Energy Management for Schools…the Education Connection

Kentucky NEED Project

and

Kentucky Green & Healthy Schools Program

The Steps in a NEED Program

GETTING STARTED

Select the grade level-appropriate activities you will use for steps one through seven according to the diagram on page 4 and the detailed information in this booklet. Complete the order form provided by your workshop presenter or on page 23 of the NEED Resource Catalog and send to NEED.

STEP ONE: SCIENCE OF ENERGY

Students need to learn the science of energy before they can learn about the sources of energy, electric power production, and energy conservation and efficiency. Students learn the forms of energy (heat, light, motion, sound, electricity) and how energy is transformed from one form into other forms. Secondary students can extend their knowledge to thermodynamics. Several hands-on kits are available for sale or rental, such as the Primary, Elementary and Secondary Science of Energy Kits, EnergyWorks, and ThermoDynamics. In many areas, rental kits are available free of charge. Call NEED Headquarters at 1-800-875-5029 or ask your workshop presenter about availability in your area.

STEP TWO: SOURCES OF ENERGY

These materials give students an understanding of the energy sources used today—their formation, exploration, production, distribution, consumption, and economic and environmental trade-offs. NEED Infobooks provide comprehensive information on the major energy sources at four reading levels. Class sets of infobooks are available.

STEP THREE: ELECTRICITY

These materials provide students with information and hands-on explorations of the scientific concepts of electricity and electricity generation, transmission, and efficient use of electricity. NEED Infobooks provide background information on electricity. An ElectroWorks Kit with Teacher and Student Guides is available.

STEP FOUR: TRANSPORTATION FUELS

Students learn about the transportation sector of the economy, conventional and alternative fuels, and fuels of the future.

STEP FIVE: ENERGY EFFICIENCY AND CONSERVATION

Students learn how energy is used, new energy efficient technologies, and ways to conserve energy at home and at school. School Energy Surveys and Energy Management Kits are available for all grade levels.

STEP SIX: SYNTHESIS, REINFORCEMENT, EXTENSION

There are many hands-on activities available to reinforce, synthesize, and extend the information the students have learned. Also available are activities for students to teach others what they have learned.

STEP SEVEN: EVALUATION

Most NEED activities contain evaluation strategies. This blueprint contains a Unit Exam with multiple choice questions and essay questions that require students to draw upon their knowledge of energy to write an explanation or suggest a plan of action and can be done in teams and/or individually. The Energy Polls are additional evaluation tools included in this booklet.

STEP EIGHT: RECOGNITION

The Youth Awards Guide (in Projects and Activities) gives you all the information you need to document your energy activities in a scrapbook and to participate in the Youth Awards Program for Energy Achievement.

Green & Healthy Schools

A new and voluntary effort to empower students and staff with the tools needed to take action and make their school operate at peak efficiency.

Nine Inventories

- Energy
- Health & Safety
- Solid Waste
- Green Spaces
- Indoor Air Quality
- Transportation
- Hazardous Chemicals
- Water

Step One

The Science of Energy

Students investigate the forms of energy and energy transformations.

SECONDARY SCIENCE OF ENERGY

SCIENCE OF ENERGY

GRADE LEVEL
8–12

SUBJECT AREAS
Science
Math
Language Arts
Public Speaking

This booklet includes hands-on experiments that students use to teach themselves and others about forms of energy and energy transformation.

NEED
2006-2007
Putting Energy into Education

NEED Project P.O Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

FORMS OF ENERGY

All forms of energy fall under two categories

POTENTIAL

Potential energy is stored energy and the energy of position (gravitational).

CHEMICAL ENERGY

Chemical energy is the energy stored in the bonds of atoms and molecules. Biomass, petroleum, natural gas, propane and coal are examples of stored chemical energy.

NUCLEAR ENERGY

Nuclear energy is the energy stored in the nucleus of an atom. It is the energy that holds the nucleus together. The nucleus of a uranium atom is an example of nuclear energy.

STORED MECHANICAL ENERGY

Stored mechanical energy is energy stored in objects or substances by the application of a force. Compressed metal springs and stretched rubber bands are examples of stored mechanical energy.

GRAVITATIONAL ENERGY

Gravitational energy is the energy of place or position. Water held in a reservoir behind a hydropower dam is an example of potential gravitational energy. When the water in the reservoir is released to spin the turbines, it becomes motion energy.

