor in the tube emits ultraviolet radiation that is converted to visible light by the fluorescent material. Compact Fluorescent Lights (CFLs) contain an average of 4 milligrams of mercury sealed within the glass tubing. No mercury is released when the bulbs are intact (not broken) or in use. EPA recommends that CFLs be recycled to prevent mercury from being released if it is sent to a landfill and broken. The following U.S. EPA website has information on proper disposal/recycling of mercury- containing light bulbs:
http://www.epa.gov/epawaste/hazard/wastetypes/universal/lamps/index.htm

Why Should We Use Compact Fluorescent Lights? (CFLs)
Source U.S. EPA website:
http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf

According to the U.S. EPA, switching from traditional light bulbs (called incandescent) to CFLs is an effective, simple change that can be made to reduce the amount of electricity being used. ENERGY STAR qualified CFLs use up to 75 percent less energy (electricity) than incandescent light bulbs, last up to 10 times longer, and provide a quick return on investment. EPA estimates the U.S. is responsible for the release of 104 metric tons of mercury emissions each year. Most of these emissions come from coal-fired electrical power. Electricity use is the main source of mercury emissions in the U.S. CFLs use less electricity than incandescent lights, meaning CFLs reduce the amount of mercury into the environment.

Should You Turn Fluorescent Lights Off?
Some people think that fluorescent lights should be left on unless you will be leaving the room for a long time. With the newer technology of fluorescent lights, the initial power surge used to turn on the fluorescent light is so brief that its energy use is the equivalent of a few seconds or so of normal operation, according to estimates from the U.S. Department of Energy. There is, however, some wear and tear on the bulb from turning it on and off. So it may make the most sense to turn the fluorescent lights off when you are leaving the room for more than one minute.


Compact Fluorescent Bulbs


T12 Fluorescent Tubes


T8 Fluorescent Tubes


LED Fluorescent Tubes

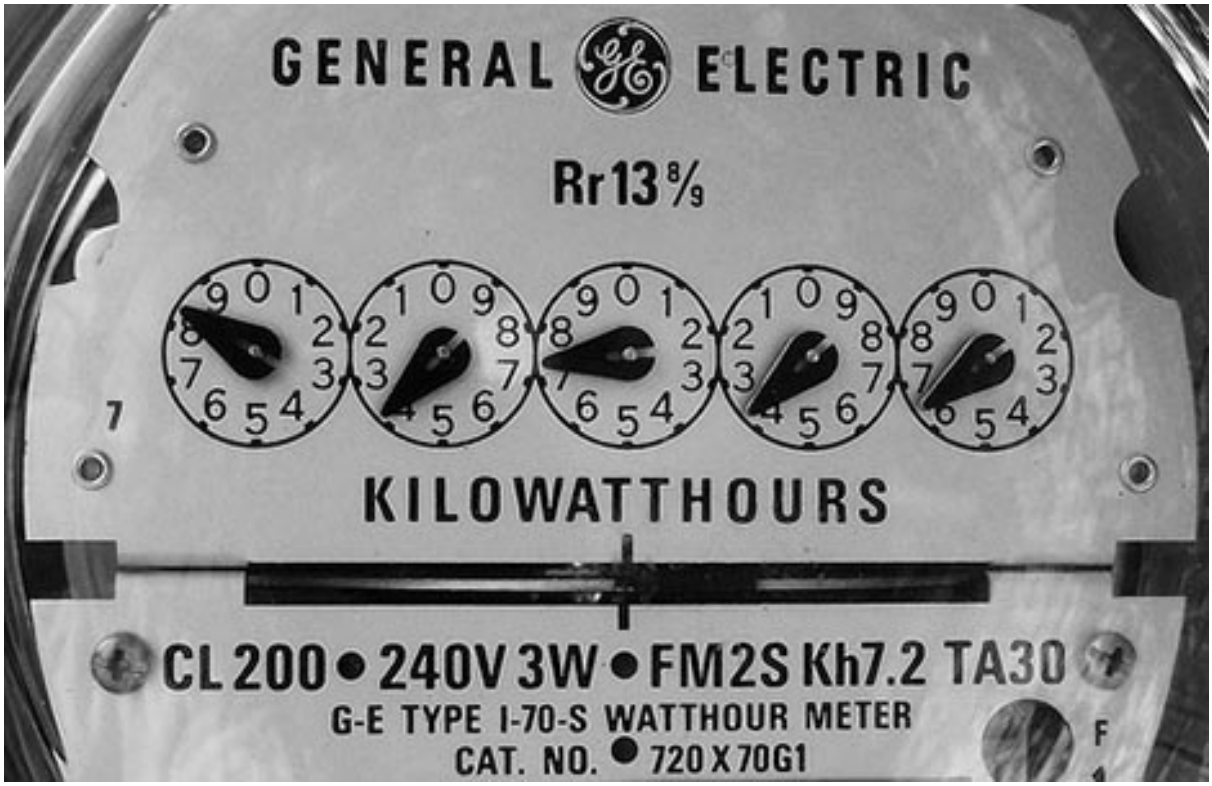

Incandescent


HiDischarge (HID)


