FUTURE TRAVEL

Practical Project
For Teachers **p2&3**, for Students **p4**

HEALTH AND SAFETY

Students should be encouraged to make their own risk assessment before they carry out any activity, including surveys. In all circumstances this must be checked by a competent person. Students using specialised equipment should be supervised at all times.

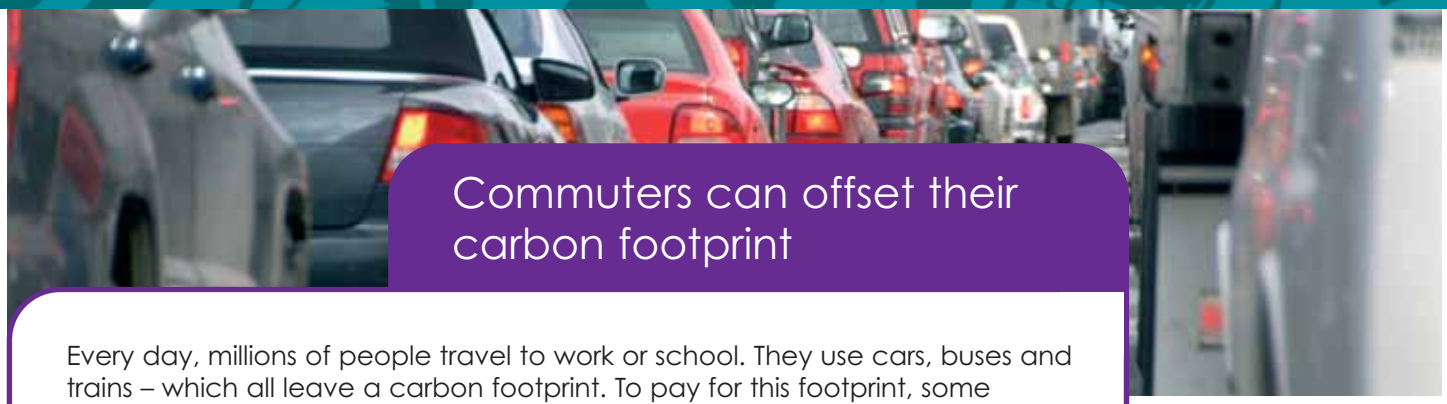
Combustion of fuels requires careful risk assessment and close supervision. Students should plan and carry out their project, but all practical work must be vetted.

The aim of the project is to investigate how CO_2 emissions can be measured. Petrol and other low flash point hydrocarbons must not be used. Alcohols, paraffin, cooking oil and gaseous fuels may be acceptable.

Students may want to set up unorthodox experiments and you may need to seek specialist advice. Organisations such as CLEAPSS and the Royal Society of Chemistry are able to help.

FUTURE TRAVEL:

Bronze **Practical** Project - For Teachers



Commuters can offset their carbon footprint

Every day, millions of people travel to work or school. They use cars, buses and trains – which all leave a carbon footprint. To pay for this footprint, some commuters use schemes called 'carbon offsetting'. They use online calculators which work out the carbon footprint of their daily commute. Then they pay some money. The money goes towards projects that reduce the emission of greenhouse gases. Some people think this is a great idea. Other people think we should just be greener – and walk to work or school!

HAVE YOU EVER WONDERED?

…how you can measure, and compare, carbon dioxide (CO_2) emissions from different fuels?

You might like to imagine yourself in a situation such as…

The media publish lots of information, facts and figures about carbon footprints and how much energy we use. You'd like to know how they measure such things. So, you decide to **undertake practical experiments** to investigate:

- how to compare carbon dioxide (CO_2) emissions from various fuels
- how we could trap the CO_2 instead of letting it escape into the atmosphere.

POSSIBLE EQUIPMENT, MATERIALS AND RESOURCES

Equipment and materials for:

- burning fuels (e.g. spirit lamps, food-fuel calorimeter)
- condensing water vapour / drying gases
- absorbing carbon dioxide
- creating gas flow (e.g. filter pump)
- weighing to at least 2 d.p.

Prompts

The **Student Brief** gives some triggers to start students thinking. They should realise that each trigger implies several items to research and compare. Encourage students to identify these themselves. However, if necessary, prompts such as those below might be given, to point students in suitable directions.

- What does 'emissions' actually mean?
  - What's the difference, if any, between 'CO_2 emissions' and 'carbon footprint'?
  - Electric trains give off no CO_2 themselves, but are they really 'zero-emission'?
- What factors determine the amount of CO_2 emissions for a particular fuel?
  - Does it depend on the type of vehicle, the type of fuel, or both?
  - Why are some fuels, such as biodiesel and ethanol, considered to be 'greener' fuels?
- How will you make sure that your comparisons of different fuels are fair?
  - What factors or variables do you need to keep constant?
  - How might you keep them constant?
- Burning fuels produce a mixture of gases.
  - What other gases are likely to be produced; and do these depend on what fuel you use?
  - How might you measure the CO_2 alone?
- How can you perform experiments with flammable fuels safely?
  - What fuels can you safely burn in the laboratory?
  - What safety precautions must you take?
- Could 'carbon capture' be used for vehicle emissions?
  - What is 'carbon capture', and how might you try it out in the laboratory?
  - Can you think up a way to capture the carbon emissions from a moving vehicle?

Internet search

- Animated equations for methane combustion with excess oxygen and insufficient oxygen
  ausetute.com.au/combusta.html
- Carbon capture and storage - Triple Science Support Programme Quick Guide
  crm.lsnlearning.org.uk/user/order.aspx?code=080106

Suggestions for supporting students

Though primarily based on laboratory investigations, the Practical project will require some initial research into the constituents of fuels for transport, and laboratory methods for burning fuels safely and measuring the carbon dioxide produced.

Students may need some direction from you, both to identify the required information and to ensure that practical procedures are appropriate, feasible and safe.

Although Bronze Award students are not expected to have an official Mentor for their project, access to expert advice makes students feel their work is important. Also, if the topic is not in your area of expertise, you may find a Mentor valuable. Your CREST Local Coordinator may be able to suggest suitable contacts.

Depending upon the investigation undertaken, someone with knowledge and/or experience of one or more of the following could be ideal:

- assessing the environmental impact of CO_2 emissions
- measuring CO_2 in gas mixtures
- quantifying CO_2 emissions / measuring carbon footprints
- development and/or use of 'green' fuels
- carbon capture.

Discuss with students how they will manage their time (after school clubs, working during lunch hours, homework). Agree a completion date with them.

- Students should decide their focus, although this may alter in the light of experience as the project progresses.

Useful resources

Basic chemistry texts and/or practical manuals and worksheets – methods for:

- burning solid, liquid and gaseous fuels safely
- collecting combustion products
- removing water vapour
- absorbing, and determining the mass of, carbon dioxide

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Some things to think about...

- What does 'emissions' actually mean?
- What factors determine the amount of CO_2 emissions for a particular fuel?
- How will you make sure that your comparisons of different fuels are fair?
- Burning fuels produce a mixture of gases.
- How can you perform experiments with flammable fuels safely?
- What is 'carbon capture'? Could it be used for vehicle emissions?

Health and Safety

Should you decide to carry out any experiment or practical activity:

(a) find out if any of the substances, equipment or procedures are hazardous.

(b) assess the risks (think about what could go wrong and how serious it might be).

(c) decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on).

(d) make sure your teacher agrees with your plan and risk assessment.

NOTE: Your teacher will check your risk assessment against that of your school. If no risk assessment exists for the activity, your teacher may need to obtain special advice. This may take some time.

(e) if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.