

Expeditions

IN YOUR CLASSROOM

for Common Core State Standards



Middle School Mathematics

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Project Skills Chart

Projects always challenge students to flex more than one mental muscle at a time and integrate skills they often see dissected and covered in discrete units of study. Use this chart as a reference to help you find the best project for your needs. The grade levels and domains the activities address are shown below.

Project	<i>Ratios and Proportional Relationships</i>	<i>The Number System</i>	<i>Expressions and Equations</i>	<i>Functions</i>	<i>Geometry</i>	<i>Statistics and Probability</i>
Energy Audit			6, 7			
Choosing How to Save	6, 7		6, 7			
How to Green Your School	6, 7					6, 7
Finding the Best Players						6
Changing Communities						8
Affording Fun			6, 7			
Hottest Jobs						8
Not As Hot As It Feels				8		6
Growing Gardens	6				6, 7	6
Building in Tens		6, 7			7	

Project Assessment Rubric

	% of grade	4 (Excellent)	3 (Good)	2 (Fair)	1 (Poor)
Knowledge and skills specific to project		Defines all key mathematical terms, with examples. Actively uses terms, methods, and skills and transfers them to other situations and contexts.	Defines majority of terms, with examples. Majority of skills are applied correctly. Sometimes transfers skills to other situations or contexts.	Definitions and explanations are confusing or incorrect. Some skills are used correctly.	There is no evidence of knowledge or skill development. There are few correct methods and few correct answers.
Mathematical knowledge		Work shows high-quality understanding of mathematical concept. Applications of knowledge are sophisticated and used consistently to support problem solving.	Work reflects solid mathematical knowledge. Applications are used to solve problems.	There is little evidence of mathematical understanding. Application of understanding is inconsistent.	There is no evidence of mathematical understanding.
Computation		Excellent use of computational skills. Understanding of numbers and operations clearly demonstrated. Problem solving is efficient. Student reviews work methodically for errors.	Uses computation skills. Understanding of numbers and operations is consistent. Student reviews work for errors.	Computation skills are inconsistent. Understanding of numbers and operations is inconsistent. Student sometimes reviews work for errors.	There are serious errors. There is little or no attempt to check work.
Mathematical thinking		Mathematical thinking is clearly presented and well reasoned. Shows creativity in applications of understanding.	Mathematical thinking is clear and presented in an organized way.	Mathematical thinking is vague. Organization is weak or inconsistent.	Mathematical thinking is unclear. There is little evidence of organization.
Reasoning and problem solving		Reasoning is sophisticated, logical, and well supported. Problem solving is efficient. Can demonstrate varied ways to solve a problem.	Reasoning is logical and well supported. Application of problem-solving skills is good.	Reasoning is weak and lacks supporting evidence. Problem solving is rote.	Reasoning is unclear. Steps in problem solving are erratic.
Final product		Meets all criteria. Organization and information exceed expectations.	Meets all criteria. Organization and information are presented clearly.	Meets most criteria. Some elements or components are missing.	Did not contribute. Did not submit or missing major components.
Presentation		Reflects excellent understanding of project content.	Reflects good understanding of project content.	Almost completed within time. Little preparation evident. Misses a number of important points.	Did not participate, did not prepare, was way under or over time, or information was confusing and disjointed.
Teamwork		Completed within specific time. Evidence of preparation is obvious. Emphasizes most important information.	Almost completed within time. Preparation evident. Covers majority of main points.	Workloads varied considerably. Student did not contribute fair share.	Few members contributed. Student made little to no contribution.
Class participation		Workload divided and shared equally by all members.	Most members, including student, contributed fair share.	Contributed some.	Contributed very little.
		Contributed substantially.	Contributed fair share.		

Energy Audit

Overview

Students will investigate energy use in their homes. They will develop formulas to determine electricity use per person and per square foot of their homes. Students will calculate predictions of electricity savings from conservation steps and create a booklet containing tips to save electricity.