KINETIC

Kinetic energy is motion. It is the motion of waves, electrons, atoms, molecules and substances.

RADIANT ENERGY

Radiant energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Solar energy is an example of radiant energy.

THERMAL ENERGY

Thermal energy (or heat) is the internal energy in substances. It is the vibration and movement of atoms and molecules within substances. Geothermal energy is an example of thermal energy.

MOTION

The movement of objects or substances from one place to another is motion. Wind is an example of motion energy.

SOUND

Sound is the movement of energy through objects or substances in longitudinal (compression/ rarefaction) waves.

ELECTRICAL ENERGY

Electrical energy is the movement of electrons. Lightning and electricity are examples of electrical energy.

Lab Safety Rules

E SAFETY

- ☐ Always wear safety glasses when performing experiments.

E SAFETY

- ☐ Do not heat any substance or piece of equipment unless specifically instructed to do so.
- ☐ Be careful of loose clothing. Do not reach across or over a flame.
- ☐ Always keep long hair pulled back and secured.
- ☐ Do not heat any substance in a closed container.
- ☐ Always use the tongs or protective gloves when handling hot objects. Do not touch hot objects with your hands.
- ☐ Keep all lab equipment, chemicals, papers, and personal effects away from the flame.
- ☐ Extinguish the flame as soon as you are finished with the experiment and move it away from the immediate work area.

AT SAFETY

- ☐ Always use tongs or protective gloves when handling hot objects and substances.
- ☐ Keep hot objects away from the edge of the lab table—in a place where no one will accidentally come into contact with them.
- ☐ Do not use the steam generator without the assistance of your teacher.
- ☐ Remember that many objects will remain hot for a long time after the heat source is removed or turned off.

ASS SAFETY

- ☐ Never use a piece of glass equipment that appears cracked or broken.
- ☐ Handle glass equipment carefully. If a piece of glassware breaks, do not attempt to clean it up yourself. Inform your teacher.
- ☐ Glass equipment can become very hot. Use tongs if glass has been heated.
- ☐ Clean glass equipment carefully before packing it away.

EMICAL SAFETY

- ☐ Do not smell, touch, or taste chemicals unless instructed to do so.
- ☐ Keep chemical containers closed except when using them.
- ☐ Do not mix chemicals without specific instructions.
- ☐ Do not shake or heat chemicals without specific instructions.
- ☐ Dispose of used chemicals as instructed. Do not pour chemicals back into containers without specific instructions to do so from your teacher.
- ☐ Do not pour a chemical down the laboratory drain unless instructed to do so.
- ☐ If a chemical accidentally touches your skin, immediately wash the area with water and inform your teacher.

-DS Safety Sheets are included for all chemicals in the kits as well as the products of all chemical reactions.

ntact Safety: The solutions contained in the lightsticks are nontoxic and will not cause injury to the skin or eyes. contact may cause temporary discomfort similar to that produced by soaps or shampoos. Should a lightstick ture, rinse the affected area thoroughly with water, then repeat the process. The solutions can soften or mar paint l varnish, and can stain fabric. If you have any concerns about possible allergic reactions or sensitivities, please k with Omniglow's medical emergency contact at 1-800-228-5535, ext. 162.

Step Two

Sources of Energy

Students investigate traditional energy sources and alternative sources including wind and solar.

Energy Roundup

This activity is a good way to introduce energy sources OR as a way reinforce students' knowledge of our nation's leading sources of energy.

Introduction: Students will be given the name of one energy source and will have to find the poster identifying that source.

Reinforcement: Students are instructed to number a piece of paper from 1- 10. They will read the clues on each poster and identify the energy source.

FORMS & SOURCES OF ENERGY

1. Write the form of energy—the form in which the energy is stored or delivered—for each source on the line to the right of the source.