Halogen Bulbs

Reading an Electric Meter

Many non-digital electric meters consist of four or five round dials. To determine the number of kilowatt-hours used, start by reading the dial on the right. If the dial lies between two numbers, record the smaller number. If the dial is between 9 and 0, you record 9. In the first example the dial is between 1 and 2. You record 1. Moving to the left, the next dial is between 3 and 4. You record the 3. (The dial is 1/10th of the way between the two numbers because the previous dial was on 1). You repeat this process for the remaining dials. The answer for the first meter is 4131. Next, work with the students to determine the second meter reading. Covering the answer, have the students work through each of the four dials to figure out the reading.



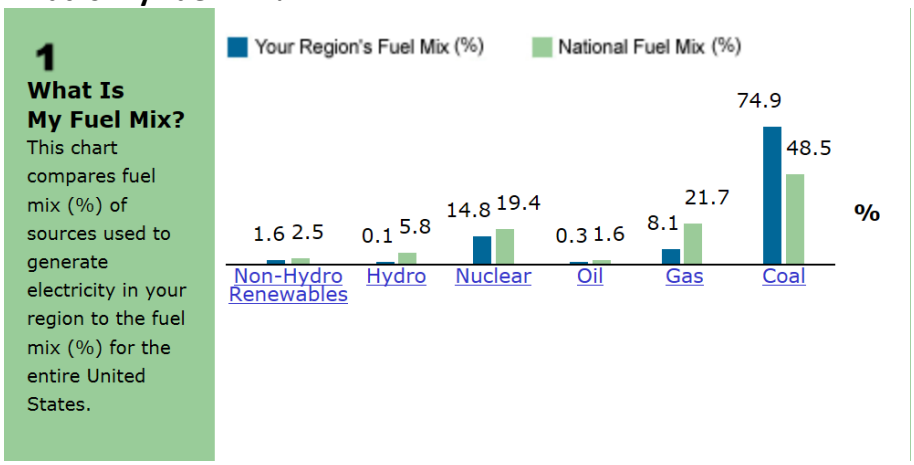
How to Find the Fuel Mix for Your School

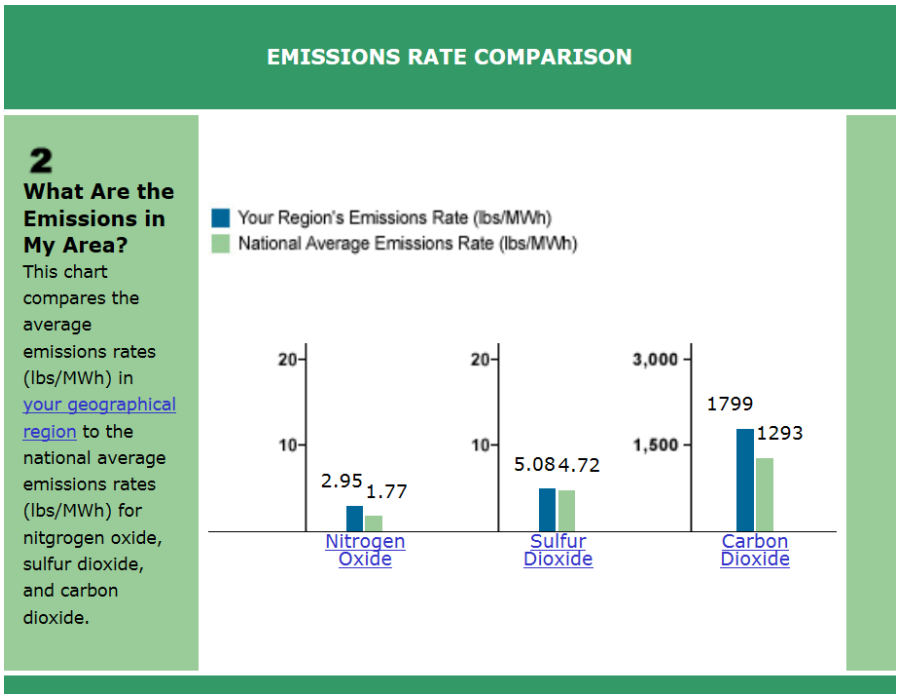
To find out the main sources of energy for your school, you can contact the electricity provider for your school (try the communications or media relations department). You can also try the following U.S. EPA website to find out your region's energy sources: http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html

Following is a sample page from the U.S. EPA's website that shows the fuel mix for the zip code area for 66502 (Manhattan, KS). The table below contains two charts:

- The first chart compares the fuel mix used to generate electricity in the zip code region of 66502 (Manhattan, KS) to the national fuel mix.
- The second chart compares the average air emissions rates in the zip code region of 66502 (Manhattan, KS) to the national average emissions rates.