Time

Total time: 6 to 8 hours

- **Before You Go—Where Does Our Electricity Go?** one class and 1 hour of homework, p. 12
- **Activity 1—Comparing Electricity Use:** one class and 15 minutes of homework, p. 18
- **Activity 2—Using Symbols to Represent Ideas:** one class and 40 minutes of homework, pp. 21–23
- **Activity 3—Making Changes:** two classes and 40 minutes of homework, p. 24
- **Check Yourself! Skill Check and Self-Assessment and Reflection** worksheets: 30 minutes of class time or homework, pp. 26–27

Skill Focus

- using variables in equations
- making conjectures
- problem solving
- reasoning

Prior Knowledge

- working with variables
- calculating mean and mode

Team Formation

Students work in pairs, as individuals, and as a whole class.

Lingo to Learn—Terms to Know

- **energy efficiency:** using the least amount of energy possible to accomplish a given task
- **formula:** symbols that are combined to make a mathematical statement
- **kWh (kilowatt hour):** the amount of electricity used to generate 1 kW for 1 hour; a standard unit of electricity
- **mean:** the value found by adding together a set of numbers and dividing by the number of values (often called an *average*)

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- **mode:** the most common value in a set
- **scatter plot:** a graph of points that shows the relationship between two sets of numbers
- **variable:** a symbol used to represent a set of values

Suggested Steps

Preparation

- Review all the materials and activities for the expedition. Note printables that you'll need to copy.
- It is helpful to use a white board or an overhead transparency and wipe-off pens when students are developing equations on electricity use.
- It might be beneficial to contact the school administration to get support for the project and invite them to address the class prior to the project and at its end.
- Consider contacting an energy auditor and inviting him or her to speak to the class about common sources of energy loss in buildings and solutions.
- If you would like to have students send their findings to parents, obtain permission from the school administration to do so.
- Students might benefit from writing support from an English language arts teacher and support from a science teacher on discussing electricity.
- Students should have access to computers to complete the data table in a spreadsheet program and the Energy Savers booklet page in a word-processing program.
- Before beginning this expedition, direct students to ask their parents for copies of their family's electric bill (at least 4 bills, one per season) in order to complete the **Tracking Electricity Use Expedition Tool** (pp. 13–17). Copies of electric bills may be available online through their electricity provider's Web site. You may wish to use copies of your own bill, with your personal information redacted, for students who do not have their own copies.

Day 1

1. Have students complete a quickwrite, a short 5-minute writing response to the following question: What are the best ways to conserve energy?
2. Have students discuss their ideas in groups of two or three and then as a whole class.
3. Make a master list of strategies for conserving energy.
4. Distribute **Before You Go: Where Does Our Electricity Go?** (p. 12) and **Expedition Tool: Tracking Electricity Use** (pp. 13–17).
5. Students will look at the U.S. average electricity use for a family of four. Ask students to use the list of activities to estimate the percentage of overall electricity use for each different purpose.

Energy Audit

6. Have students discuss their answers in groups of two or three and then as a whole class.
7. Have students look at annual electricity use for a family and predict whether the family's electricity use throughout a year would be constant or would vary.
8. Have students graph their predicted annual electricity use for the family.
9. Ask students to share their graphs in small groups.
10. As a whole class, discuss how electricity use varies throughout a year in your region.
11. Explain that students will be examining electricity use in their homes to identify steps that can be taken to conserve electricity. They will create a booklet on electricity-saving steps. If desired, the booklet can be distributed to the community or posted on the school Web site.
12. Review the survey students will first conduct of their own family's electricity use.

Homework

Students should conduct a home electricity analysis using at least four electricity bills, each representing one month per season (January through March, April through June, July through September, and October through December). Students will graph their family's electricity use for a year. Students will complete survey questions about electricity identifying appliances, light fixtures, heat and/or cooling sources, house size, windows, and so forth.