RENEWABLE

Biomass	chemical
Hydropower	motion
Geothermal	thermal
Wind	motion
Solar	radiant

NONRENEWABLE

Petroleum	chemical
Natural Gas	chemical
Coal	chemical
Uranium	nuclear
Propane	chemical

2. What percentage of the nation's energy is provided by each form of energy? By renewables? By nonrenewables?

Chemical	88.2%
Nuclear	8.2%
Motion	3.15%
Thermal	.35%
Radiant	.1%

Renewables	6.9%
Nonrenewables	93.1%

U.S. Energy Consumption by Source 2006

PETROLEUM 38.8%
nonrenewable
transportation, manufacturing

BIOMASS 3.3%
renewable
heating, electricity, transportation

COAL 22.6%
nonrenewable
electricity, manufacturing

HYDROPOWER 2.9%
renewable
electricity

NATURAL GAS 21.6%
nonrenewable
heating, manufacturing, electricity

GEOTHERMAL 0.35%
renewable
heating, electricity

URANIUM 8.2%
nonrenewable
electricity

WIND 0.25%
renewable
electricity

PROPANE 1.9%
nonrenewable
manufacturing, heating

SOLAR 0.1%
renewable
light, heating, electricity

Step Three

Electricity

Activities to help students explore how electricity is produced and the economic and environmental impacts of production. Students investigate local, state, national and global issues.

Electric Connections

U.S. ELECTRIC POWER GENERATION SOURCES

Name	Statistics	Rank	Your Rank	Error Points	Group Rank	Error Points
Biomass	In 2004, biomass produced 60 billion kilowatt-hours of electricity, 1.5 percent of the nation's total. Biomass energy is usually the result of burning wood waste, landfill gas, and solid waste.	5				
Coal	Ninety-two percent of the nation's coal is consumed by electric utility companies to produce electricity. In 2004, coal produced 1,976 billion kilowatt-hours of electricity, which was 50 percent of the nation's electricity.	1				
Geothermal	In 2004, geothermal power plants produced 15 billion kilowatt-hours of electricity, chiefly from facilities in the western U.S. Geothermal energy produced less than one percent of the nation's electricity.	7				
Hydropower	Five–10 percent of U.S. electricity is generated by 2,000 hydro dams nationwide. Hydro plants produced 262 billion kilowatt-hours of electricity in 2004. It is the leading renewable energy source used to provide electricity.	4				
Natural Gas	Natural gas produced 715 billion kilowatt-hours of electricity in 2004, generating 18.1 percent of the nation's electricity. Approximately one-half of this natural gas is used by gas turbines to provide electricity during peak hours of demand.	3				
Petroleum	Petroleum provided 3.0 percent of U.S. electricity, generating 118 billion kilowatt-hours of electric power in 2004.	6				
Propane	There are no statistics available for propane's contribution to electrical production. Very little propane, if any, is used to produce electricity.	10				
Solar	Solar energy provided less than one percent of U.S. electricity in 2004, amounting to 0.3 billion kilowatt-hours of electricity. Electricity was generated by solar thermal systems or photovoltaics.	9				
Uranium	One hundred nuclear power plants provided the nation with 20.3 percent of its electrical energy needs in 2004. Nuclear energy produced 789 billion kilowatt-hours of electricity.	2				
Wind	Wind energy produced almost 10 billion kilowatt-hours of electricity in 2004. Wind provided less than one percent of the nation's electricity. Most of the wind generated electricity is produced in California.	8				

Error Points Totals _____ _____

Error points are the absolute difference between your ranks and EIA's (disregard plus or minus signs).

Source: Energy Information Admininstration–2004

Scoring:				
0-12	Excellent	13-18	Good
19-24	Average	25-30	Fair
31-36	Poor	37-42	Very Poor

ENERGY FLOW Activity

Adapted from *Cool Coal Story* found in NEED's Primary Stories and More

Students will demonstrate the flow of energy to produce electricity using props.

Depending on the audience, signs with the different forms of energy can be used by the students to identify the energy transformations. This activity can also be used to demonstrate other energy flows, re: biodiesel, ethanol, natural gas, etc.)

Sun - Nuclear Fusion – produces energy (PROP: Yellow Ball – 1 student)

Radiant Energy – Nuclear energy in the sun is transformed to radiant energy and travels through space to earth. Radiant energy travels in WAVES.

(PROP: Long pieces of yellow ribbon, 3-4 students 'wave' them in the air.)

Chemical Energy - Radiant energy is absorbed by green plants and through photosynthesis converts radiant energy to chemical energy.

