

# Science KS4

## Blended Learning

### C10 Sustainable Development

Name:

Form:

*Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan*

*All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.*

*The online textbook has all the key information and vocabulary to help you with this unit*

**To log on to the online textbook:**

- <https://connect.collins.co.uk/school/portal.aspx>
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year



School name: Stewards Academy - CM18 7NQ(CM18 7NQ) : [Not your school?](#)

Date of birth   First letter of surname

Year group

[Login](#)



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Lesson - Revision

Knowledge organiser

SAL

**(T) = Triple scientists only**



# Big Picture – Year 11 Overview Science

Next step...

GCSE's  
Good Luck



End of Unit Test

Gravity (T)

Red-shift (T)

How elements were formed (T)

Life cycle of stars (T)

Moons, planets and artificial satellites (T)

I will be able to explain how our solar system is organized and how its existence is affected by the lifecycle of a star (T). I will be able to explain how objects move in space and how space itself is ever increasing in size (T). I will be able to explain the importance of red-shift as evidence for the Big Bang theory (T). I will be able to describe the importance of the role of gravity in space (T).

Space



End of Unit Test

UNIT P8 (T)

The solar system (T)

Alternative methods of metal extraction

Preventing corrosion and using alloys (T)

Ceramics, polymers and composites (T)

Production and use of fertilisers (T)

End of Unit Test

UNIT P8 (T)

The solar system (T)



Sustainability

I will be able to explain how we can sustain resources for future generations. I will be able to describe the processes required to make water potable and also process required to treat sewage and waste water. I will be able to describe methods for reducing resource waste and lessening the environmental impact of removing resources from the Earth. I will be able to describe alternative methods of extracting metals. Finally, I will be able to describe the importance of fertilisers in maintaining food security (T)

LCA's and recycling

Portable and waste water

Sustainable use of the Earth resources

End of Unit Test

Food security and biotechnology (T)

Maintaining biodiversity

Waste management and pollution



Ecology

I will be able to describe the factors that affect living organisms within a habitat. I will be able to explain how plants and animals interact within a habitat. I will be able to explain how human activities impact biodiversity. I will be able to explain how carbon and water are recycled and how factors affect the rate of decay (T)

Land use and changing environments (T)

Transformers (T)

End of Unit Test

UNIT B8

Investigating ecosystems

Predator prey relationships

Trophic levels and transferring biomass (T)

Water cycle, carbon cycle and decay (T)

I will be able to describe the shape of the magnetic field that surrounds a magnet. I will be able to explain how an electric current can be used to generate a magnetic field and give some example of the uses of electromagnets (T). I will be able to explain how a motor works. I will be able to explain how a transformer works and how this links to supplying electrical energy efficiently.

Electromagnetism



Loudspeakers (T)

Force on a conductor and electric motors

Electromagnets and their uses (T)

Magnetic forces and fields

UNIT P7

End of Unit Test

Atmospheric pollutants and their effects



The Atmosphere

I will be able to describe what the early atmosphere was like and how and why it changed. I will be able to explain the consequences of the green house effect, how humans add to the impact of the green house effect and what we can do to reduce this. I will be able to describe how various atmospheric pollutants are formed and the effects that they have on the environment.

UNIT C9

The early atmosphere

Evolution of the atmosphere

Human impact on Greenhouse gases

Global climate change

Carbon footprints

End of Unit Test

I will be able to explain what causes variation and its effects on the individual. I will be able to explain how variation contributes to natural selection and the evolution of new species. I will be able to describe the causes of extinction.