Day 2

1. Have students share graphs of their family's electricity use with a partner.
2. As a whole class, discuss how a family's electricity use changes. Identify whether electricity use changes at a constant rate in the same direction or at varying rates.
3. Have students create a list of what might make their family's electricity use vary during the year.
4. As a whole class, discuss the changes in electricity use. Review with students what a variable is.
5. Make a list of the variables the students identified as increasing or decreasing electricity use during different seasons.
6. Distribute **Activity 1: Comparing Electricity Use** (p. 18) and **Expedition Tool: Analyzing Electricity Demand** (p. 20).

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7. Distribute **Comparing Electricity Use In Our Classroom** (p. 19). Each student may need more than one copy in order to list all the students in the class. You may wish to make a copy of the worksheet and fill in the student names before copying and distributing to students.
8. Review how to calculate a mean or average. Have each student calculate his or her family's average monthly electricity use.
9. Support students in calculating the average annual daily electricity use.
10. Have students work in pairs to calculate the average monthly electricity use per person in their household.
11. Ask students to individually calculate the annual average electricity use per square foot of their home.
12. As calculations are completed, have students enter the data from their home survey into the class table or spreadsheet you created.
13. Each student should enter the family name, the number of people in the household, the house size, the use of electric heat or air conditioning, the number of light fixtures, the number of hours of television viewing, the number of hours of computer use, their calculated average monthly electricity use, their calculated average electricity use per person in the household, the average daily use, and their calculated average electricity use per square foot of their home.
14. Students should copy the data from the rest of the class into their own tables.
15. Ask students for any observations they can make about the calculations in the table. Can they see any relationships between the values? How do the ranges in the values differ?
16. Review the homework assignment.

Homework

Ask students to examine the data in the table and write three reasons why they think the average annual electricity per household varies.

Day 3

1. Have students share their ideas in groups of two to four. Each group should select the best reason from all their lists and create three statements justifying their reasoning with class data.

Energy Audit

2. Ask each group to present their idea and one justification. If other groups have the same ideas, they can add any additional justifications they identified.
3. Distribute **Activity 2: Using Symbols to Represent Ideas** (pp. 21–23).
4. Select one of the students' conjectures about variation in electricity use between homes to use as an example. Write a statement that summarizes the idea. For example, the change in electricity use is the per person use times the number of residents. Ask students if they can use symbols to represent this statement. An example could be $E = xy$, where E equals the annual average electricity use, x equals the average electricity use per person, and y equals the number of people per household.
5. Have students check this idea by examining the values in the class table and identifying the mode for monthly average electricity use per person. Use this value for x .
6. Have students complete the formula using the y -value as the number of people in their household.
7. Compare students' calculations for E using the formula with their actual family's monthly average electricity use. Identify any difference in the two figures.
8. Make a scatter plot. In one color, plot the values for monthly average electricity as calculated with the equation for each family. In another color, plot each family's actual monthly average electricity use per person.
9. Discuss the results. Did the difference appear equal for all household sizes? Decide whether the data indicates that this is the only reason for variations in electricity use.
10. Work through another example, or have students work in pairs on another example before they work independently to develop a formula for another factor that might be causing the variation in electricity use.
11. Review homework.

Homework

Have students select another variable that might have an effect on electricity use (such as the number of light fixtures). Students will create a formula for this variation. They will calculate their formula for six families in their class data table. They will write a description of their results and indicate why the data shows the variable does or does not have a relationship to electricity use.

