4. LIGHT BULB EFFICIENCY

Using your understanding of energy transfer and transformation, how can you determine the efficiency of a light bulb?

Objectives

- Measure, record, and interpret data.
- Identify indicators of a lower efficiency light bulb.
- Create and use existing code to create a new program to identify a change.

Materials and Equipment

- Data collection system
- //code.Node
- 2 lamp clamps
- Measuring tape
- LED light bulb, 16-20-watt
- Incandescent light bulb, 100-watt
- Ring stand and clamp

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

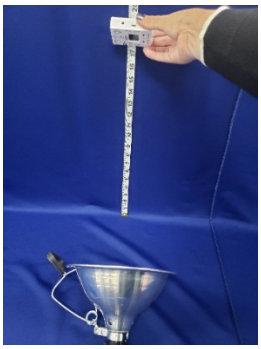
- To prevent burns, do not touch the bulbs during or after the investigation.

Procedure

Part 1 – Temperature Change

1. Select Sensor Data in SPARKvue.
2. Connect your //code.Node to your device.
3. Select only Temperature under Measurements and disable all other controls.
4. Select the Graph display under Templates.
5. Look at the bottom left-hand side of the SPARKvue screen. You will see that the device is set at 20 HZ. Click on the button and adjust your rate to 1 HZ. Hertz is a measurement of frequency and when you adjust to 1 HZ the device will record a data point every second.

6. Either attach your //code.Node to a ring stand with a clamp or hold the //code.Node approximately 15 cm above your light bulb.



7. Start recording in SPARKvue.

8. Turn on the LED bulb and record data for 4 minutes.

9. After 4 minutes press Stop and scale your graph.

10. Using the Coordinates Tool, mark the starting and ending temperatures of this run and enter them into Table 1.

11. Repeat steps 5 - 10 using the incandescent bulb.

12. Calculate the change in temperature (change in temperature = ending - starting) and enter the data for both bulbs in Table 1.

13. Show both runs in SPARKvue and scale the display. Sketch your results in Graph 1. Include numbers on the x- and y-axes. Add a key to identify each run.

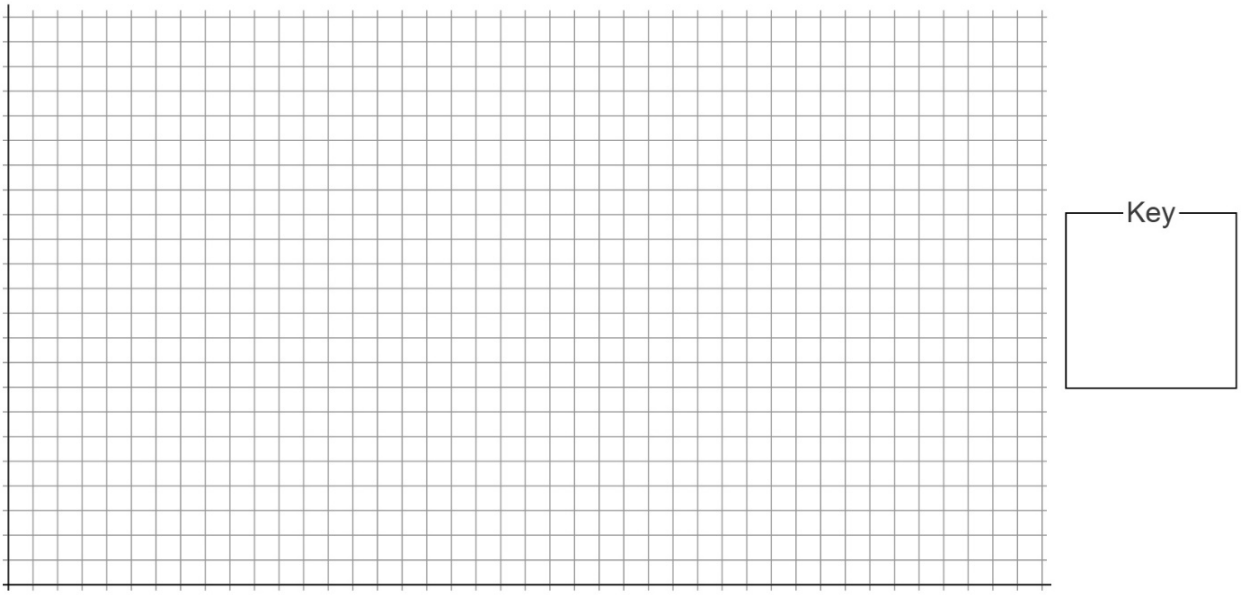
Data Collection

Part 1 – Energy Transfer and Transformation

Table 1: Change in temperature of light bulbs

Type of bulb	Starting temperature (˚C)	Ending Temperature (˚C)	Temperature Change (˚C)
LED			
Incandescent			

