

6. SUSTAINABLE SOURCES OF ENERGY: WHICH PLANT MATERIAL?

2–3 HOURS

Children learn about what fossil fuels are and how they are used, in particular to make electricity. The discussion focusses on the need for renewable energy and how this can be less harmful to the environment. Children are challenged to carry out two investigations for a fictitious company in order to find a sustainable plant-based source of fuel. They will then learn about a real company's solution to producing energy for heating and electricity from natural, sustainable sources such as plants.

The original activity and comprehensive background information can be found on Activity 2 of <http://www.ciec.org.uk/pdfs/resources/renewables-dont-run-out.pdf>.

TYPE OF ENQUIRY

Observing changes over time / Carrying out comparative and fair tests

OBJECTIVES

Compare and group together everyday materials on the basis of their properties (Y5 Properties and changes of materials)

Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials (Y5 Properties and changes of materials)

Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda (Y5 Properties and changes of materials)

Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations (UKS2 Working Scientifically)

SCIENCE VOCABULARY

crude oil, fossil fuel, non-renewable, carbon dioxide, climate change, burn, compressing

RESOURCES

per class

- 1 large bowl of each: straw, hay, wood shavings/chips
- 1 bucket of sand or water (emergency use)
- timers – 1 per child or pair if possible
- 3 clear sealable plastic bags
- safety glasses
- 3 metal baking trays/roasting tins or similar
- 1 safety lighter (teacher use)
- **Activity Sheet 7** (letter from company)

RESOURCES

per group of 4, unless otherwise stated

- Access to straw, hay, wood shavings/chips Note: the plant material must be completely dried
- 1 x 500g food can or 1 x 1kg weight
- Access to push meters of different scales if possible
- Interactive planning tool <http://www.ciec.org.uk/resources/interactive-planning-tool.html> or **Activity Sheet 6**: Post-it planning template
- 1 x 1000ml jug and 1 circular disc of thick card measured to fit inside of the jug
- Access to weighing scales
- Two colours of post-it notes
- Industry sustainability story: **Presentation**

PRIOR KNOWLEDGE / EXPERIENCE

Children will have had some experience of setting up simple practical enquiries, comparative and fair tests.

ACTIVITY NOTES

Introduction: Activity Sheet 6 is a letter which introduces the children to a fictitious company and forms the context to both activities in this lesson. Discuss with the children why the company might want to find an alternative fuel to crude oil. Explain that this is a thick, yellowy-black liquid found naturally by drilling down through rocks on land or off-shore. Because it burns very well it is considered to be one of the world's most important fuel sources.

Presentation slide 2: Continue the discussion to include how crude oil is called a fossil fuel because it was formed from the remains of animals and plants that lived millions of years ago before the dinosaurs. Over many years, the remains were covered by layers of mud. Heat and pressure from these layers helped the remains turn into what we call oil.

Explain to children that crude oil is a non-renewable fuel as it takes millions of years to form and will eventually run out. (**Presentation slide 3**) Fossil fuels also release carbon dioxide gas into the air when it is burned, and this can contribute towards climate change. Discuss how it is important that we find new, environmentally friendly, sources of fuel for things like heating and making electricity.

Focus the discussion on how the population of the world is increasing, so to ensure that there will be enough energy for future generations, it is important to consider the 'sustainability' of the sources we use.

MAIN ACTIVITY 1: WHICH PLANT MATERIAL BURNS BEST?

Firstly, children are going to generate ideas for how they can compare samples of straw, hay and wood shavings/chips to find out which plants are best for the company to burn in their boiler. Each group should discuss what being 'best' means, e.g. burns for the longest, brightest flame etc. The **interactive planning tool** <http://www.ciec.org.uk/resources/interactive-planning-tool.html> or post-it planning template (Activity Sheet 6) can be used to generate ideas at this stage, before collating suggestions as a whole class. The best aspects of each group's plans can be combined to provide the teacher demonstration.

The children can be involved in several aspects of the practical activity, such as: measuring equal amounts of plant material, emptying the measured material into a metal tray ready for testing, photographing and filming the process, measuring and recording close observations such as the duration of burning, flame type, smoke produced etc., creating a commentary.

The amount of ash and burnt material can be collected and, once cool, could be put into a clear plastic bag and used for display purposes. It could also be weighed and compared to the weight of the plant material at the start. Discuss why there may be a difference and what has happened to the plant material during the burning, i.e. an irreversible change.

SAMPLE BURNING RESULTS

hay	Takes time to ignite, smoulders rather than burns, produces a lot of smoke, and does not burn out completely.
straw	Burns readily, produces little smoke, quickly burns itself out, and leaves very little ash.
wood shavings/ chips	Ignite readily, produce little smoke, burn slowly but steadily and leaves ash.

Ask groups of children to consider what their findings tell them, and which burning properties would be attractive to a company. They will hopefully conclude that the company would be looking for a plant material that burns slowly and cleanly with little smoke and produces small amounts of ash.