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Day 4

1. Have students share their ideas in groups of two to four. Students should select the best reason from their calculations and create three statements justifying their reasoning with data.
2. Ask each group to present their idea and one justification. If other groups have the same ideas, they can add any additional justifications they identified.
3. Distribute **Activity 3: Making Changes** (p. 24).
4. Have students look at both their family survey and the information about electricity use from the **Tracking Electricity Use** worksheet (pp. 13–14).
5. Have students work in pairs to identify three steps their families could take to reduce electricity use.
6. Have students create a formula that identifies the amount of savings both families could make by reducing the uses by the given amount of time.
7. Ask students to share one item on their list.
8. Create a class list of steps to reduce electricity use with the amount of savings.
9. Instruct students to work in pairs and use a computer to complete a page on one of the electricity-saving steps for the Energy Savers booklet. The page should include a summary of the data from the class on electricity use and a graph of the data from the class family surveys that relates to the electricity-saving step. For example, if suggesting changes in lighting, students should graph the class monthly average electricity use. If suggesting reducing television watching, students should graph the average monthly use per person. If suggesting turning off air conditioning, students should graph average electricity use per square foot in homes that have air conditioning. Students should include a description of the electricity-saving step, a description of the electrical use and savings, and a calculation of the money saved.

Homework

Students should create a draft of their page for the Energy Savers booklet.

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Day 5

1. Have students continue to work on the booklet.
2. Circulate to each team to meet for an accuracy and completeness check.
3. As students complete their pages, have them find another pair of students to peer-review their work.
4. After any revisions, have students find another pair of students to proofread their work.
5. Compile all the pages into one booklet and share the booklet with the class.
6. If desired, present the compiled booklet to the administration and post it on the school Web site. A list of electricity-saving tips can also be compiled and sent home to parents.
7. If desired, ask a local newspaper or television reporter to interview students and investigate the project.

Final Day

1. Have students complete the **Check Yourself! Skill Check** questions (p. 26).
2. Check and review answers.
3. Have students complete the **Check Yourself! Self-Assessment and Reflection** worksheet (p. 27) and submit it (optional).

Project Management Tips and Notes

- You can help struggling students by pairing them with stronger students and working through examples as a whole class.
- If students are engaged in this task, they will be motivated to tackle some difficult algebra concepts. To increase this motivation, make it clear from the beginning that students are working to address a real issue. You can reinforce this by having a science teacher talk about the need for energy conservation. If you plan to send information to parents or post students' findings on the school Web site, have the school administrator indicate his or her willingness to share the students' results. It might also be helpful to involve an English language arts teacher in the writing of the booklet pages.

Energy Audit

Suggested Assessment

Use the Project Assessment Rubric or the following point system:

Team and class participation	10 points
Student quickwrite	10 points
Before You Go	15 points
Activity 1	15 points
Activity 2	15 points
Activity 3	10 points
Energy Savers booklet page	20 points
Self-Assessment and Reflection	5 points

Extension Activities

- Have each student write his or her own booklet, illustrating each page.
- Have students present their findings to other students or to the Parent Teacher Association.
- Ask students to conduct a survey of the student body to determine their willingness to change behavior.
- Have students do a follow-up survey to see how many students implemented the changes and whether there was a difference in their electricity bills.

Common Core State Standards Connection

Grade 6

- 6.EE.5.** Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
- 6.EE.6.** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- 6.EE.9.** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

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Grade 7

- 7.EE.4a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p , q , and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

Answer Key

Activity 2: Using Symbols to Represent Ideas

- 1–2. Answers will vary.
3. Answers will vary. Sample answer:
 $E = xy$, where E equals the monthly average electricity use, x equals the average electricity use per person, and y equals the number of people per household
4. Using the sample answer above:
 Students should identify the mode from the class data for average monthly electricity use per person. They would then use this value as x in the equation. After selecting six families in the classroom, students would multiply the mode times the number of people in each of the six households selected.
5. Answers will vary.
- 6–9. Answers will vary. Check that graphs match information in student tables.
10. Answers will vary. Make sure that summaries are reflective of student charts and graphs.

Check Yourself! Skill Check

1. Energy conservation is using less energy to perform everyday tasks.
2. A kWh is a kilowatt hour. It is a measurement of an amount of electricity.
3. A variable is a letter or symbol that is used to represent unknown values in an equation.
4. Answers may vary. Sample answer:
 $A = lw$ (area equals length times width)
5. The mean is the average of all the values in a set of data. It can be found by adding together all of the values and dividing by the number of values. A mode is the most frequent value in a set of data.

