

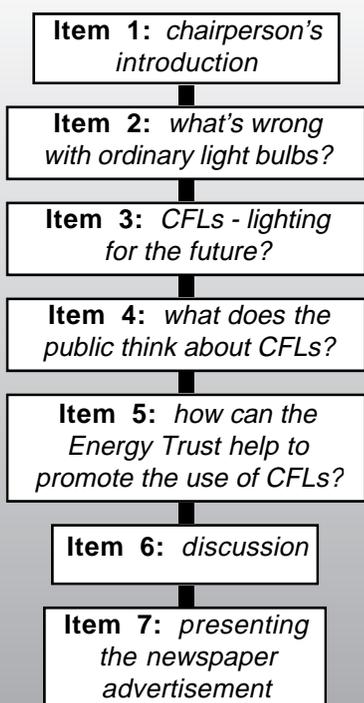
Pupil Research Brief

Teachers' Notes

Syllabus Coverage *Subject Knowledge and Understanding*

- electrical energy is readily transferred as heat (thermal energy) and light
- the amount of energy transferred from the mains is measured in kilowatt hours, called Units
- the fraction of energy supplied to an appliance which is usefully transferred is called the efficiency of the appliance
- energy transferred = power x time
(kWh) (kW) (h)
- the power of an appliance is measured in watts (W) or kilowatts (kW) (1 kW = 1000W)
- the cost of this energy can be calculated using:
total cost = No. of Units x cost per Unit

Route through the Brief



Introduction

The aim of this short Brief is for pupils to learn about Compact Fluorescent Lamps (CFLs), the energy-efficient alternative to ordinary light bulbs. The context for the Brief and the pupils' roles are based on a real-life issue.

In 1992, after the Rio Earth Summit, the government set up an organisation called the Energy Trust, to help it meet its commitment to reduce carbon dioxide emissions. The Energy Trust runs campaigns to encourage people to use energy more efficiently at home, and one of these targets the use of CFLs.

The pupils, working in groups, are invited to take the role of members of the *Energy Trust's Energy Efficient Lighting Committee*. Their task is to produce a promotional newspaper advertisement to encourage the public to switch over to CFLs. They are given briefing notes and are required to work through a committee meeting agenda, taking it in turns to give short presentations on each agenda item. As well as covering basic information about light bulbs and costing electricity, they learn about the short-comings of using ordinary filament bulbs and the benefits of CFLs. They also learn about the results of market research into why some people switch to using CFLs and why others do not.

They then go on to produce a draft of a newspaper advertisement as part of a national promotional campaign for CFLs.

Pupil Research Brief

Teachers' Notes continued

Prior knowledge

This Brief is meant to be used in the context of work on using mains electricity. It would be helpful if pupils had some idea of the concept of energy efficiency.

Pupil grouping

Pupils could work in a number of groupings during this Brief. Suggestions are :

- Initial briefing* - whole class; teacher introduces topic outlining context and pupil roles
- Committee meeting-* ideally groups of 5 with one as chairperson (groups of more or less than 5 will require pairing for an item, or one pupil being responsible for two items)
- preparation of agenda items* - individual or pairs (depending on number in each meeting group)
- presentation of agenda items* - meeting groups (as above)
- planning and discussion of newspaper advertisement* - meeting groups
- Plenary session (optional)* - whole class; reporting back by meeting groups and discussion of findings
- Written reports* - individual, if notes are to be used for assessment purposes

Timing

This Brief is likely to take about 70 minutes of classroom time.

Activities

The teacher should issue pupils with the **Study Guide** which provides pupils with a summary of what they should produce as they work through the Brief. It can also act as a checklist for pupils to monitor their own progress. Set the scene by introducing the Energy Trust and outlining pupils' roles as members of the Energy Efficient Lighting Committee who are required to produce a draft of a newspaper advertisement (80 words maximum and include an eye-catching illustration), as part of a national campaign to

promote widespread use of CFLs. They should do this by the end of the meeting (double lesson). Tell them that as committee members given the task of producing the advertisement, they will need to first make sure they have sufficient knowledge about CFLs and their benefits. Hence the need to work through the **background notes** attached to the **meeting agenda**. You do not need to tell the pupils much more at the beginning because what they have to do will become clear as they work through the agenda.

Split the class into 'committees' of five pupils ideally, although as pointed out earlier, four or six pupils will work. Either, have each group select a chairperson or do so yourself. The chairperson will be responsible for introducing the meeting, chairing the question and answer sessions, leading the discussion and the drafting of the advertisement. Give the chairperson the **agenda**, his or her **briefing notes**, and the **set of briefing notes** for the agenda items. In committee groups, before the meeting starts, pupils should be allocated an **agenda item topic** and given about 10 minutes to read through the item briefing notes and prepare their presentation for the meeting.

