

Preface and acknowledgments

There are 55 experiments presented in this volume. They are arranged as a set of teacher's notes followed by the student's worksheets. The worksheets and teacher's notes can be photocopied for use within the purchasing institute. The accompanying CD includes the setup files referred to in the Student's notes which can be automatically installed into the **EASYSense** software.

It is hoped the experiments will make it easier for teachers to introduce data logging to students in a meaningful manner. The experiments cover a wide range of ability levels and curriculum requirements. They have been organised into topic areas, where possible. Within each topic area a higher experiment number indicates a more complex or challenging experiment.

These experiments have been written after use in a classroom and they have come from many sources. It is not the intention to suggest they are original, they are experiments that users have told us are useful in teaching science or for introducing students to data logging.

A correct assessment of the safety risks associated with the experiment should be carried out by the teachers conducting the experiments. The inclusion or exclusion of safety information is not an indication of responsibility by the publisher. Teachers must follow local safety regulations and advice to ensure the safety of the teacher and students is maintained. Disposal and use of chemicals associated with the experiments should follow local regulations.



The help and ideas of the following are gratefully acknowledged,

Ian Birrell of SSERC.

Gerry Gibbons of the Royal Latin School, Buckingham.

Barry Hawkins of Data Harvest.

Barbara Higginbotham of Data Harvest.

Tony Brown. Ex-head of chemistry. Queensbury School, Dunstable.

Brian Orger. Ex-head of chemistry. Stowe School, Buckingham.

David Everett. Head of chemistry. Felsted School, Dunmow.

Document No. **D0171** (*Issue 1*)

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Teacher's notes

1T - Burning a fossil fuel

Read

In this investigation a Humidity and Oxygen sensor is used to measure the changes in the air in a bell jar as a candle burns. The amount of air in a bell jar is quite small so students must be prepared to work quickly.

To introduce the work student's ideas about fuels and their understanding of the term should be identified. A list of examples they can give of fuels can be created, you may wish to introduce some unfamiliar fuels e.g. recycled chip fat for cars, animal; dung etc. The difference between fossil fuels and renewable fuels may need to be defined.

All fuels that burn in air are rich in carbon and ask pupils to suggest what might be formed when they burn. Using BioFuels does not reduce carbon emissions, it simply holds the increase in check.

Demonstrate that carbon dioxide (and water) is produced when methane (a fossil fuel - but also one that can be made from breakdown of organic materials) burns. If possible, extend the demonstration by using other fuels containing hydrogen and carbon, e.g. wax, ethanol, wood. Discuss with pupils whether it is likely that carbon dioxide and water could be turned back into fuel (introducing photosynthesis and the carbon cycle).

The word equation that describes the burning of a fossil fuel is Fuel + oxygen — produces → carbon dioxide + water + energy.

Apparatus

1. An EASYSense logger.
2. A Smart Q Oxygen sensor set to the 0 - 25% O₂ in air range.
3. A Smart Q Humidity sensor.
4. Bell jar. Use a high bell jar to prevent the flame from damaging the delicate membrane of the Oxygen or the Humidity sensor.
5. Blu-tack or plasticine to make an air tight seal.
6. Tea light / small candle.

7. Petroleum jelly e.g. Vaseline, to seal the base of the bell jar.
8. A sheet of smooth plastic or glass for standing the bell jar on.

Setting up the software / logger

The experiment uses the **EasyLog** function of **EASYSSENSE** to provide a simple 'click and record' session.

Notes

The sensors must be kept away from the candle flame.

Light the candle, and place the bell jar gently over it, make sure the flame is to one side of the sensors to prevent direct heat from reaching the sensor .

The bell jar will need a small amount of 'sticky gel' such as Vaseline / petrol jelly to make a good airtight seal between it and the sheeting.

The sheeting used to form the base should be heat proof (e.g. glass), it is not likely that the tea light will produce enough heat for the short time it is alight in the experiment to cause damage, but the tea light may be burning for some time during the pre experiment explanations.

Results and analysis

1. Identify, and use **Add Text** to label, the set of data that matches each sensor.
2. Use **Add Text** to mark the point at which the candle flame went out.
3. Indicate how temperature and humidity increase.

