



School Energy Audit Lights Out

Schools use a lot of electricity for lighting. In Saskatchewan, almost 80% of our electricity is generated by burning fossil fuels, which contribute to climate change. The purpose of this audit is to determine which lights are on when not needed, and to help you calculate greenhouse gas emission reductions from turning out unneeded lights.

There are two ways to save lighting energy:

Behaviour (or, the things we do):

- use natural light, like windows
- only turn on the number of switches needed to light the room, and
- turn out lights when you leave the room.

Technology (or, the stuff we use):

- determine the power used by classroom light bulbs, and
- change out inefficient bulbs to LED's.

Note: This audit is detailed. If you want a simpler version, try the [Lights Half Off Campaign](#). For younger students the teacher or SES can do the calculations for your audits.

Pre-Audit (Use the chart on page 4)

Using your lights as normal for 3 days, record how lighting is used in each room you audit. Make a copy of the chart for each room.

Note: In the example chart on page 3, students divided the day into periods that fit their instruction and recess times.

- Decide which rooms you want to check,
- Decide when, and how often you want to check classrooms, and
- Be consistent in your pre and post audits in order to get accurate results.

POWER: How much power does each light use?

- In the chart, mark how many lamps (lights bulbs) are controlled by each switch.
- Check with the caretaker if you aren't sure what kind of lights are in your classroom.
 - Most schools have T8 fluorescent bulbs, which use **30W** each.
 - Some schools have more efficient LED lights. If you have LED lights and your caretaker doesn't know how much power they use, assume **17W** per tube.
- If you have lamps and other task lighting, look on the bulb, somewhere it will have a number, followed by W (E.g. 60W)



TIME: How long is the light on?

How long is each switch on each day? Write that in the **Day** column. It's hard to know exactly when the lights are off and on unless you are in the room all the time. Check at the same times every day.

- Add up the time for each switch and write it in the **Total Time** column.
- Add up the time for each day you checked and write it at the bottom of the total time column. That is the total number of hours that lights are on in the room for the days you checked.

ENERGY: How much energy does each classroom use?

- In the energy column, multiply the Power by the Total Time, and divide by 1000. That gives you the energy used in kWh (kilo Watt hours).
- Add up the energy used by each switch and write it at the bottom of the Energy column. That is the total energy used by the lights on the days you checked.

$$\begin{aligned}\text{Energy} &= \text{Power} \times \text{Time} \\ \text{Energy} &= \text{Watts} \times \text{hours} = \text{Wh} \\ \text{Wh} \div 1000 &= \text{kWh}\end{aligned}$$

“kWh” means kilo Watt hour. A kilo Watt hour is 1000 Watt hours. (1kWh = 1000Wh)

Repeat this for each room you audit.

- Then add up the total number of hours lights are on in all rooms you checked.
- Add up the energy used by the lights in the rooms you checked.

Lights Out Audit Chart (pre audit example)

Room (name or number)	Power (Watts) (W)	Day 1 (hours) √ if switch is on for each time period	Day 2 (hours) √ if switch is on for each time period	Day 3 (hours) √ if switch is on for each time period	Total Time (hrs)	Energy = Power x Time (W x hrs) ÷ 1000 = kWh
Example – Grade 5 Mr. D.	Switch 1 20 lamps 30W x 20 = 600W	1 st / 9:00-10:30 1.5hrs √	√	√	Total = 6.5hrs + 6hrs + 5.25hrs = 17.75hrs	600W x 17.75hrs = 10,650Wh 10,650Wh ÷ 1000 =10.65kWh
		Recess/10:30- 10:45 ¼ hr. √				
		2 nd / 10:45-12:00 1 ¼ hrs √	√	√		
		Lunch/12:00- 12:45 ¾ hr √	√			
		3 rd /12:45-2:15 1.5hrs. √	√	√		
		Recess/2:15-2:30 1/4hr √				
		4 th /2:30-3:30 1hr. √	√	√		
		Total = 6.5hrs	Total = 6hrs	Total = 5.25hrs		
Switch 2 5 lamps 30W x 5 = 150W	√	√	√	Total = 1.5hrs + 3.75hrs + 2.25hrs = 7.5hrs	150W x 7.5hrs = 1125Wh 1125Wh ÷ 1000 = 1.13kWh	
	-	√	-			
	-	-	-			
	-	√	√			
	-	-	-			
	-	√	--			
	-	√				
	Total= 1.5hrs	Total = 3.75hrs	Total = 2.25hrs			
Switch 3 Only 2 switches in this room	-	-	-	Total = 0 hrs	0	
	-	-	-			
	-	-	-			
	-	-	-			
	-	-	-			
	-	-	-			
	-	-	-			
	0	0	0			
Totals					25.25hrs	11.78kWh

Lights Out Audit Chart (copy one for each room)

Room (name or number)	Power (Watts) (W)	Day 1 (hours) √ if switch is on for each time period	Day 2 (hours) √ if switch is on for each time period	Day 3 (hours) √ if switch is on for each time period	Total Time (hrs)	Energy = Power x Time (W x hrs) ÷ 1000 = kWh
	Switch 1					
		Total	Total	Total		
	Switch 2					
	Total	Total	Total			
	Switch 3					
	Total	Total	Total			
Totals						



Taking Action

Use the information from your pre-audit to plan your actions.