(PROP: Green Plants - I use 'silk' leaves)

Stored Chemical Energy - Green plants die and are compressed under extreme pressure over a LONG period of time and become COAL. Chemical energy is stored in the coal.

(PROP: Students step on leaves)

Coal is mined and taken to a power plant. (Additional details may be added if desired)

(PROP: pieces of coal OR wads of black construction paper)

Thermal Energy - Coal is burned in the furnace. Stored chemical energy produces thermal energy.

(PROP: empty box simulates furnace)

The thermal energy heats the water - water becomes steam.

(PROP: hot pot or bottled water)

Steam travels down pipes (plastic tubing) to the turbine.

(PROP: connect tube to container of water used above)

Motion/mechanical energy - Steam causes the turbine blades to spin

(PROP: student stands with arms outstretched and bent upwards at the elbow OR use blades from kid wind activity – student 'spins' when steam hits the blades)

Electrical Energy - The turbine is connected to the generator - causing the magnets to spin around the copper coils - producing electrical energy.

(PROP: three students hold bar magnets, one student is 'wrapped' in copper colored ribbon or wire. Students with magnets 'spin' around copper wire.)

Electrical energy travels down the power lines to our homes.

(PROP: Use a twisted rope to designate high voltage lines and then pull away the smaller pieces to designate the low voltage lines that come into our homes.)

Electrical energy powers our homes. When the demonstration is complete, pull the chain on the light bulb and it comes on.

(PROP: Use a 'magic' light bulb that is connected to a piece of extension cord or one of the "as seen on TV" bulbs. Some magic shops have 'magic' light bulbs.)

VARIATIONS: Other energy flows can be demonstrated, substituting them for the coal.

Step Four

Transportation

Activities to introduce students to alternative transportation vehicles and fuels. Topics such as biodiesel, ethanol and others are explored. Students investigate economic and environmental impacts of our transportation choices.

Step Five

Energy Efficiency

&

Conservation

Students and teachers explore ways to reduce energy consumption in their school, learning how energy behaviors can and do make a difference.

School Energy Costs

For most school districts, energy costs are the second highest budget item.

Energy Management

NEED's hands-on units explore energy consumption and conservation using the school as a real-world laboratory.

Activities that encourage and support…

- cooperative learning
- math
- science
- art
- language arts
- critical thinking skills

Building Buddies

For Primary Students

- Energy sources
- Energy conservation at home and school
- Energy efficiency and conservation