Variation & Evolution



Classification - The tree of life

Genetic engineering and cloning (T)

Natural selection and selective breeding

Darwin and Wallace (T)

Variation and evolution

UNIT B7

Year 11

- Sustainability Consultant
- Waste Management
- Recycling Centre Operator



# MY LEARNING JOURNEY:

*Subject: Sustainable Development Year: 11 Unit: C10*

**AIMS**

Students will learn about how we can sustain resources for future generations by reducing waste, recycling and the use of modern technology. How we can ensure access to clean drinking water and the importance of water treatment plants. They will further develop ideas regarding land use for farming and optimising food production. Students will learn about the different aspects of sustainable development. They will find out what is required to produce potable water and to treat waste water. They will consider alternative methods to extract a metal from low-grade ores that avoid the environmental impact of mining. Students will fit their knowledge of recycling into a wider framework of life cycle assessments (LCAs), in which they will compare the impact of products from their raw materials through to their disposal. They will study recycling alongside reusing and reducing resource use.

**DEVELOPING COURAGE**

C The future of the planet is in your hands  
 O Investigate issues sustainability  
 U We need to work together to use the World's resources responsibly  
 R Make responsible well researched choices as a consumer  
 A What a special and unique place the Earth is  
 G Aim to leave the world a better place for future generations  
 E Knowing that we can take action now to preserve resources for future generations

**PREVIOUS LEARNING**

Pupils will have some knowledge about using natural resources versus man made resources and the need to re-use and recycle. They will understand the importance of the water cycle and how it provides us with fresh drinking water. They will also be aware of the need for farmers to provide enough food to feed an increasing population a healthy diet, and the need for food production to be maximised using fertilisers.

**WHAT WE KNOW/REMEMBER**

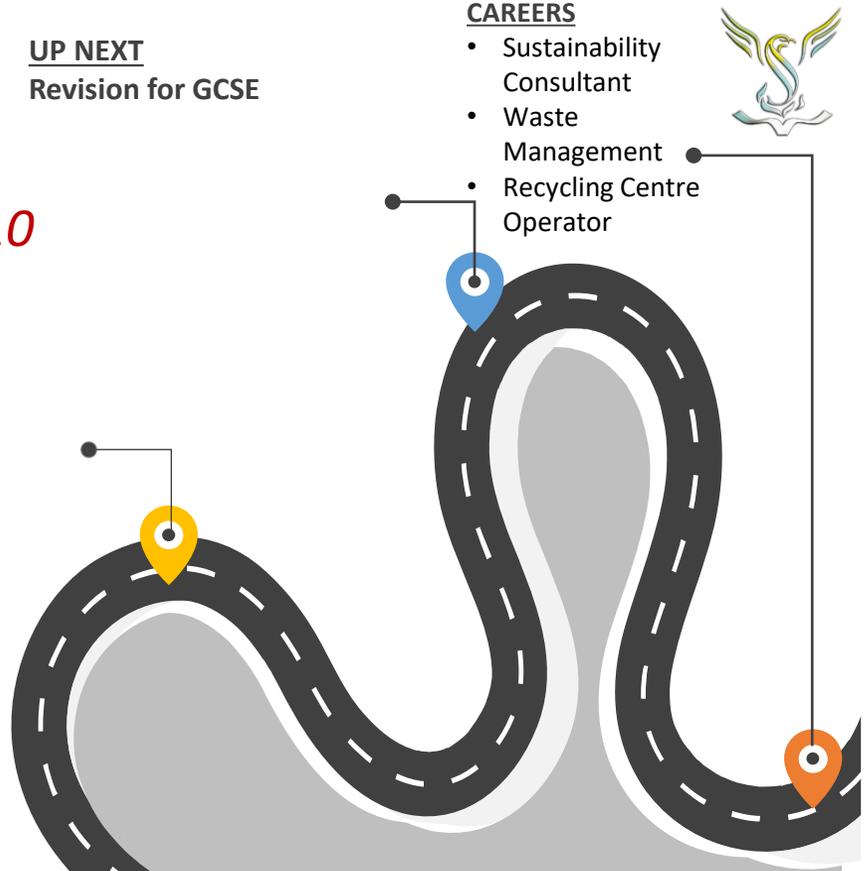
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**RECOMMENDED READING**

1. What A Waste: Rubbish, Recycling, and Protecting our Planet by Jess French.
2. This Book is Not Rubbish: 50 Ways to Ditch Plastic, Reduce Rubbish and Save the World! by Isabel Thomas.
3. Introducing Natural Resources by Graham Park

**PERSONAL OBJECTIVES**

- .....
- .....
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## Connection

Have a look at the topic overview and the C10 zoom in.

