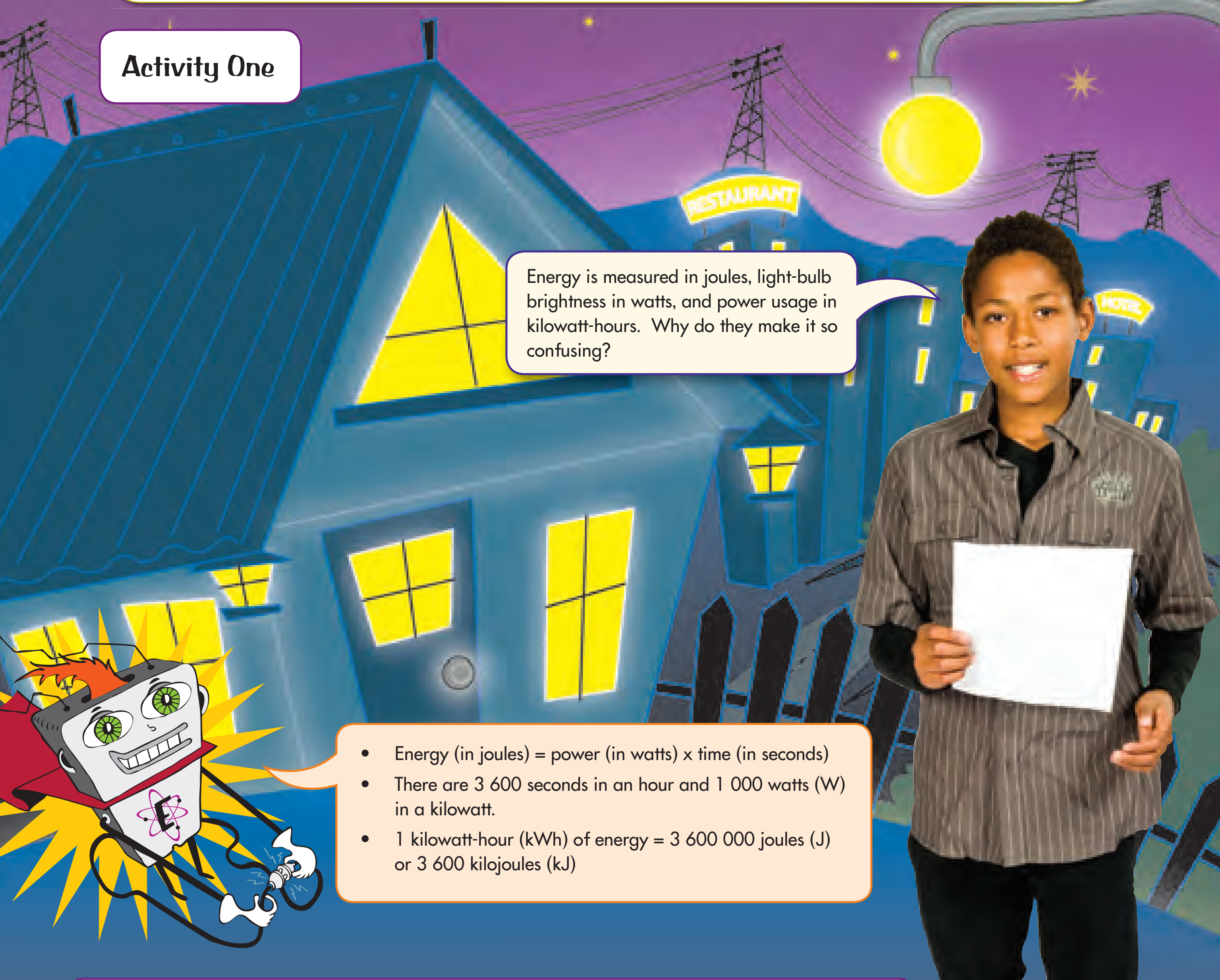
Using Electricity

You need

- the wattage table for **Activity Three** (see copymaster)
- an electric jug
- water
- a timer or watch
- a cup
- a computer spreadsheet or a calculator and graph paper
- a classmate