Monitoring and Mentoring

For Intermediate Students

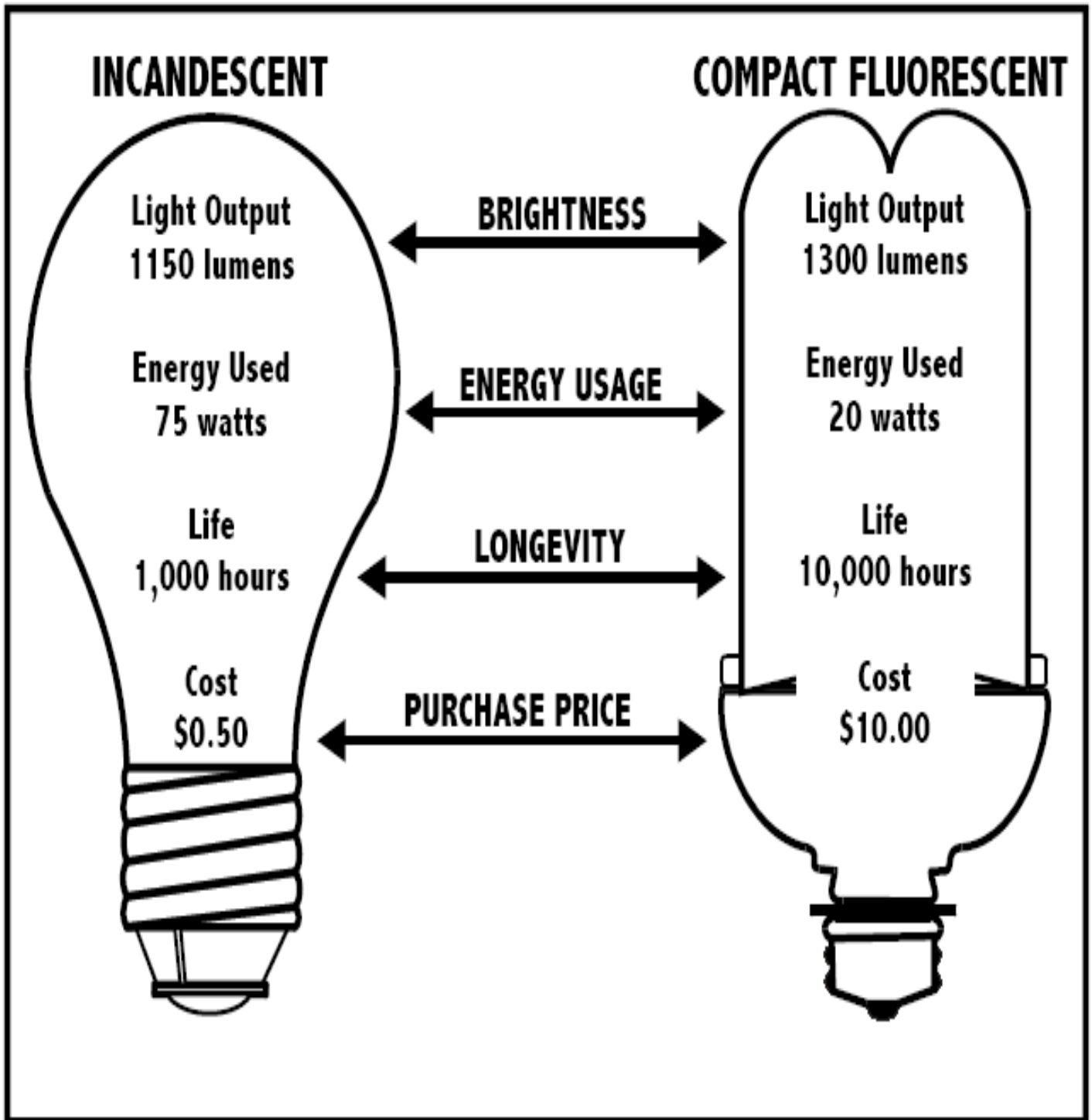
- Monitor energy use
- Mentor younger students
- Promotes changes in behavior that encourage wise energy decision making

Learning and Conserving

Secondary Students

- Gather data from appliance and machines
- Monitor energy usage in the school
- Read EnergyGuide Labels

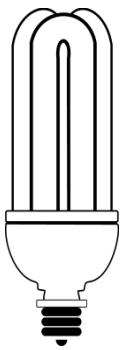
What do the numbers on a light bulb box tell us?



Do the Math!

$5.00 + $80.00 = $85.00

Cost of bulbs + Cost of electricity = Life Cycle Cost



$4.00 + $25.00 = $29.00

Cost of bulb/s + Cost of electricity = Life Cycle Cost

85.00 - $29.00 = $56.00

Incandescent Life Cycle Cost - CFL Life Cycle Cost = Total Potential Life Cycle Saving

Take the ENERGY STAR **Change a Light** Pledge

Change just one light and see how a small step can make a big difference.

Change a Light, Change the World

NEED Teacher's Guide

"I pledge to do my part to save energy and help protect our environment by changing a light in my home to an ENERGY STAR qualified one."

Change a Light, Change the World Pledge

"I'll do my part to save energy resources and help protect our environment by changing a light to one that's earned the government's ENERGY STAR® for energy efficiency."

☐ • Check this box to verify that you are over the age of 13. ENERGY STAR asks that a person be thirteen years or older to take the pledge. If you are under age 13, please ask a parent or guardian to complete the pledge for you.