Energy Audit

Expedition Overview

Challenge

It's up to you to investigate ways that families can conserve energy and save money on their electric bills. You will use your findings to create an Energy Savers booklet containing tips to save electricity.

Objectives

- To collect data on your family's electricity use
- To compare electricity use among all the households in your class
- To create formulas for identifying why electricity use varies between households
- To create a booklet to share ways families at your school can save electricity

Project Activities

Before You Go

- Where Does Our Electricity Go?

Off You Go

- Activity 1: Comparing Electricity Use
- Activity 2: Using Symbols to Represent Ideas
- Activity 3: Making Changes

Expedition Tools

- Tracking Electricity Use
- Analyzing Electricity Demand
- Comparing Electricity Use in Our Classroom

Other Materials Needed

- notebook
- access to computer with word processor and/or spreadsheet program
- graph paper
- colored pencils or thin-tip markers

Lingo to Learn—Terms to Know

- energy efficiency
- formula
- kWh (kilowatt hour)
- mean
- mode
- scatter plot
- variable

Energy Audit

Expedition Overview

Helpful Web Resources

- The American Council for an Energy-Efficient Economy
www.aceee.org
- Build It Solar: 1/2—Conservation Projects
www.builditsolar.com/References/Half/ProjectsConservation.htm
- Clallam County Public Utilities Department—Conservation
www.clallampud.net/conservation/
At the bottom of the Web page, click the “Typical Appliance Energy Use and Costs” link to launch a PDF guide to energy usage costs.
- Energy Information Administration—Energy Kids: Using and Saving Energy
www.eia.doe.gov/kids/energyfacts/saving/efficiency/savingenergy.html
- Home Energy Saver
<http://hes.lbl.gov>
- Saving Electricity
<http://michaelbluejay.com/electricity/howmuch.html>
- U.S. Department of Energy—Estimating Appliance and Home Electronic Energy Use
www.eere.energy.gov/consumer/your_home/appliances/index.cfm/mytopic=10040

Energy Audit

Before You Go

Where Does Our Electricity Go?

Goal:	To learn about your family's electricity use throughout a year
Materials:	notebook, graph paper, calculator or computer
Tool:	Tracking Electricity Use

Directions

1. Use the **Tracking Electricity Use** worksheet to find the U.S. average annual electricity use for a family of four.
2. Look at the list of appliances and the amount of electricity they use. Select ten appliances.
3. Estimate the percentage of the whole electricity used for the selected appliances.
4. Discuss your answers in your small group.
5. Look again at the U.S. average annual electricity use for a family of four.
6. Predict whether the family electricity use would be same throughout a year or if it would vary.
7. On a separate sheet of paper, make a graph of your predictions of the family's electricity use for each month in a year. (The figures do not include electricity for heat or air conditioning.)
8. Share your graph.
9. For homework, complete the **Tracking Electricity Use** worksheet.
10. Collect at least four electricity bills for your family. Get one bill for each season. (Seasons are January through March, April through June, July through September, and October through December.)
11. Graph your family's electricity use for a year.
12. Complete the **Family Electricity Survey**.
13. Identify how electricity use changes in your home over the year. Does it vary at a constant rate (always increasing the same amount or always decreasing) during a year? Does it change at varying rates (both increasing and decreasing by different amounts)?
14. Make a list of causes for the changes in your family's electricity use during a year.

Energy Audit

Expedition Tool

Tracking Electricity Use

Section 1: How Much Electricity Does It Use?

The average annual electricity use for a family of four is 12,263 kilowatt hours (kWh) per year. Appliances use various amounts of electricity. The amount used varies by the number of watts of electricity the appliance needs to run. Below are some examples of the wattages used by various household appliances for each hour they are used.