The pupils should now be able to work through items 2 - 5 unaided.

You may wish to bring the whole class together in a plenary session to present and discuss respective group advertisements, to reinforce key learning points and to evaluate the experience. If they produce their advertisements on an OHT it would make it easier, or alternatively, a poster display would allow pupils to move around and ask questions of other groups.

Using IT. Pupils could use word processing or DTP (desk top publishing) packages to produce their advertisement.

Scottish syllabus coverage

Standard Grade Physics - *Energy Matters*

Further research opportunities

Pupils could be asked to produce a "professional looking" advertisement using a word-processor, or even a leaflet or poster for a "school-wide" campaign or competition.

They could calculate how much money their family could save if they switched all the bulbs in their home over to CFLs.

Green Light

Setting the Scene

You are a researcher acting as a consultant to the Energy Efficient Lighting Committee deciding on the style and content of a newspaper advertisement to promote the benefits of compact fluorescent lamps (CFLs) and to encourage their widespread use in the home. You will present information required on specific aspects of CFLs and ordinary filament lamps, including costs and benefits, in order to produce the advertisement.

Pupil Research Brief

Study Guide

Syllabus Targets *Science you will learn about in this Brief*

- electrical energy is readily transferred as heat (thermal energy) and light
- the amount of energy transferred from the mains is measured in kilowatt hours, called Units
- the fraction of energy supplied to an appliance which is usefully transferred is called the efficiency of the appliance
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Route through the Brief

Item 1: chairperson's introduction

Item 2: what's wrong with ordinary light bulbs?

Item 3: CFLs - lighting for the future?

Item 4: what does the public think about CFLs?

Item 5: how can the Energy Trust help to promote the use of CFLs?

Item 6: discussion

Item 7: presenting the newspaper advertisement

Outcome Checklist

You will produce a newspaper advertisement promoting the use of CFLs in the home as part of the Energy Trust's nationwide energy saving campaign. You should make sure you produce the following items as you work through the Brief.

Items 1-5

- information on filament lamps and CFLs
- calculation of energy savings from the use of CFLs

Items 6 and 7

- newspaper advertisement promoting the use of CFLs in the home
- presentation plan to Energy Trust

the energy trust

energy efficient lighting committee

meeting agenda

Item	Description	Suggested times	Presenter
1	Chairperson's introduction.	2 mins	
2	What's wrong with ordinary light bulbs?	3 mins	
3	Compact fluorescent lamps (CFLs) - lighting for the future ?	3 mins	
4	What do the public think about CFLs?	3 mins	
5	How can the Energy Trust help to promote the use of CFLs ?	5 mins	
6	Discussion about newspaper advertisement.	30-35 mins	
7	Presentation of the final draft of newspaper advertisement.	4 mins	

Committee meeting notes for the chairperson

Item 1 Starting the meeting - introduction

- welcome the members who will be acting as consultants to the committee
- outline the purpose of the meeting :

this Energy Efficient Lighting Committee has been convened by the Energy Trust to produce a nationwide advertising campaign to promote the benefits and encourage the widespread use of compact fluorescent lamps (CFLs) in the home. The purpose of today's meeting is to produce an effective newspaper advertisement that will begin this campaign launch

- read out the items on the agenda
- invite each member to give his/her presentation in turn.

Items 2-5

- after each presentation ask if anyone has a question
- try to make sure each item lasts no more than the time allotted on the agenda.

Items 6-7

- chair the discussion for the calculation of cost saving for a CFL, referred to in item 5
- chair discussion about the style and content of the newspaper advertisement (**it should be no more than 80 words and include an eye-catching illustration**)
- oversee the final draft of the advertisement.

Item 2

What's wrong with ordinary light bulbs?

Notes for presenter

Please read before the meeting

You are going to give a brief presentation (~3 minutes) about this topic.

- Prepare yourself by studying the information in the box.
- Use the pictures of the light bulb as a visual aid.
- It would be helpful to draw a pie chart showing how electricity is converted to heat and light in a filament lamp, using the figures given in paragraph 3 in the box.