Activity One



- Energy (in joules) = power (in watts) x time (in seconds)
- There are 3 600 seconds in an hour and 1 000 watts (W) in a kilowatt.
- 1 kilowatt-hour (kWh) of energy = 3 600 000 joules (J) or 3 600 kilojoules (kJ)

1. How many kilojoules are there in 5 kWh?
2. If a 60 W light bulb is on for 2 hours, how many joules of electrical energy does it use?
3. A typical apple has 150 kJ of chemical energy.
   a. About how many kilowatt-hours is 150 kJ?
   b. How long will it take a 100 W light bulb to burn 150 kJ of electricity?
4. Why do you think electricity bills are in kilowatt-hours instead of joules?

Boiling a full jug of water for 1 or 2 cups of tea must waste a lot of energy!

If the water in the jug always heats at the same rate, will a full jug take twice as long to boil as half a jug?

Activity Two

With a classmate, investigate Melanie's ideas.

1. a. Measure 2 cups of cold water into an electric jug. Time how long it takes for the water to boil. Record this time (in seconds) in a spreadsheet or table. Empty the jug and let it cool.

Cups	Time (seconds)
2	

b. Repeat the steps in **a** for 4, 5, and 8 cups.

c. Graph your data. What does it tell you?

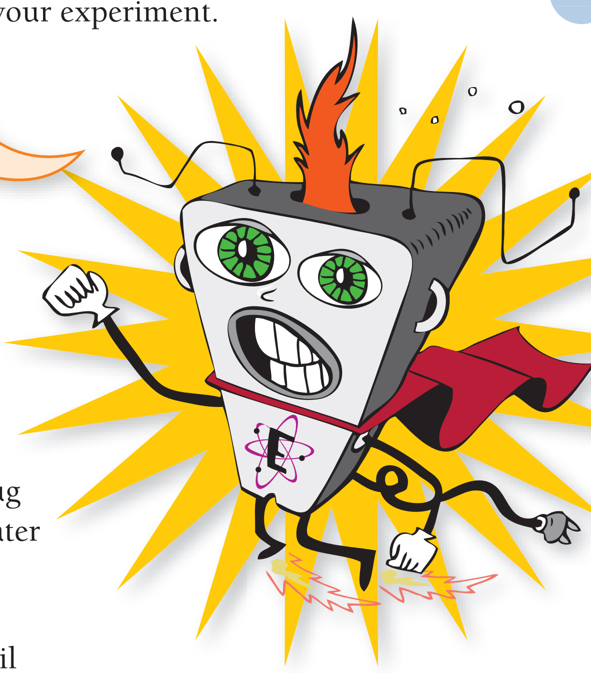
d. Use your graph to estimate how long it would take to boil 1, 3, 6, and 7 cups.

e. Check your estimates by boiling 7 cups.

2. What response could you now give to Melanie's ideas?

3. a. If a jug draws 2 200 W (2.2 kW) of power, calculate the amount of energy it will take to boil each number of cups in your experiment. Use the formula:

energy (kWh) = power (in kilowatts) x time (in seconds) ÷ 3 600



b. Estimate how much energy is wasted boiling a whole jug to make 1 cup of tea.