(*) Indicates a required field

Print Name*_____

Zip*_____ Email*_____

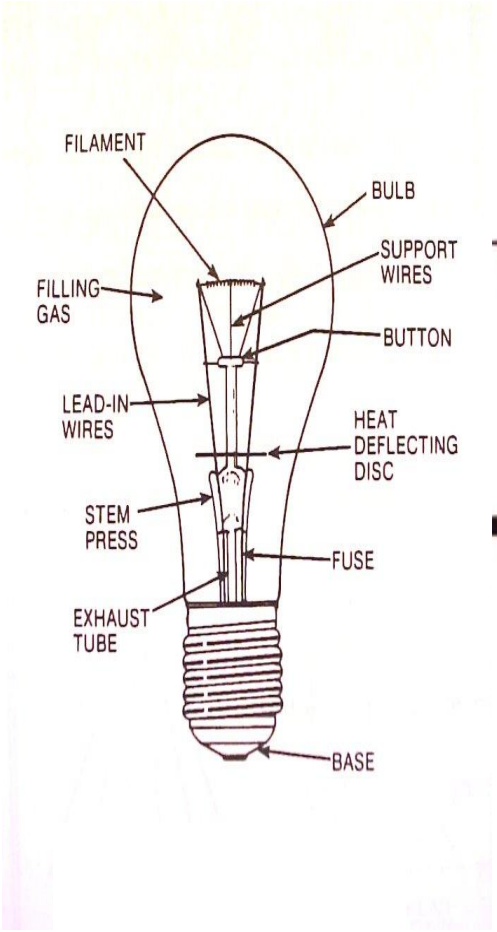
PRIVACY DISCLAIMER: Your identifying information will be used only for the purposes of the ENERGY STAR® Change a Light Pledge. This information will never be provided or sold to third parties.

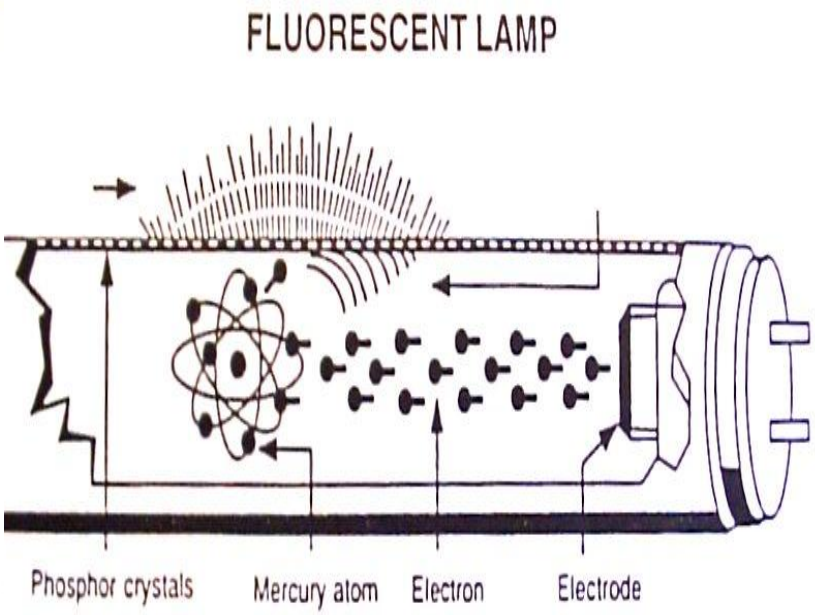
CHANGING A LIGHT IS A SIMPLE STEP WE CAN EACH TAKE TO PRESERVE ENERGY RESOURCES, SAVE MONEY AND HELP PROTECT OUR ENVIRONMENT.

Products that earn the ENERGY STAR® prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE A LIGHT
CHANGE THE WORLD
ENERGY STAR®

Lighting
Incandescent
vs
Compact Fluorescent





Compact Fluorescent

The Flicker Checker

Fluorescent lights with electronic ballasts will produce a pattern like this.

RECOMMENDED LIGHT LEVELS

Below is a list of recommended illumination levels for school locations in footcandles.

AREA	FOOTCANDLES	TYPE OF LIGHTING
Classrooms-general	50-75	Fluorescent
Classrooms-art	50-75	Fluorescent
Classrooms-computer	50-75	Fluorescent (indirect)
Classrooms-drafting	75-100	Fluorescent
Classrooms-sewing	75-100	Fluorescent (task lighting)
Labs-general	50-75	Fluorescent
Labs-demonstrations	100-150	Fluorescent (task lighting)
Auditorium seating areas	10-15	Fluorescent
Auditorium concerts on stage	50-75	Fluorescent
Kitchens	50-75	Fluorescent
Cashiers	20-30	Fluorescent (task lighting)
Dishwashing areas	20-30	Fluorescent
Dining areas	10-20	Fluorescent
Corridors & stairwells-elem	10-15	Fluorescent
Corridors & stairwells-middle	20-30	Fluorescent
Corridors & stairwells-high	20-30	Fluorescent
Gymnasiums	20-30	Metal Halide/Fluorescent
Media centers	50-75	Fluorescent
Offices	75-100	Fluorescent
Teacher workrooms	30-50	Fluorescent
Conference rooms	30-50	Fluorescent
Washrooms	20-30	Fluorescent
Building exteriors & parking lots	1-2	Sodium/Metal Halide