Graph 1: Temperature change of light bulbs



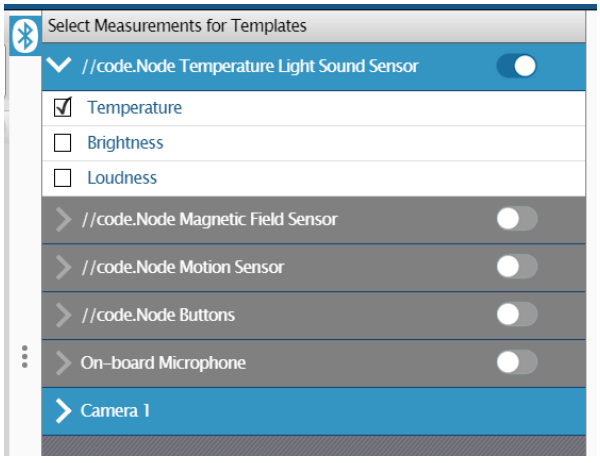
Part 2 – Coding for Efficiency

1. Since we know the LED temperature stayed nearly constant in our first investigation, use the incandescent bulb to set up a code that alerts us to when this bulb becomes lower efficiency due to thermal output.

2. Start a new experiment and select Sensor Data in SPARKvue.

3. Connect your //code.Node to your device.

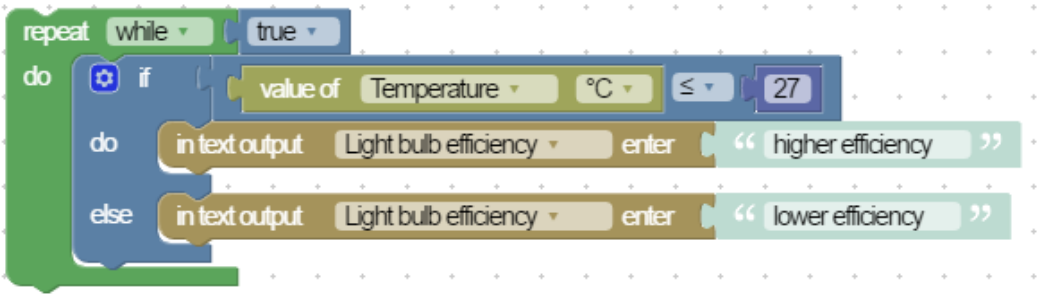
4. Select only Temperature under Measurements and disable all other controls.



5. Select the Digits Template.

6. Click on the code icon  .

7. Replicate the following code using the blocks found on the left-hand side of the screen.



8. Either attach the //code.Node to a ring stand with a clamp or hold the device approximately 15 cm above the incandescent bulb.

9. Click Done and add a page. Choose the two-sided template.

10. On the left choose the digits display and under Select Measurement, choose temperature.

11. On the right choose the digits display, Select Measurement, User-entered, then light bulb efficiency.

12. Click Start.

13. If your code is correct, you should see a text output that alerts you to a change as the temperature rises over 27 ˚C. This may take a few minutes.

14. Click Stop.

15. If you would like a challenge, add to your code to create an alarm, in addition to the text output, to alert you to a lower efficiency change.

Part 3 – Energy = Power x Time

1. We have discovered that incandescent bulbs release thermal energy which makes them less efficient then newer LED style bulbs. We can also determine efficiency of a bulb by the amount of energy it takes to power them. Fill in the data below in Table 2 based on the bulbs you used today.

2. Joules are a unit of energy. To determine the units of energy needed to run each bulb, complete the following calculation (Joules = watts x seconds) and enter the results in Table 2.

Table 2: Energy needed to run bulbs

Type of bulb	Watts	Time (s)	Joules (watts x sec)
LED			
Incandescent			

Questions and Analysis

1. Based on your results, which bulb is of a lower efficiency? Use evidence from your investigations to support your answer.

2. What additional code did you add to include an alarm? What challenges did you face completing this task?

3. Why do you think 27 ˚C was chosen as the set temperature in the code? Would your results have been different if you used a different setting?