N5

National 5 ENGINEERING SCIENCE

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BrightRED Study Guide

Curriculum for Excellence

N5

ENGINEERING SCIENCE

REVISED AND UPDATED FOR SQA CHANGES

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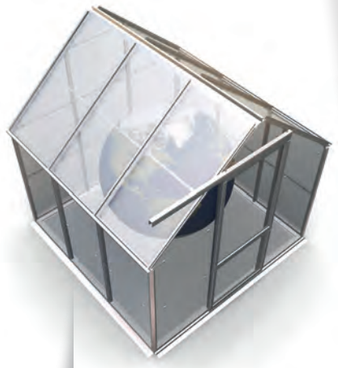
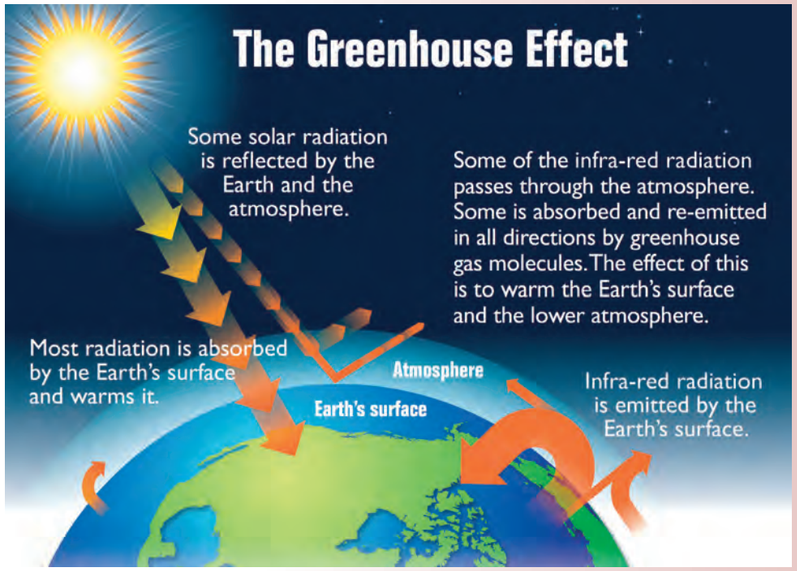
CONTENTS

ENERGY: THE GREENHOUSE EFFECT AND THE CONSERVATION OF ENERGY



THE GREENHOUSE EFFECT

A greenhouse is a house made of glass that is used to grow tomatoes, flowers and other plants in it. A greenhouse stays warm inside, no matter the temperature outside. Sunlight shines in and warms the plants and air inside, but the heat is trapped inside by the glass. The Earth's atmosphere does the same thing as the greenhouse. Gases that have been propelled into the atmosphere, such as carbon dioxide, do what a greenhouse does, and stop the heat escaping. These gases mainly exist through the burning of fossil fuels. This has triggered global warming, which has caused severe weather incidents such as flooding and droughts, a rising sea level and the melting of the polar ice caps.



ONLINE

Click onto the BBC Bitesize link at www.brightredbooks.net to get more information on global warming and the greenhouse effect.

ONLINE

Click onto the Practical Action link at www.brightredbooks.net to play Moja Island to reinforce your understanding of renewable energies.

VIDEO LINK

Check out the clip 'None like it hot' at www.brightredbooks.net for more on global warming.

ONLINE

Click onto the 'My Sustainable House' link at www.brightredbooks.net to play a game to strengthen your understanding of sustainability and energy-saving.

CONSERVATION OF RESOURCES

The law of conservation of energy is: '*Energy cannot be created or destroyed. It can only be changed from one form to another.*' But our current energy use is inefficient and dangerous for the planet. The best thing we can do to help save the Earth is to use and to waste less energy. This will put fewer greenhouse gases into the atmosphere, as well as other poisonous gases which can have dangerous consequences such as acid rain. Acid rain has a lower pH than normal, which can have harmful effects on plants, aquatic animals and infrastructure. In addition to this, it will help to save and prolong the fuels we have left.

Our modern industrialised society has been very wasteful of energy, but there are many ways in which we can improve. Engineers have been working on ways to combat climate change, and many solutions have been put in place to do this. Examples of this are the research into carbon capture and storage, the vast improvement in the efficiency of renewable-energy generators, and the increase in alternative powered transport.

contd

A carbon footprint is the measurement of the total greenhouse gas emissions that are caused directly and indirectly by a person or organisation. We are currently leaving behind a very large carbon footprint, and we need to change this for the sake of our planet. If we use more energy-efficient methods, we could save up to ¾ of all energy we use in our homes, offices, factories and modes of transport. Energy-saving is something that can be easily done, particularly at home. For example, we can reduce our carbon footprint by switching off unneeded electrical items overnight, or at least putting them into stand-by mode. If every Sky box in the UK was turned onto stand-by overnight, the amount of energy saved would be enough to power Birmingham for a whole year!