Thermostat Settings

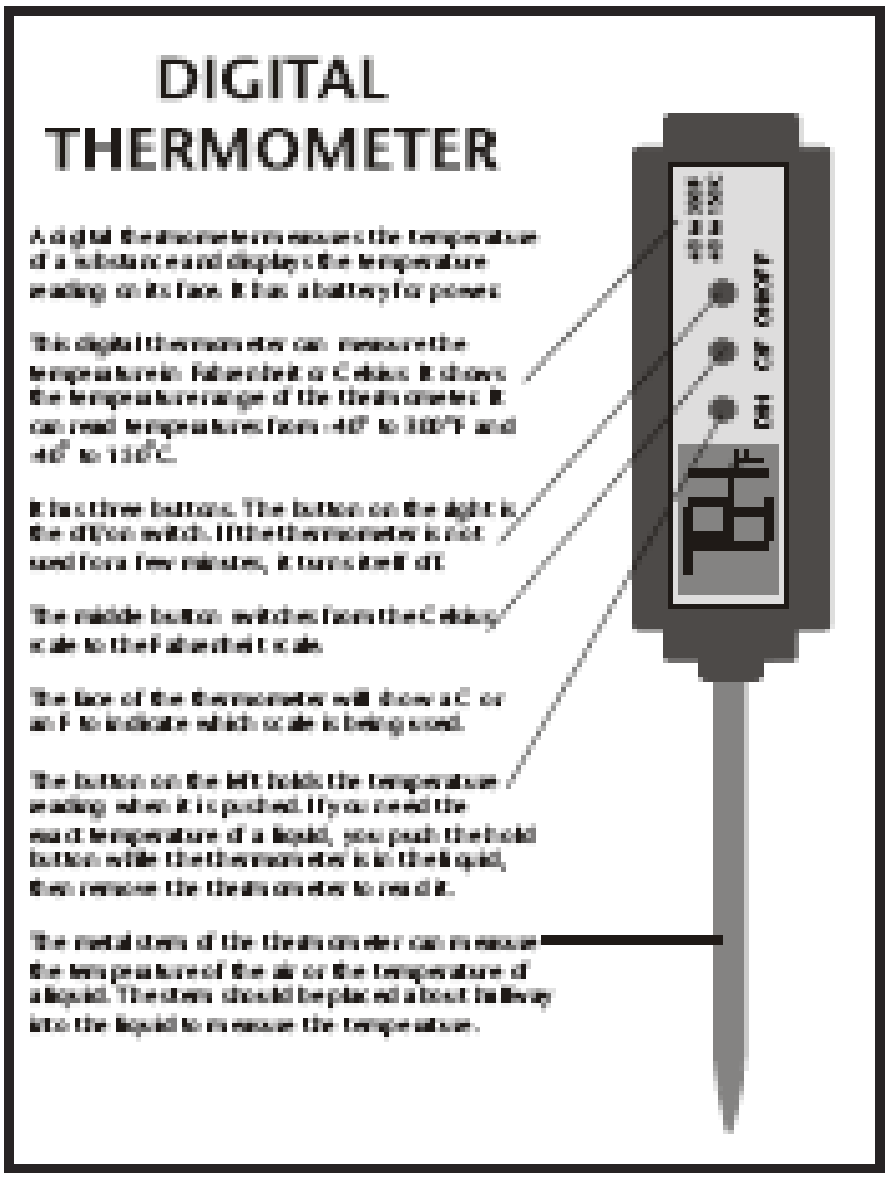
Cooling season

76° - 78°

Heating season

66° - 68°

Digital Thermometer



Doors and Windows

It’s only a LITTLE crack…but

Weather-stripping???

A pair of exterior doors with no weather-stripping can easily have an opening of ¼” where the doors meet.