What Is My Fuel Mix?





Part 6: Curriculum Connections

Student Reading Suggestion

- *Energy for Keeps: Electricity from Renewable Energy* by Educators for the Environment (2003). ISBN-10: 0974476501. Grades 6-12. This book provides information on how energy is produced, sources of energy, and different types of renewable energy. For a preview of this book and information for teachers, go to http://www.energyforkeeps.com/.
- *The Wind at Work: An Activity Guide to Windmills* by Gretchen Woelfle. Chicago Review Press; 1st edition (June 28, 1997). ISBN 1556523084. Grades 4-9. An introduction to windmills and their advantages as a renewable energy source; includes educational and fun wind-related activities.

Project Learning Tree Curriculum Connections- Energy

Project Learning Tree (PLT) has a variety of environmental education curriculum materials that support and enhance the *Kansas Green Schools* Energy Investigation. Educators may want to conduct one or more of the following PLT activities to prepare students for the investigation. Through these activities, students will learn energy terminology, why it is important to reduce energy use, and ways students can reduce energy use at school and at home.

Preschool – 8th Grade

Energy & Society Activity Guide

(Energy Education PreK-8; Available through workshops, see schedule at www.kacee.org/workshops)

#1 Energy Detectives

Students search their classroom for energy connections and record the ways they use energy throughout a typical day in an energy journal.

#2 May the Source Be with You

Students learn about various renewable and nonrenewable energy resources. They research one energy resource and create a poster that describes that resource in detail.

#3 Energy Chains

Students will identify the different forms of energy and construct an "energy chain" showing how different energy forms change.

#4 What Powers the Move?

Students will examine transportation systems vital to their community. They will identify transportation methods and design a future transportation system for their community.

#5 In the Driver's Seat

Students learn about gasoline, then explore fuel conservation and energy efficiency by simulating the distance they can travel on a set amount of gasoline using different vehicles.

#6 Energy Challenge Game

Students review energy concepts and information through the use of a game similar to *Jeopardy*.

***PLT's PreK-8 Environmental Education Guide*:**

(Project Learning Tree Environmental Education PreK-8 Guide; Available through workshops, see schedule at www.kacee.org/workshops)

#14 Renewable or Not?
Students learn the terms renewable, nonrenewable, recyclable, and reusable and then they discover why sustainable use of natural resources is important.

#36 Pollution Search
Students take a closer look at pollution: what it is, what its sources are, and what people can do about it.

#39 Energy Sleuths
Students learn about renewable and nonrenewable sources of energy, advantages and disadvantages to their use, and how energy is used in their daily lives.

#52 A Look at Aluminum
Students will learn about the sequence of steps that go into making aluminum products and participate in a service learning project to encourage aluminum recycling in their community.

#53 On the Move
Students compare various transportation methods for getting to and from school, and research transportation systems used in their community.

#55 Planning the Ideal Community
Students survey the area around their school to look for components of the human community in which they live. They then plan an ideal community that meets all the needs of its residents.

#57 Democracy in Action
Students learn about the roles and responsibilities of citizens' groups in environmental policies and decision-making.

#72 Air We Breathe
Students will learn about indoor air quality at home and at school, and ways that they can improve it.

#73 Waste Watchers
Energy seems easy to use, but obtaining it is often not easy on the environment. When we reduce the amount of energy we use, we decrease the pollution that results from producing that energy. In this activity, students conduct an audit of the energy they use in their own homes and create an action plan to reduce energy use.

#82 Resource-Go-Round
This activity gives students the opportunity to explore a variety of natural resources and products that people depend on every day. They learn about product life cycles, using a pencil as an example.

#84 The Global Climate
Students will learn about the relationship between carbon dioxide (CO_2) and the Earth's climate, and explore ways to reduce the amount of CO_2 they generate.

#85 In the Driver's Seat
Students keep a log of their family's transportation for a week, learn how petroleum is refined, and then explore fuel conservation and energy efficiency by simulating the distance they can travel using different vehicles.

#96 Improve Your Place
Students learn about the steps involved in developing a service learning project. They plan and conduct a project that focuses on making positive environmental changes in their community.

***PLT's Secondary Level Materials*:**
(Project Learning Tree Environmental Education; Available through workshops, see schedule at www.kacee.org/workshops)

#4 Neighborhood Design
Students explore the current design of their neighborhood, critically evaluate a variety of development options, and formulate ideas for guiding further change or growth in the neighborhood.

#7 Far-Reaching Decisions
Students develop graphic organizers and creative presentations to illustrate how individual decisions can affect the local environment, as well as distant communities. Students will also measure their own ecological footprint.