More to do

1. If you have access to a light sensor it may be worth while showing how the flame responds to drop in oxygen levels in the bell jar. You may need to provide some form of shading to restrict light from sources other than the flame reaching the sensor.
2. Use a large pipette to remove some of the air to shake with lime water and show that carbon dioxide has been formed.

Sensors: Oxygen, Humidity
Loggers: Any EASYSense

Logging time: EasyLog

1 - Burning a fossil fuel

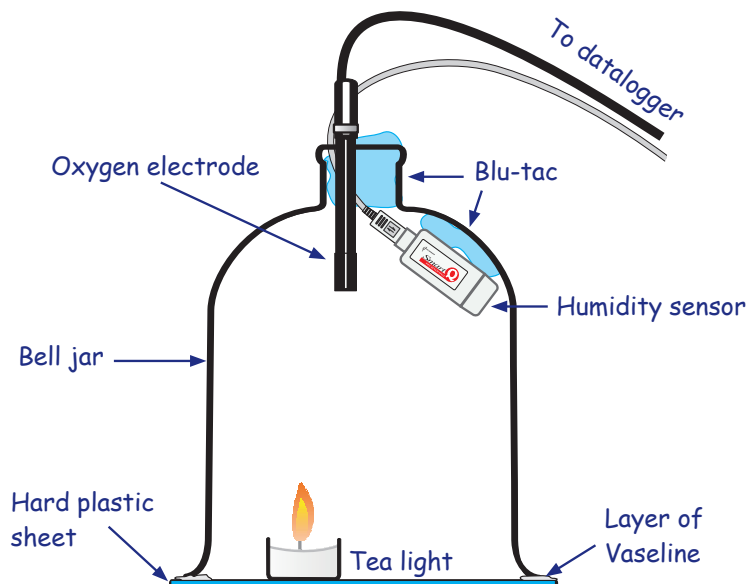
Read



A fuel is a substance which is burned to produce energy as heat. Most fuels used today are fossil fuels, which were formed over millions of years by the decomposition of prehistoric animal and plant life under pressure. Crude oil, is a fossil fuel usually found at great depths beneath the earth or sea-bed. To make crude oil useful it is refined and processed, this converts it into more useful products.

Paraffin wax is a soft solid separated from oil after the first stage of refining. When other materials are added to the paraffin wax it can be made to harden and is then used to make candles. By changing the mixture of wax in the candle you can control how much heat and light the candle produces.

When the candle burns you can see the light and feel the heat it is producing. In this investigation you will find out what else is being produced during burning by using a Humidity sensor and an Oxygen sensor to measure the changes in the air in the bell jar as the candle burns. The amount of air in a bell jar is quite small, so be prepared to work quickly.



What you need

1. An EASYSense logger.
2. A Smart Q Oxygen sensor.

3. A Smart Q Humidity sensor.
4. Bell jar.
5. Blu-tack or plasticine.
6. Tea light / small candle.
7. Petroleum jelly e.g. Vaseline, to seal the base of the bell jar.
8. A sheet of smooth plastic or glass for standing the bell jar on.

Hazard information

Naked flame. Take care to keep the sensors away from the candle flame.

What you need to do

Input 1	Input 2
Oxygen	Humidity

1. Start **EASYSSENSE** and select **EasyLog** from the **Home page**.
2. Light the candle and make sure it is burning with a good flame, click on **Start** to begin logging.
3. Place the bell jar over the candle and let the candle burn itself out.
4. Stop the logging.

Results



1. Identify and label the set of data that matches each sensor.
2. Use a **Add Text** to mark the points.
 - a. At which the candle flame went out.
 - b. At which the bell jar was placed over the candle.

Questions

1. What is need for something to burn?
2. In this experiment which thing needed for burning is running out?
3. The candle is made of a fossil fuel (paraffin wax). What is the gas produced when a fossil fuel is burnt? How is it made?
4. How much did the temperature rise inside the bell jar?
5. The rise in temperature is caused by the release of?

More to do

1. Does the light from the candle flame change during the experiment?
2. Do all candles produce the same amount of heat for the same amount of oxygen used?
3. Do any other fossil fuels give more energy for the same amount of oxygen used?
4. If you have access to a carbon dioxide sensor try comparing the oxygen used to the CO_2 produced.