MAIN ACTIVITY 2: WHICH PLANT MATERIAL CAN BE STORED MOST EASILY?

Each group is given samples of the straw, hay and wood shavings/chips to observe and handle. Children should think about how large quantities of plant material would take up a lot of space and so would be inefficient to transport and store. They should refer back to the original letter and discuss why many deliveries by lorry would not be an environmentally friendly solution to the problem.

Small groups should explore the effect of compressing the dried plant material, e.g. How can we reduce the space (volume) it takes up? Does compressing change the weight? Does it make it easier to transport? Could the compressed material be used for anything else?

Using the questions above, small groups of children should plan their test and choose resources needed to carry it out. The interactive planning tool or post-it planning template (Activity Sheet 6) can be used to help limit the independent variable to one (the plant material) and maintain fair test conditions. Dependent variables to consider include the amount of plant material, the method of compressing, length of time of compression, the method of measuring compression.

The following process provides one possible way to investigate the changes taking place and suggested method of collecting data:

1. Fill a jug with plant material up to the 1000ml line (be careful not to compress any of the material).
2. Place the circular card disc on top of the plant material and ensure that it lies exactly on the 1000ml measurement line (you might need to add more plant material or remove some).
3. Weigh the filled jug.
4. Compress the material using weights (a heavy food can will work well) or by pushing down an agreed force using a push-meter for an agreed amount of time.
5. Remove the weights/stop pushing and note the new volume of the plant material using the scale on the jug.
6. Re-weigh the jug.

Each group should report their findings on the compression of the dried plant materials, explaining what they have found out with respect to mass and volume, and possibly density – when material is squashed to make it smaller, it weighs the same but becomes more dense.

Discuss the idea that reducing the volume of the plant material by compressing it will reduce the number of vehicles required to transport it. By producing briquettes, small compressed packs of material, it is easier to handle and transport and will be in a form that can be used easily when adding to the boiler.

Children should combine their findings from the compression investigation with their observations made during the burning activity, and then make final decisions regarding which plant material would make the best sustainable source of fuel for the company.

EXTENSION OR HOME-BASED ACTIVITIES

Children might like to draft and produce a letter to the company in order to make their final recommendations. They could include data and results from their investigations in an appropriate format as additional evidence to support their conclusions.

Children might also be interested to research other forms of renewable energy and how these are created. They could look for solar powered items around the home, such as calculators, garden lights or roof panels. They may live near to wind turbines and could find out more about what they are and what they do.

QUESTIONS FOR THINKING

- How do the plant materials compare to the most common fuels; gas, electricity, coal and oil?
- Can the waste products be used for other purposes? (e.g. ash can be used to manufacture concrete and be used as fertilizer.)
- What problems could there be in transporting enough dried plant material to the company to keep the boiler going?
- What difficulties might there be with storing large quantities of plant material on site?
- Why might it be more convenient to convert fuel to electricity and supply it through a cable rather than burn the fuels on site?

SAFETY GUIDANCE

The burning investigation is a teacher-led practical activity and the following safety precautions must be taken:

Carry out the activity in the open-air (middle schools may have a fume cupboard) or liaise with the local secondary school. Only burn small samples of plant materials and have a bucket of sand or water close by for use as an extinguisher, if necessary. Only supervising adults should extinguish flames, not children. The teacher should wear safety goggles and have long hair tied back. Be aware of the weather conditions so that the children are not downwind of the activity and are out of the way of any smoke produced or any material which may get blown about. Check for children who may have allergies to plant material and ensure that children who have asthma have ready access to their inhalers.

For more comprehensive safety guidance, provided by CLEAPSS, please log in and go to: <http://primary.cleapss.org.uk/Resource-File/P018-Investigating-burning.pdf>

INDUSTRY LINKS AND AMBASSADORS

Ambassadors visiting the classroom could talk about how they produce heat and electricity for their site, what targets they have set themselves and what they are doing to be more environmentally friendly. Children will be interested to hear about job roles including Environmental Officer. Some companies have introduced initiatives such as: electric vehicles for staff, energy saving lighting installed in all offices as well as using landfill gases as a source of energy. Some companies have won awards or special recognition for aspects of sustainability and it is important for the children to hear stories of positive environmental impact.

To enable children to explore one company's solution to the search for more sustainable sources of food, teachers and children should follow the slides on the presentation **Sustainable sources of energy: which plant material?** and engage in discussion points and activities to develop a further understanding of industrial contexts.

CROSS CURRICULAR LINKS

English: identify the audience for and purpose of the writing, select the appropriate form and use other similar writing as models for their own. Plan their writing by noting and developing initial ideas, drawing on reading and research where necessary.

Mathematics: estimate, compare and calculate different measures.

PSHE: learn what improves and harms their local, natural and built environments and develop strategies and skills needed to care for these (including conserving energy); learn that resources can be allocated in different ways and that these economic choices affect individuals, communities and the sustainability of the environment across the world.