Electricity Use of Appliances

air conditioning (window unit)	1,100 watts
air conditioning (central)	6,000 watts
clock radio	10 watts
coffeemaker	1,200 watts
clothes washer	400 watts
clothes dryer	4,600 watts
dishwasher	1,200 watts
dehumidifier	785 watts
electric blanket (double)	100 watts
ceiling fan	80 watts
window fan	115 watts
furnace	750 watts
hair dryer	1,500 watts
portable heater	1,000 watts
electric baseboard heater (8 feet)	2,000 watts
heat pump (central)	5,000 watts
iron	1,000 watts
incandescent light	by wattage
compact fluorescent light	100-watt replacement—25 watts 75-watt replacement—20 watts
microwave oven	1,000 watts
computer CPU	120 watts
computer monitor	150 watts
laptop computer	50 watts
refrigerator (frost-free, 16 cubic feet)	725 watts

(chart continued on next page)

Energy Audit

Expedition Tool

stereo	200 watts
stove burner	800 watts
oven	2,000 watts
standard color television	300 watts
flat-screen television	120 watts
toaster	1,000 watts
DVD player	20 watts
vacuum cleaner	1,000 watts
water heater	4,500 watts

Electricity Costs

Utility companies sell electricity by the kilowatt hour (kWh). A kilowatt hour is the number of watts an appliance uses in 1 hour. There are 1,000 watts in 1 kilowatt (kW). You can calculate the kilowatts an appliance uses by dividing the number of watts it needs per hour by 1,000. For instance, a vacuum cleaner requires 1,000 watts per hour. This is 1 kW.

To calculate the cost of using an appliance, you must calculate the kWh it uses. This is done by multiplying the number of kW by the hours, or parts of hours, the appliance is used. To find the cost to use the appliance, multiply the kWh by the cost per kWh charged by your utility.

$$\text{cost} = (\text{watts}/1000 \times \text{hours}) \times \text{rate} = \text{kilowatt-hours (kWh)} \times \text{rate}$$

1. Select ten items from the list of appliances that are used most frequently in a home. List them below. Predict what percentage of an average family's total electricity use for one year went to power each appliance. (*Hint: Percentage of use should add up to 100%.*)

2. On a sheet of graph paper, make a graph that predicts how much electricity a family of four would use each month if their annual electricity use was 12,263 kilowatt hours (kWh). Be sure to properly title and label your graph. Check your work by adding the amounts for each month to be sure they equal 12,263 kWh.

Energy Audit

Expedition Tool

Section 2: Family Electricity Use Survey

1. Complete the table below by putting the number of kilowatt hours (kWh) used by your family for one month in each season.

Electricity Use for a Year

	January to March	April to June	July to September	October to December	Mean electricity use per month
Electricity use for one month (kWh)					

2. On a sheet of graph paper, graph your family's electricity use over a year.
3. How many people live in your home?
People in home: _____
4. How many people are home all day?
Number of people: _____
5. How many square feet of living space are in your home? (Multiply the length of the house by the width, and multiply that by the number of floors there are.)
Square feet of living space: _____
6. Complete the table on the next page if you have air conditioning or electric heat.
 - In column 2, answer *yes* or *no* if you use central air conditioning or central electric heat.
 - In column 3, list the number and size (wattage) of window air conditioners or portable heaters you use.
 - In column 4, record the temperature settings for central air conditioning and/or heating.
 - In column 5, record the total number of hours all the air conditioners and heaters are used each day.
 - In column 6, record what months the air conditioning and heating are used.

Energy Audit

Expedition Tool

Home Heating and Cooling

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
	Central electric heat and/or air-conditioning system	Number and size of window air conditioners and/or portable heaters	Temperature settings for heating and/or cooling	Average number of hours of use per day	Months of use
Air conditioners					
Electric heaters					

7. Record how many light fixtures there are in your home, both ceiling lights and lamps.

Number of light fixtures: _____

8. Record the number of the following major electric appliances you have:

refrigerator/freezer: _____ clothes dryer: _____ portable television: _____

freezer: _____ floor fan: _____ flat-screen television
(or television more than 26"): _____

stove: _____ ceiling fan: _____

water heater: _____ window fan: _____ laptop computer: _____

dishwasher: _____ stereo: _____ desktop computer: _____

clothes washer: _____ television (more than 20"): _____ DVD player: _____

Energy Audit

Expedition Tool

9. Record the number of hours your family watches television each day. (Be sure to add up the use for all televisions if there is more than one in your home.) Multiply daily usage by 365 to calculate how much television your family watches each year.