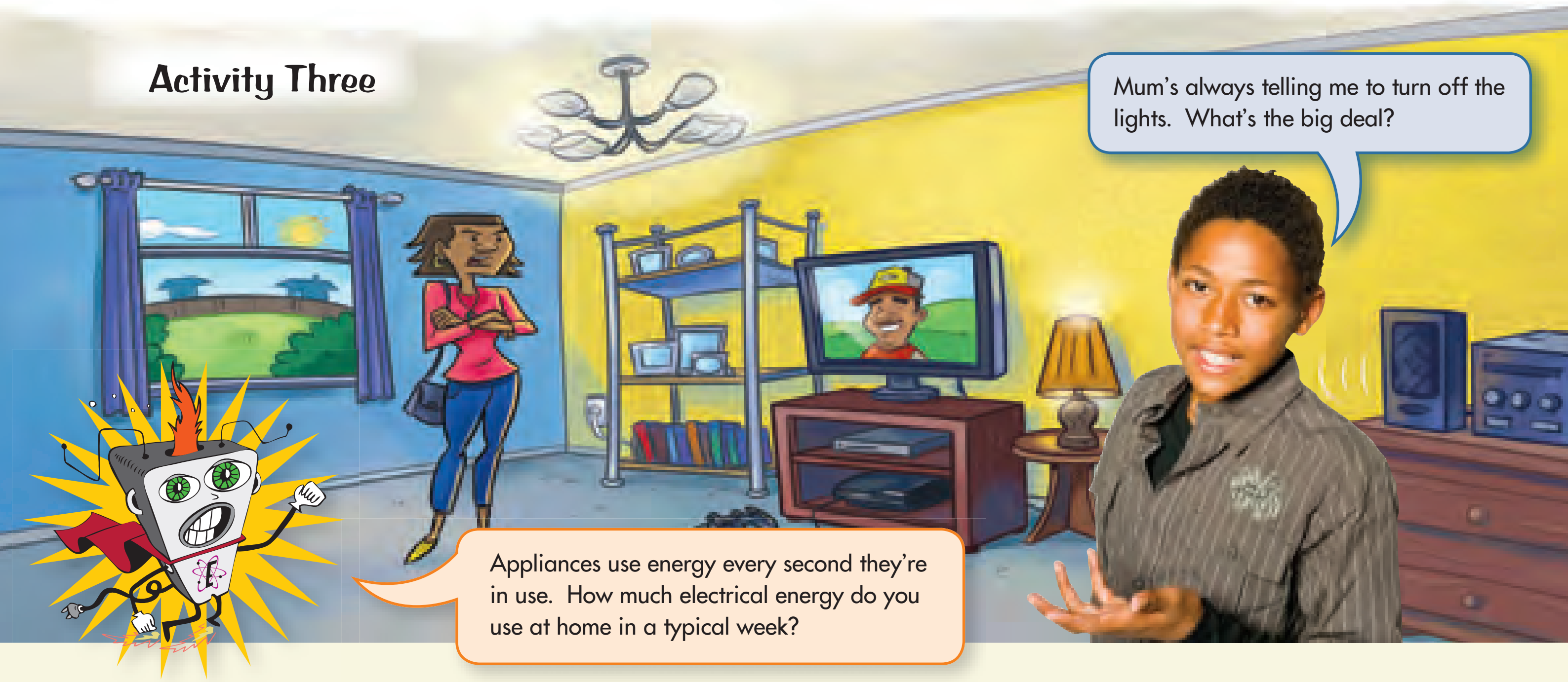
c. How long could this wasted energy run a 100 W light bulb?

4. a. Try this with your classmate:

Measure 4 cups of cold water into a cool electric jug and boil it. Add 4 cups of cold water to the hot water in the jug. Measure how long it takes to bring the jug to the boil again.

b. How does this compare with the time it took to boil 8 cups of cold water in question **1b**?

Activity Three



1. Use the figures on your copy of the wattage table to estimate (in column 3) how much time you use each appliance in a typical week in summer or winter. Include your share of appliances used by the family; you might not run the washing machine yourself, but your washing goes into it!

Appliance	Wattage	Time used (hours per week)	Energy (kWh)
100 W light bulb	100		
Clock radio	4		
Fridge or freezer	50 (average)		
Stereo	30		
Television	300		
...			

2. a. Calculate the energy used by your appliances using the formula:

energy (kWh) = watts x hours ÷ 1 000

b. Estimate your total use of electrical energy for 1 week.

c. Which appliances use the most energy?

d. Suggest changes that you and your family could make to reduce your electricity bill.

3. The average New Zealand home has two refrigeration appliances (fridge and freezer). If there are approximately 1.58 million homes in New Zealand, how much energy would be saved if every home had only a combined fridge-freezer?

Focus Calculating with rates