THINGS TO DO AND THINK ABOUT

Pick a type of renewable energy and complete these sentences.

- Renewable energy is good because ...
- But it has some problems, for example ...
- I think to meet Scotland's energy needs in the future we should ...
- I can reduce my carbon footprint by ...

ONLINE

Go to the 'WWF Footprint Calculator' link at www.brightredbooks.net to work out your carbon footprint and find out ways to reduce this.

ONLINE TEST

Head to www.brightredbooks.net to test yourself on energy.

DON'T FORGET

As a future engineer, your role is directly and indirectly about saving the planet. By knowing what your waste energy is, it allows you to make your engineering solutions more efficient by trying to reduce or remove these. The more efficient a design is, the more the client will save money, meaning they are more likely to use your solution.

VIDEO LINK

Watch the video at www.brightredbooks.net to get a greater understanding of the need for sustainable energy.

MECHANISMS AND STRUCTURES

STRUCTURES: STRENGTH OF STRUCTURES

ONLINE

Follow the link at www.brightredbooks.net to get a greater understanding of a career in structural engineering.

WHAT IS STRUCTURAL ENGINEERING?

Structural engineers help to create the constructed world that's all around us – whether this is bridges, tunnels or buildings.

Structural engineers are concerned with all aspects of a structure and its stability, meaning that they must be specialists in design, construction, repair, conversion and conservation. They are an integral part of a design and construction team, working alongside civil engineers, architects and other professionals to create a safe working structure.

Every structure has to deal with the conditions in which it is built. Houses in Norway and Canada will have to deal with large amounts of snow. Their roads have to deal with being frozen for prolonged periods of time. Buildings near the edge of tectonic plates have to deal with earthquakes. Bridges all around the world will need to carry different kinds of weights and loads. It is a structural engineer's job to consider all possible factors.

WHAT IS A STRUCTURE?

A structure can be defined as something that has an arrangement of parts that are joined together in a manner which provides some sort of strength. This means it is able to carry some form of load. There are many different types of structure from buildings to bridges, from chairs to vehicles.

The factors which contribute to the strength in a structure are:

- the materials used
- the shapes of the parts
- the methods used to join the parts together
- the manner in which they are arranged.

MATERIAL CHOICE

One thing a structural engineer would have to consider is the material being used – and this decision could include several different engineers to ensure that the correct material has been chosen. For example, a chemical engineer may be part of this discussion, as they would have the knowledge of how the material would react in different conditions, or what finish could be used to help protect it from the elements.

If you are asked to choose a material or a potential material for an engineering challenge, there are several things you could base this decision on.

First, how much will it cost? Engineers are given a budget when designing an engineering solution, and this has to be stuck to.

Second, will it corrode? For example, if you decided that steel was the material you would use, this will rust. Does this mean it will need to be painted or given some sort of rustproof finish?

Third, what are the properties of the material, and will it be suitable? Every material has strengths and weaknesses that will affect its performance.

Strength

A strong material can resist force. Some materials, like mild steel, are strong in tension but weak in compression. The opposite is also true for some materials that are strong in compression but weak in tension, like concrete. This is one of the reasons that concrete is often reinforced with mild steel.

Elasticity

An elastic material can return to its original length or shape once a load or force has been removed. For example, rubber is seen as having high elasticity.

Plasticity

A material with plasticity can change its shape or length under a load and can stay deformed even when the load is removed. 'Play-doh' has high plasticity.

Brittleness

A material is brittle if it can be easily cracked, snapped or broken.

Toughness

A tough material can absorb a sudden sharp load without causing permanent deformation or failure. Tough materials also need to have high elasticity.

Hardness

A hard material can resist erosion or surface wear.

Ductility

A ductile material can be stretched without breaking, and can be formed into shapes such as very thin sheets or very thin wire. Copper is seen as ductile.

You do not need to remember these properties in National 5, but they are good reference if you have to decide on a material for an engineering solution.

DON'T FORGET

If you are ever asked to choose a material for a potential engineering solution, always make sure you have analysed the requirements and compared a minimum of 2 suitable possibilities – and then make a choice, justifying that decision.

THINGS TO DO AND THINK ABOUT

Copy and complete this table.

Add extra materials, and think of their uses and what the material properties would be.

Material	Uses	Material properties
Nylon fibres	tights	elastic
Polyethylene	washing-up bowl	tough, brittle
Rubber		
Wood		

ONLINE TEST

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ENGINEERING SCIENCE

Paul MacBeath

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- **A glossary of key terms** helps you really learn and revise important course concepts.

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