While this doesn’t look or sound Like much….this would add up to the same space in a 16 inch hole!

Kill A Watt Meter

Measures energy consumption

FRONT BACK

CLOSE-UP

Phantom Loads

Many modern appliances consume electricity whenever they are plugged in even if the switch says OFF!

Items such as:

- **mobile phone chargers**
- **instant-on features**
- **appliance clocks**
- **wall cubes (black boxes)**
- **VCR**

Recording Form

DATE:

TIME:

Common Area # _____

Number of Windows	_____		
Indoor Temperature	_____		
Relative Humidity	_____		
Light Meter Reading	_____		
Is there a thermostat?		Yes	No
Are there adjustable vents?		Yes	No
Are there adjustable lights?		Yes	No
Are the lights on?	No	Some	All
Are the windows open?	No	Some	All
Are the blinds closed?	No	Some	All
Are doors tightly closed?	No	Some	All

List the electrical appliances that are turned on. Are they in use?

Other Comments:

DATE:

TIME:

Non-Class Room # _____

Number of Windows	_____		
Indoor Temperature	_____		
Relative Humidity	_____		
Light Meter Reading	_____		
Hot Water Temperature	_____		
Is there a thermostat?		Yes	No
Are there adjustable vents?		Yes	No
Are there adjustable lights?		Yes	No
Are the lights on?	No	Some	All
Are the windows open?	No	Some	All
Are the blinds closed?	No	Some	All
Are the faucets dripping?	No	Some	All

List the electrical appliances that are turned on. Are they in use?

Other Comments:

Talking Trash

Elementary Students explore the relationship between trash and energy by constructing and presenting exhibits on different aspects of trash such as reducing, recycling, landfilling and incineration.

Museum of Solid Waste & Energy

A cooperative learning activity where students work together in small groups to:

- **study solid waste and energy topics**
- **create ‘museum’ stations**
- **enhance reading, writing, public speaking and artistic skills**

Students CAN make a difference!

Students can help reduce energy costs by addressing energy consumption in the school and at home.

Students CAN help facilitate an energy management program for your school.

Students CAN help their families reduce energy consumption.

Step Seven

Evaluation

NEED Energy Poll

Energy Poll Guide

GRADES: 1–12 (FOUR READING LEVELS AVAILABLE)
PREPARATION: LOW
TIME: 20 MINUTES

A QUICK LOOK AT THE ENERGY POLLS

The Energy Polls can be used to assess students' basic energy knowledge, as well as their opinions about energy, before and after your classroom energy unit. There are polls on four reading levels—Primary (Grades 1-3), Elementary (Grades 4-5), Intermediate (Grades 6-8), and Secondary (Grades 9-12).

The polls are also available on the NEED website, www.need.org, where the results will be compiled for you. NEED requests that everyone who has the computer capability use the web-based polls. The polls are designed as a valuable evaluation tool for the NEED program, as well as for your classroom program. Call 1-800-875-5029 or email NEED at info@need.org if you have questions about the web-based polls.

GET READY IF NOT USING WEB-BASED POLLS

Choose the applicable poll for the reading level of your class. Make one copy of the poll for each student. If you prefer, you can make one transparency of the poll and have the students answer the questions on a piece of paper. In either case, keep the results of the pre-poll so that students can compare their answers after your energy unit.

GO

Direct the students to take the poll as honestly as possible and not to make wild guesses. Explain that the poll will be an important assessment tool to show what they have learned and how their attitudes have changed.

Once you have administered the poll, go over the answers with the students. As a supplemental activity, discuss and chart the answers to the opinion questions. Collect the answers and save them to use after your energy unit is completed.

Step Eight

Recognition

NEED Youth Awards for Energy Achievement

Kentucky Green & Healthy Schools

May 19, 2009

Frankfort, KY

NEED

Youth Awards for Energy Achievement

June 26 – 29, 2009

Hyatt Regency

Crystal City, VA

Kentucky NEED Energy Tour for Educators

June 8 – 12, 2009

5-day tour of Western Kentucky

All Expenses Paid

Travel on Tour Bus

Meet KY Energy Professionals

LOTS of RESOURCES!

Energy Conference for Educators

July 19 – 23, 2009

Nashville, TN

*** Limited number of scholarships available**

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