LESSON 2
WHY HAS LONDON INTRODUCED THE CONGESTION CHARGE ZONE AND LOW EMISSION ZONE?



THE BIG IDEA

This lesson will introduce more ideas about combustion/incomplete combustion and the production of carbon monoxide, particulates and their relationship to health.

LEARNING OUTCOMES

Could produce and write symbol equations for the combustion of carbon and methane using models.

Should explain how combustion results in the production of carbon dioxide, carbon monoxide and carbon particles.

Should describe the health effects of a build up of carbon monoxide and particulates in the environment.

Must be able to name combustion as the reaction producing energy to drive transport vehicles.

RESOURCES

Resource 2.1: Combustion of methane by Bunsen burner

Resource 2.2: What is particulate matter?

KEY WORDS

- Combustion
- Exothermic
- Heat energy
- Fuel
- Hydrocarbon
- Oxygen
- Chemical reaction
- Congestion zone
- Low emission zone

LESSON 2
WHY HAS LONDON INTRODUCED THE CONGESTION ZONE AND LOW EMISSION ZONE?

YOU WILL ALSO NEED

For: Starter

- Eye protection
- Cut down mineral water bottle with tube to connect to gas tap
- Soap solution
- Metre ruler with clothes peg attached by tape
- Wooden splints

For: Main 1

- Eye protection
- Glass funnel (about 6 cm in diameter)
- x2 Boiling tubes
- x2 Two-holed rubber bungs to fit the boiling tubes, and fitted with one long and one short piece of glass tubing
- Pump
- Glass or plastic tubing for connections
- Candle
- Piece of blue cobalt chloride paper (TOXIC)
- Limewater (treat as IRRITANT), about 20 cm^3

LESSON 2: WHY HAS LONDON INTRODUCED THE CONGESTION ZONE AND LOW EMISSION ZONE?

SETTING THE SCENE

London buses, taxis and cars run mainly on the hydrocarbon fuels, petrol and diesel. Some mainline trains are still diesel trains. Combustion reactions are exothermic and the energy generated by these chemical reactions is used to drive our transport systems. However, additional outputs from these reactions include carbon dioxide, carbon monoxide and carbon particulates as well as a series of nitrogen oxides. Unfortunately these products of combustion are damaging to the environment and the health of Londoners. This lesson focuses on the basics of understanding combustion of hydrocarbons, the products of incomplete combustion and the impact on health.

A 'SPECIAL TRAIN PASSES SOUTH THROUGH SOUTH QUAY DLR STATION

LESSON 2: WHY HAS LONDON INTRODUCED THE CONGESTION ZONE AND LOW EMISSION ZONE?

ACTIVITIES

STARTER: BURNING METHANE BUBBLES

Remind students that most transport relies on combustion reactions directly.

For instructions and standard risk assessment see Conducting a Risk assessment (page 2). Students write down two sentences to describe what they know about combustion using keywords from the list.

MAIN 1

Demonstrate burning hydrocarbon fuels. For instructions see:

nuffieldfoundation.org/practical-chemistry/identifying-products-combustion

Ask the students to construct word equations.

Differentiation

Extend students with a modelling activity to make symbol equations with carbon and oxygen, and methane and oxygen. Students can watch the videos and animations on the following website before making their own models using sweets eg cocktail sticks:

11567.stem.org.uk/v1_1.html

MAIN 2

Model complete and incomplete combustion reactions using Resource 2.1: Combustion of methane by Bunsen burner (page 24).

Possible discussion should include the amount of oxygen in the engine during burning so this can lead to students explaining why carbon and carbon monoxide can be found in exhaust gases of London buses.

Differentiation

To support students give some guidance on how to record observations from the experiment.

MAIN 3

Why is it important to understand combustion reactions for our health?

What impact does the Congestion Charge Zone have on this?

Resource 2.2: What is particulate matter (page 25) gives information on particulates (products of hydrocarbon combustion) and health. Students can read the sheet and watch one of the videos.

Plenary

Students list three new facts they have learnt about combustion in transport and one question they still have.

Further reading

Some careers related sites:

learn.org/articles/What_is_Combustion_Engineering.html

Combustion Engineering Association:

cea.org.uk

Report on air pollution from diesel trains:

londonair.org.uk/london/reports/KCL_Air_pollution_emissions_from_diesel_trains_in_London.pdf

News items on the success of the Congestion Charge Zone can be found at:

bbc.co.uk/news/uk-england-london-21451245

LESSON 2: WHY HAS LONDON INTRODUCED THE CONGESTION ZONE AND LOW EMISSION ZONE?

RESOURCE 2.1: COMBUSTION OF METHANE BY BUNSEN BURNER

Using the Bunsen Burner to model complete and incomplete combustion reactions. You will need:

- Bunsen Burner
- Tripod
- Gauze
- Benchmat
- Tongs

1. Look at the gauze on both sides and write down a description.
2. Set up the Bunsen burner tripod and gauze and light it leaving the air hole closed.
3. After two minutes use the tongs to pick up the gauze (careful very hot). Place upside down on the bench mat. Describe what you can see and what you think has happened to the gauze.
4. Using tongs place the gauze back as it was on the tripod. Now open the air hole on the Bunsen fully and leave for another two minutes.
5. Repeat number 3 above.

What has happened?

Think about the following questions:

- What gas is burning in the Bunsen? What is the gas made from?
- What might happen if there is not enough air for the gas to burn completely?
- When is there more air available for burning in the Bunsen – i.e. air hole open or closed?
- What do you think was left on the gauze after you burnt the gas with the air hole closed?
- What happens when carbon burns in oxygen?
- Why was the gauze clean again at the end?

LESSON 2: WHY HAS LONDON INTRODUCED THE CONGESTION ZONE AND LOW EMISSION ZONE?

RESOURCE 2.2: WHAT IS PARTICULATE MATTER?

There are things floating around in the air. Most of them, you cannot even see. They are a kind of air pollution called particles or particulate matter. In fact, particulate matter may be the air pollutant that most commonly affects people's health.

These particulates are formed in the exhaust of cars and other petrol or diesel forms of transport.

© Transport for London

Breathing it in.

When you inhale, you breathe in air along with any particles that are in the air. The air and the particles travel into your respiratory system (your lungs and airway). Along the way the particles can stick to the sides of the airway or travel deeper into the lungs.

Your body responds to the particulate invasion!

Your lungs produce mucous to trap the particles, and tiny hairs wiggle to move the mucous and particles out of the lung. You may notice something in the back of your throat (this is the mucous); the mucous leaves the airway by coughing or swallowing. If the particle is small and it gets very far into the lungs, special cells in the lung trap the particles and then they can't get out.

Exposure to particulate matter leads to increased use of medication and more visits to the doctor or hospital. Health effects include the following:

- Coughing, wheezing, shortness of breath
- Aggravated asthma
- Lung damage (including decreased lung function and lifelong respiratory disease)
- Premature death in individuals with existing heart or lung diseases