- Energy = **Power** x **Time**. Knowing this, what are the two ways you can save energy with lighting?
- Do some light switches have more Watts of lighting than others? How could you use that information to help reduce energy use?
- Do all classrooms have windows? Are most classrooms keeping the blinds open during the day? Why or why not? How could natural lighting be used to reduce energy use? In your classroom, do you like working with the blinds open and lights off? Why or why not, and how can you use that in your campaign?
- How often did you find lights on in unoccupied rooms? Is it happening more in some rooms than in others?
- What do you want others to do, and how will you give them that information? Posters, presentations, newsletter items?
- **Action at home:** How can you apply what you've learned in this audit at home? If you switch from incandescent lighting to LED lighting at home, how will that affect your energy use?

Post-Audit: (use the chart on page 4)

For your post audit, go back to the same rooms at the same times, and check how lights are being used. Record the information on your chart. **Important:** Check the lights at the same times of day as you did for your pre-audit.

Compare how lights were used in each room before and after taking action.

Time Saved:

- Total time of pre-audit – total time of post-audit
= The lighting hours you have saved.

Energy Saved:

- Total energy of your pre-audit – total energy of your post-audit
= The energy you have saved.

Calculate the cost of the lighting energy saved

How much money will you save?

At school we pay about 13 ¢/kWh (\$0.13/kWh) for our electricity, including taxes.

Cost	=	Energy saved	x	Electricity rate
Cost	=	Energy (kWh)	x	\$0.13/kWh = \$



Action at home: At home, you pay about 16¢ for every kWh. If we turn out lights an extra 2 hours per day, we can save \$14/month, 600 kgCO_{2e}/year and 1000 kWh/year.

Calculate the greenhouse gas emissions reduced

In Saskatchewan, for every kWh we use, 0.6 kgCO_{2e} (kilograms of carbon dioxide equivalent) are released.

$$\text{Emissions} = \text{Energy saved} \times \text{Emission rate}$$
$$\text{Emissions} = \text{Energy saved (kWh)} \times 0.6 \text{ kgCO}_{2e}/\text{kWh} = \text{kgCO}_{2e}$$

Calculate how much energy, cost and greenhouse gas emissions you could save by reducing light use for a year. You reduced light use for 3 days. There are about 195 days in a school year.

$$\text{Annual Savings} = 3 \text{ day savings} \times 195/3$$
$$\text{Annual Energy Savings} = 3 \text{ day energy savings} \times 195/3 = (\text{kWh/year})$$
$$\text{Annual cost savings} = 3 \text{ day cost savings} \times 195/3 = (\$/\text{year})$$
$$\text{Annual greenhouse gas emission savings} = 3 \text{ day greenhouse gas emission savings} \times 195/3 = (\text{kgCO}_{2e} / \text{year})$$



Curriculum Connections

Grade 4 Physical Science: Outcome LI4.1 Investigate the characteristics and physical properties of natural and artificial sources of light in the environment.

LI4.2 Analyze how light interacts with different objects and materials to create phenomena such as shadows, reflection, refraction, and dispersion.

LI4.3 Assess personal, societal, and environmental impacts of light-related technological innovations including optical devices.

Social Studies: Outcome RW4.1 Analyze the strategies Saskatchewan people have developed to meet the challenges presented by the natural environment.

Mathematics: Outcome N4.1 Demonstrate an understanding of whole numbers to 10 000 (pictorially, physically, orally, in writing, and symbolically).

N4.2 Demonstrate an understanding of addition of whole numbers with answers to 10 000 and their corresponding subtractions (limited to 3 and 4-digit numerals)

N4.3 Demonstrate an understanding of multiplication of whole numbers (limited to numbers less than or equal to 10).

N4.4 Demonstrate an understanding of multiplication (2- or 3-digit by 1-digit)

N4.5 Demonstrate an understanding of division (1-digit divisor and up to 2-digit dividend) to solve problems

P4.1 Demonstrate an understanding of patterns and relations

Grade 5 Mathematics: Outcome N5.2 Analyze models of, develop strategies for, and carry out multiplication of whole numbers.

N5.3 Demonstrate, with and without concrete materials, an understanding of division (3-digit by 1-digit) and interpret remainders to solve problems.

N5.6 Demonstrate understanding of decimals to thousandths

P5.2 Write, solve, and verify solutions of single-variable, one-step equations with whole number coefficients and whole number solutions.

SP5.1 Differentiate between first-hand and second-hand data.

SP5.2 Construct and interpret double bar graphs to draw conclusions.

Grade 6 Physical Science: Outcome EL6.1 Assess personal, societal, economic and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts.

EL6.2 Investigate the characteristics and application of static electric charges, conductors, an insulators, switches and electromagnetism.

EL6.3 Explain and model the properties of simple series and parallel circuits.

Mathematics: Outcome: N6.3 Demonstrate understanding of the order of operations on whole numbers (excluding exponents) with and without technology.

N6.4 Extend understanding of multiplication and division to decimals (1-digit whole number multipliers and 1-digit natural number divisors).

P6.1 Extend understanding of patterns and relationships in tables of values and graphs.

SP6.1 Extend understanding of data analysis to include: line graphs; graphs of discrete data; data collection through questionnaires, experiments, databases, and electronic media;



interpolation and extrapolation.

Grade 7 Mathematics: Outcome: N7.2 Expand and demonstrate understanding of the addition, subtraction, multiplication, and division of decimals to greater numbers of decimal places, and the order of operations.

SP7.1 Demonstrate an understanding of the measures of central tendency and range for sets of data.

SP7.2 Demonstrate an understanding of circle graphs.

Grade 8 Life Science: Outcome OP8.1 Identify and describe, through experimentation, sources and properties of visible light including: rectilinear propagation, reflection, refraction.

Mathematics: Outcome: N8.5 Demonstrate understanding of multiplication and division of integers concretely, pictorially, and symbolically.

SP8.1 Analyze the modes of displaying data and the reasonableness of conclusions.