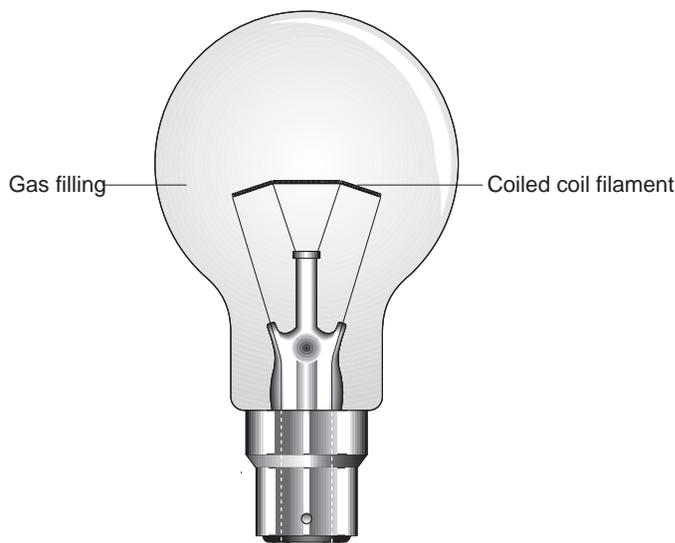
Ordinary light bulbs are cheap but they have two big disadvantages. They waste a lot of energy and they have a short life span. To understand why, we need to see how a light bulb works.

Inside the bulb is a long, thin piece of metal wire called a filament. Switch on the power and an electric current passes through the filament, heating it to such a high temperature that it glows white hot. Although it's glowing, almost all of the energy it gives out is in the form of heat. Only a tiny fraction is useful light and so using an ordinary bulb is not an efficient way to produce light.

In fact only about 5 percent of electricity is converted to light. The rest is converted to heat (15 percent is transferred to the environment by conduction and convection, and the rest by radiation).

Also, because the filament is so hot (2500°C), it slowly evaporates away. After about 1000 hours of use, the bulb fails. This means that light bulbs have to be replaced often, roughly every 8-12 months.

A filament lamp



Item 3

CFLs - lighting for the future?

Notes for presenter

Please read before the meeting

You're going to give a brief presentation (~ 3 minutes) about this topic.

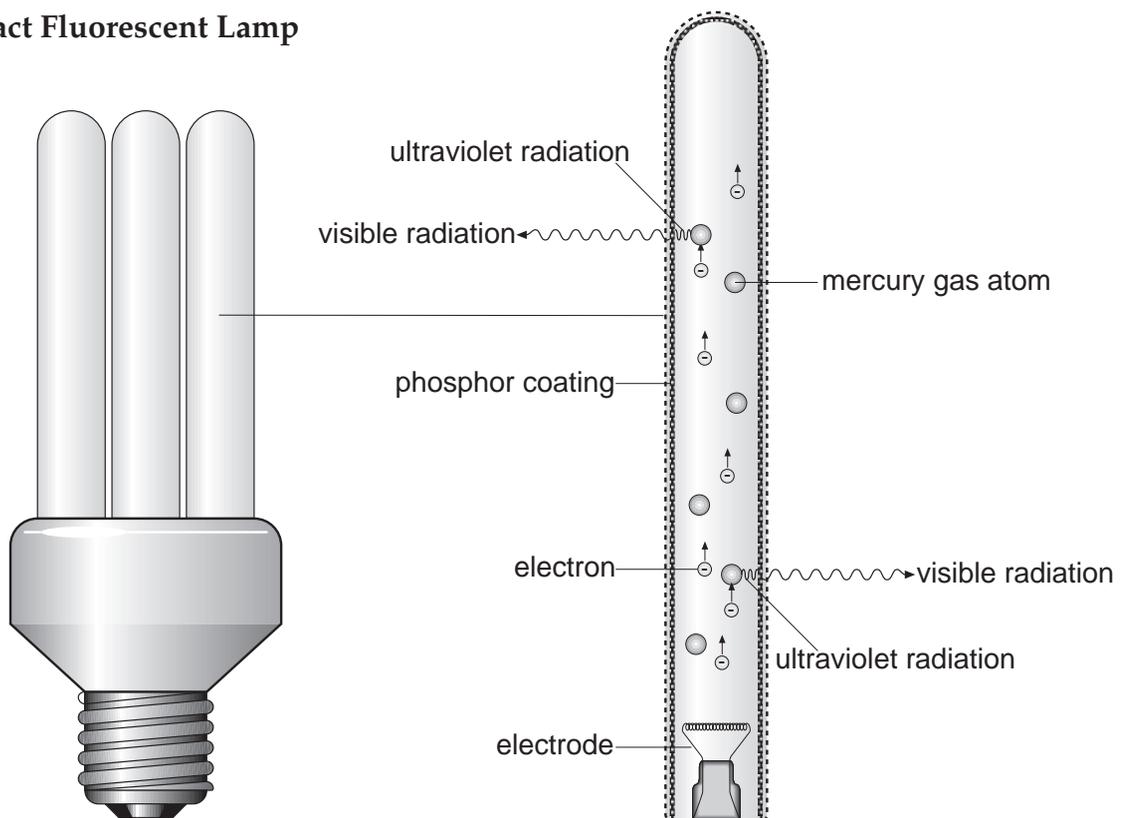
- Prepare yourself by studying the information in the box.
- Use the pictures of the compact fluorescent lamp as a visual aid.
- It would be useful to work out the efficiency of a CFL using the information given in the box.

