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**Energy awareness  
Lesson 5: Energy use calculations**

Students build on previous lessons, analysing energy use patterns by calculating the amount of energy used and its cost.

**Learning objectives**

* Calculate the amount of energy used in kWh given the time and power consumed by electric lighting
* Calculate the cost of energy used from previously recorded data

**You will need**

Downloadable resources:

* Lesson slides
* Lesson plan
* Student handouts
* Spreadsheet 5a - energy use in kWh
* Spreadsheet 5b - energy cost

Other resources:

* Student work from previous lesson, spreadsheet (optional)

**Introduction**

Recap the previous lessons' work around how long electric lights were left on. Invite students to make suggestions about how people could be encouraged to save energy used by lighting.

**Calculate energy use**

Explain that some kinds of lighting use more energy than others. Highlight that in order to encourage people to change their behaviour, it would be useful to know not just how long lighting is left on for, but how much energy is being used and the cost. Invite students to consider why this information may be more likely to contribute to behaviour change (people could save money).

Optionally show the video from the Energy cost calculation Make it: code it project to explain how to calculate energy costs from power and time data (slide 3): <https://youtu.be/uuADvz5X3h4>

Ask students what needs to be known in order to calculate how much energy has been used (slide 4):

* how long the energy source was in use (time, measured in minutes or hours)
* the power rating of the light source (measured in Watts). The wattage is often written on the light bulbs themselves, but may be hard to read so help may be required.
* we can then work out how much electricity was used in kWh (kilowatt hours)
* kWh = watts ÷ 1000 × minutes ÷ 60

Ask students to calculate on paper or modify their spreadsheet/table used in lesson 4 to calculate the amount of energy used. They should use the information about wattage gathered in lesson 2 and the time data gathered in lessons 3 and 4. See below and the example spreadsheet 5a in the download bundle.

Table

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In this example the classroom has 8 fluorescent lights operated by the same switch, each rated at 40w, making 320w in total.

The amount of energy used is calculated in cell C5 by multiplying the wattage by the time.

The formula used is =320/1000\*B5/60

320 is divided by 1000 to convert watts to kilowatts.

Cell B5 contains the time in minutes, which is divided by 60 to convert minutes to hours.

kW multiplied by hours = kWh (slide 5).

(If needed, you can explain that we don’t need brackets in that spreadsheet formula as division takes precedence over multiplication in the order of operations - sometimes referred to as BIDMAS or BODMAS)

The formula can be copied to other cells - for example the formula in C6 reads =320/1000\*B6/60

The totals and average energy usage are then calculated depending on the data (slide 6).

**Calculate energy cost**

To calculate the cost of the energy used, we need to know the unit cost of electricity. This is how much the electricity company charges for each kWh. If you don’t know what your school pays, students could research this online and see what different energy providers charge, and whether the source of energy is from sustainable sources (e.g wind/solar).

Students can either calculate this on paper or modify their spreadsheet as below to look like spreadsheet 5b in the download bundle:

Graphical user interface, application, table, Excel

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In this example the unit cost of electricity is in cell B3.

The formula to calculate Monday’s cost is in cell D5: =C5\*$B$3

This formula multiplies the energy used in kWh by the unit cost. The $ is used in the unit cost cell (B3) so this remains the same when copying the formula down to the rows below (slide 7).

The weekly cost is calculated in cell D13: =SUM(D5:D10)/100

This divides the sum of the daily cost in pence by 100 to convert to pounds and the cell is formatted to currency to show the pound sign (slide 8).

**Analysing costs**

Invite students to share their cost of lighting calculations. (Slide 9)

The cost of lighting they have calculated may seem small, so invite them to consider:

* the cost over a year
* the cost across a whole school
* depending on your location, if the data was collected when there are more hours of daylight, whether the costs may be higher at other times of the year (e.g. in winter)

**Review**

Ask students to summarise what they can conclude about their findings and note down what they would recommend for the school. For example:

* How much energy/money could be saved in a year by changing behaviour? For example by not leaving lights on overnight or at the weekend.
* How much energy/money could be saved in a year by using low energy lighting, for example LED lighting?
* How much money could be saved in a year by finding a cheaper electricity supplier?

**Differentiation**

Support

* Students could work in carefully selected pairs or in supportive groups.
* You could provide students with partially completed spreadsheets with formulas or a blank framework to fill in.

Stretch & challenge

* Students could find and use an online carbon footprint calculator to add data about how much CO2 is being generated by lighting in school (assuming the energy is not from sustainable sources).
* They could provide visual representations of cost data in graphs or charts.

**Opportunities for assessment**

Informal, or more formal assessment of students' spreadsheets and analysis.

* Has the amount of energy been calculated correctly?
* Has the cost of energy been calculated correctly?
* Have formulas been successfully copied to other rows in the spreadsheet?
* Have they been able to make sensible conclusions and recommendations?