Total hours of television watching per day: _____ Per year: _____

10. Complete the table on family computer use.
- In column 1, identify the computer (such as “mom’s”).
 - In column 2, record whether the computer is a laptop or desktop model.
 - In column 3, record the average number of hours a day each computer is used.
 - In column 4, record the number of days a week the computer is on for those hours.
 - For column 5, calculate the average number of hours per week the computer is used by multiplying column 3 by column 4.
 - For column 6, calculate the average number of hours per year the computer is used by multiplying column 5 by 52 weeks (1 year) and place in column 6.
 - Add more lines if needed.
 - Total all the hours per year all the computers are used.

Family Computer Use

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Computer	Laptop or desktop	Average hours of use per day	Number of days per week	Total number of hours per week (number of hours × number of days)	Number of hours per year (total number of hours per week × 52 weeks)
Total					

Energy Audit

Off You Go

Activity 1: Comparing Electricity Use

Goal:	To compare the electricity use between households of different sizes
Materials:	notebook, graph paper, data from Family Electricity Use Survey
Tools:	Analyzing Electricity Demand, Comparing Electricity Use in Our Classroom

Directions

1. Your teacher will give you a copy of a spreadsheet, **Comparing Electricity Use in Our Classroom**. You will use it to compare your family's energy usage to that of your classmates' families. Each column represents a different set of data you will collect about your family's energy usage, home size, and so forth.
2. Use the data collected in your table **Electricity Use for a Year** from the **Tracking Electricity Use** worksheet to fill out the **Comparing Electricity Use in Our Classroom** worksheet. Write your name in the first horizontal row, and fill out the space under each column with the data you've already collected for your family. The remaining rows will be used to record your classmates' data. Calculate a mean or average monthly electricity use for your family. Put this value in the table **Average Electricity Use** in the **Analyzing Electricity Demand** worksheet.
3. Calculate the average daily electricity use for your family by dividing the average monthly use by 30 days. Put the value in the **Average Electricity Use** table.
4. Calculate the average monthly electricity use per person in your household by dividing your family's average monthly electricity use by the number of people in your household. Put the value in the **Average Electricity Use** table.
5. Calculate the monthly average electricity use per square foot of your home by dividing your family average monthly electricity use by the number of square feet of living space. Put the value in the **Average Electricity Use** table.
6. After you complete your calculations, enter the calculations and the data from each column of your home survey into the class spreadsheet.
7. Copy the data from other students' families into your table.
8. Examine the data from your whole class. On the **Analyzing Electricity Demand** worksheet, write three reasons why you think the average monthly electricity per household varies.

Energy Audit

Off You Go

Activity 2: Using Symbols to Represent Ideas

Goal: To learn to create formulas to examine reasons for variations in electricity use between households

Materials: pencil, notebook paper, graph paper, calculator or computer, colored pencils or thin-tip markers

Directions

1. Choose one of your reasons why electricity use varies between the families in your class.
2. Write a statement that summarizes your reason. (For example, electricity use varies in households because of the number of people living in the house.)

3. Write your statement as a formula with variables.

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4. See how well your equation predicts electricity use. Use your equation to calculate the monthly average electricity use for six families in your class data table.

5. Compare the calculations you made for the six families with the values for their actual average electricity use. Record your results in the table below.

Family	Calculated average electricity use	Actual average electricity use

6. On a sheet of graph paper, create a graph with the x -axis as the number of people per household and the y -axis as the average monthly electricity use (kWh).