Fluorescent lighting is all around us, in shops, offices and schools. CFLs are miniature versions of fluorescent tubes, designed to fit into the same sockets as ordinary light bulbs. The advantage of using CFLs over ordinary bulbs is that they save a lot of money on electricity bills. To understand why, we need to see how a CFL works.

Inside the tube (see the picture below) is a small amount of mercury vapour. Switch on the power and electrons start racing through the tube. When they collide with mercury atoms, the atoms give out ultraviolet (UV) light. Fluorescent powder on the inside of the tube converts the UV to visible light. This is an efficient way to produce light. A 100W filament lamp is only 5% efficient. The CFL that gives out the same amount of light uses only 20W of electrical power and lasts about 10 000 hours - i.e. 10 times as long as a filament lamp.

$$\text{Energy efficiency} = \frac{\text{power output}}{\text{power input}} \times 100\%$$

A Compact Fluorescent Lamp



Item 4

What does the public think about CFLs?

Notes for presenter

Please read before the meeting

You're going to give a brief presentation (~ 3 minutes) about this topic.

- prepare yourself by studying the information in the box
- it would be useful if you were to present the results of the CFL survey below in the form of two bar charts.

The Energy Trust wants to encourage people to buy CFLs instead of ordinary light bulbs. So it's important for us to know what people like about them, and what they dislike. We carried out a survey where we asked 1000 people from all over Britain the following question : **have you switched over to using CFLs to light your home?**

If they answered yes, we asked them why. If they answered no, we asked them why not. We collected and analysed the replies (see results of the survey below). What's most worrying to us is that many people haven't even heard of them yet.

Results of CFL survey

main reason for switching to CFLs	% of people
they are cheaper in the long run	64%
they last longer	29%
they produce a nicer light	5%
(other reasons)	2%

main reason for not switching to CFLs	% of people
they are too expensive	39%
they don't look attractive	27%
I haven't heard about them	21%
they are too big for our light sockets	8%
they take a long time to warm up	5%

Item 5

How can the Energy Trust help to promote the use of CFLs?

Notes for presenter

Please read before the meeting

You're going to give a brief presentation (~ 5 minutes) about this topic.

- Prepare yourself by studying the information in the box.
- Present the information clearly and concisely so that the Committee can carry out the cost saving calculation and then plan the content of the newspaper advertisement.

The Energy Trust is very keen that people should use CFLs to light their homes. They are more efficient than light bulbs, which means they use less electricity. The power stations which produce the electricity don't need to burn as much fuel. If less fuel is burned, less carbon dioxide is released into the atmosphere, causing less pollution of the environment.

In order to promote the use of CFLs in the home the Trust wants to mount a campaign to inform the public about the benefits of using CFLs. The survey of CFLs presented in item 4 showed that the main reason why people did not switch to CFLs was because they thought they were too expensive. We need to stress that in the long run they are much cheaper because they use less electricity than filament lamps for the same amount of light output and last 10 times longer.

It would be a good idea if the Committee did some calculations to compare the cost of running a CFL over its life time with the cost of using filament lamps over the same length of time. It could then decide on the text of a newspaper advertisement to promote greater use of CFLs in the home.

Useful information for calculating cost saving

- $\text{energy used (kWh)} = \text{power (kW)} \times \text{time (h)}$
- a 'Unit' of electricity = 1 kilowatt hour (kWh)
- $\text{cost of electricity} = \text{number of Units} \times \text{cost per Unit}$

Money saved

- You need to know the following information:
 - the cost of the CFL
 - the input power of the CFL (20W)
 - the cost of a Unit of electricity

The calculations are for 10 000 hours of use, which is the lifetime of the CFL.

- Calculate the amount of electrical energy that the CFL uses in 10 000 hours.
- Calculate the cost of electricity over 10 000 hours.
- Calculate the total cost of using the CFL for 10 000 hours (inc. cost of CFL).
- Calculate the cost of using an ordinary 100W filament lamp for 10 000 hours. A 100W filament lamp lasts on average 1000 hours.
- Calculate the money saved by using the CFL.