5. Oil as a fuel

1.5 hours

Children use a variety of oils as fuels and compare results to find the best fuel.

OBJECTIVES

- Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating (Y5 Properties and changes of materials)
- Planning different types of scientific enquiries to answer questions

RESOURCES

Per class

- Safety lighter

Per group of 4

- Activity sheets 2-3
- Tidy tray containing sand
- Heating stand (available from TTS)
- 2 small metal containers e.g. individual foil cake cases, empty tea light candle cases, metal screw cap lids (bottle lid)
- 1 sample per group of a selection of cooking oils e.g. corn oil, groundnut (peanut) oil, almond oil, rapeseed oil, sunflower oil, sesame oil, olive oil, vegetable oil.
- Candle wick (available from craft stores) or cotton string and plasticine
- Thermometer
- Timer
- Tweezers
- Data logger (optional)

INTRODUCING THE ACTIVITY

Read the email from the company (Activity sheet 2). With ideas from the class, create a list of examples of oils being used as fuels, e.g. heating our homes, schools and offices, fuel for transport etc, energy for industrial sites and steel making.

MAIN ACTIVITY

The planning and design of this investigation has been provided, due to the heath and safety aspects that need to be considered. The children can discuss the elements of fair testing, controlling variables, what to change, and what to measure. The development of children's measurement skills provides the investigative focus. Activity sheet 3 provides a table for them to record their results if required.

Each group collects their equipment to test one of the oil samples, and carries out the test, setting up the equipment as shown in the photograph:

Photograph showing an oil burner heating water on a heating stand. The sand tray provides a safe area for this kind of activity.

Note: To establish whether the oil is needed to keep the flame alight, a small piece of wick can be lit in the foil tray before adding the oil. The wick could also be placed in a non-flammable liquid (water) to show that the flame does not then stay alight.

The following is an example of how to carry out the activity.

1. Place a wick in the metal container and secure it with plasticine. Add a measured amount of oil to the container. Make sure the plasticine is below the oil's surface.
2. Fill a second metal container with a measured amount of water and place it on top of the heating stand. Measure the temperature of the water and record it. Light the wick in the lower container and start the timer.
   Note: If the wick has fallen into the oil, use tweezers to hold up a section prior to lighting.
3. After a set period of time (typically 5 minutes), record the temperature of the water and compare it to the start temperature to find the difference.
4. Extinguish the oil burner and leave it to cool before clearing away.

Extension: The temperature can be taken at regular intervals over a specific time period. The data can then be used to produce a graph illustrating the rise in temperature for each oil. Alternatively a data logger with a heat sensor probe can be used to produce a graph illustrating the increase in temperature.

PLENARY

All the groups' data are collated and compared. The children suggest which oil would be the best to use as a fuel and why (the maximum temperature change per unit mass of water). Some discussion of where the crop is grown, the necessary energy investment and how much the crop costs to produce can be introduced here. An email can be created, with attachments showing the experimental design and resulting tables/graphs. A willing governor or other adult may be prepared to receive the data and respond.

BACKGROUND INFORMATION

The best application for each type of oil depends on its properties. For example an ideal lubricant would not burn and would be in-volatile whereas a fuel oil would burn easily and be volatile.

Oils also have different freezing/melting points which can make them difficult to use in certain circumstances. Palm oil, grown in tropical climates, can be solid at room temperature in Britain which means it could be difficult to use during our winter. Oils from other crops may have similar properties but have a lower freezing point. A table of softening (melting) and boiling points can be found in Appendix 3.

Diesel oil used in vehicles was once susceptible to freezing in winter months. In some cold climates fuel tanks have an independent heating system to warm fuel. Improved refining methods have been able to remove more impurities from the oil lowering the freezing temperature. The impurities were fractions of oil that became solid at temperatures just below 0˚C.

Appendix 3: The effect of temperature change on oils and fats

The following table lists the softening (melting) and boiling points for commonly used oils and fats. It is not a definitive list and there may be slight variances depending on the purity of the oil. Because of the impurities, the change to a liquid takes place over a temperature range when the solid will soften.

Oil	Softening (melting) point ˚C	Boiling point ˚C
Linseed (Flax seed)	-24	316
Olive	-6	191
Peanut	3	227
Rapeseed	-10	200
Sunflower	-17	230
Palm Kernel	24	350
Palm	35	n/a
Grapeseed	10	230
Coconut	25	177
Hempseed	-8	166
Corn	-20	246
Sesame	-6	216
Lard	33	n/a
Butter	35	n/a

Palm oil, lard and butter do not have a specific boiling point. These fats are likely to break down before they change to a gas state. Oils and fats are the same chemical composition but they are described as fats when solid at room temperature.