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7. In one color, plot a point for each household based on the data from the class data table. In another color, plot a point for each household based on your equation and the number of people per household. Compare the sets of graphed points.
8. Share your results with a partner.
9. Decide whether your predicted reason for electricity variation between households is correct and if the values from calculations made with your equation match the actual values. Or, if they do not match, decide what other factors might be causing the difference in electricity use.
10. On a separate sheet of paper, write a summary of your results that includes the following:
 - a statement explaining why electricity use varies between households
 - an equation
 - a description of calculations made
 - the results of calculations in the data table
 - the scatter plot of comparative data
 - a summary of ideas on whether the reason identified is the sole reason for variations in electricity use
11. Share your summary with a small group.
12. Decide which reason presented by all the students has the greatest effect on varying electricity levels.
13. List three points in the data that support your group's thinking.
14. Be prepared to present your idea and its justification to the class.

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Off You Go

Activity 3: Making Changes

Goal: To identify ways that families can save electricity

Materials: pencil, graph paper, notebook paper, computer (optional)

Directions

1. Look back at the data from your family survey and the table of electricity use (kWh per activity) in the **Tracking Electricity Use** worksheet.
2. With a partner, identify three steps your families could take to save electricity.

3. Create a formula to calculate the amount each family could save. For example, three ways to reduce electricity are to watch 1 less hour of television per day; use the computer 1 less hour per day; and use a fan instead of a small window air conditioner while at school (10 minutes per hour for 6 hours = running 1 hour).

S = savings per week

a = cost per kWh (\$0.12)

x = kWh saved by watching less television per day

y = kWh saved by using the computer less per day

z = kWh saved by running the air conditioner less per day minus kWh for running a fan per day

$$S = (7x + 7y + 5z) a$$

$$S = [7(113/1,000) + 7(120/1,000) + 5(1,100/1,000 - 175/1,000)] (\$0.12)$$

$$S = (0.791 + 0.84 + 4.625) (\$0.12)$$

$$S = 6.256 (\$0.12)$$

$$S = \$0.75/\text{week in savings or approximately } \$3.00 \text{ per month}$$

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Off You Go

Use the space below to work out your calculations.

4. Choose one of your electricity-saving steps.
5. On a separate sheet of paper or on the computer, create a page for your class Energy Savers booklet. The page should include the following:
 - a summary of the data from your class on electricity use
 - a graph of the data from your class family surveys that relates to your electricity-saving step (For example, if you are suggesting changes in lighting, graph the class monthly average electricity use. If you are suggesting watching less television, graph the average monthly use per person. If you are suggesting turning off air conditioning, graph the average electricity use per square foot in homes that have air conditioning.)
 - a description of the electricity-saving step
 - a description of the electrical use and savings
 - a calculation of the money saved
7. When you have completed a draft of your page, have another pair of students review it and provide comments.
8. After you complete any further revisions, have another pair of students proofread the page.
9. Make any final revisions, and submit the page to your teacher to be compiled into the Energy Savers booklet.

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Check Yourself!

Skill Check

1. What is energy conservation?

2. What is kWh?

3. What is a variable in a mathematical equation?

4. Use a variable in a mathematical formula.

5. What is the difference between the mathematical mean and mode of a set of data?

Energy Audit

Check Yourself!

Self-Assessment and Reflection

Before You Go

- I understand how the use of various appliances adds up to make our electric bill.
- I understand that different appliances use different amounts of electricity.

Off You Go

- I can create a formula using variables to represent an idea.
- I can graph data to compare the accuracy of my formula to the actual electricity use.

Do You Know?

- I can define the Lingo to Learn for this project and can give an example of each.
- I completed the Skill Check questions and carefully reviewed questions I did not answer correctly.

Reflection

1. What were the most challenging aspects of this project for you and why?

2. Which skills did this project help you develop?

3. If you did this project again, what might you do differently and why?