Populate what you know and your personal objectives.

## Lesson 1: C10.1- Using the Earth's Resources and Sustainable development

### Activation

**LI: Distinguish between finite and renewable, and sustainable resources and identify where they are used.**

1. <https://www.youtube.com/watch?v=obb-ZHqBw10>
2. Make a note of the title and the LI
3. Read pages 324-325
4. Define 'Resources, Sustainable, Finite'
5. Think of ways that resources can be made sustainable.

### Consolidation

Complete and self-assess the relevant past paper question for this topic - From the C10 DIP file

### Demonstration

Attempt questions 1-6.  
In 15 mins answer as many questions as you can.  
Self-mark the questions you have done making any necessary corrections in blue pen

### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:  
Green questions to GCSE Level 3  
Blue questions to GCSE Level 6  
Purple questions to GCSE Level 9

# Answers: C10.1 Earths Resources and Sustainable Development

## Connection

- 1 NA
- 2 NA
- 3 NA

## Demonstration

- 1 Ruler / Window frame etc.
- 2 Many clothes / fabrics e.g. shirts made of polyester
- 3 Finite resources will run out since they cannot be made again e.g. crude oil
- 4a Finite. It takes a long time to form sand (thousands / millions of years). However it is abundant.
- 4b Finite. Only a small proportion of the Earth's water is fresh water (the rest is salt water etc.). It is not easy to make large quantities of water.
- 4c Finite. Coal is a fossil fuel formed over millions of years and is non-renewable.
- 4d Wood is renewable. Trees can be regrown for wood in tens of years.
- 5 There is a plentiful supply of aggregates. Slate is finite and non-renewable so its use needs to be limited.
- 6 Sustainability: The process consumes much energy which most likely comes from fossil fuels.  
Fossil fuels are non-renewable and finite. Environmental: Carbon dioxide is produced. It is a greenhouse gas and may be contributing to global warming.

## Connection

Q1. What is finite resource?

Q2. List three Fossil Fuels.

Q3. Are Fossil fuels renewable or non renewable?

## Lesson 2: C10.2 – Potable Water

### Activation

**LI: Distinguish between potable water and pure water and know how ground water and salty water are treated to produce potable water.**

1. <https://www.youtube.com/watch?v=PDeiRIQvWnM>
2. Make a note of the title and the LI
3. Read pages 326-327
4. Define 'Potable, Sedimentation, Desalination'
5. Name the sources of where water can come from.



## Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

## Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher



## Demonstration

Attempt questions 1-8.

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:

Green questions to GCSE Level 3

Blue questions to GCSE Level 6

Purple questions to GCSE Level 9



# Answers: C10.2 – Potable Water

## Connection

- 1 Something that has limited quantities and non renewable
- 2 Coal, Oil, Gas
- 3 Non Renewable

## Demonstration

- 1
  - Rain collects in the ground (ground water), reservoirs, lakes and rivers.
  - It is then treated in 3 stages.
  - Sedimentation of particles. The particles drop to the bottom of the treatment tank.
  - The water is filtered through sand so that the very fine particles are removed.
  - Microbes such as bacteria are killed by sterilisation e.g. using chlorine, ozone or ultraviolet light.
- 2 So that the water is free of microbes when it is piped to the customer. If it was sterilised earlier, microbes might reappear later in the water treatment.
- 3 No. The water is contaminated with bacteria and needs to be sterilised.
- 4 The UK has lots of rain and therefore is self-sufficient when it comes to fresh water. Spain is a hot country with a limited supply of fresh water.
- 5 To distill water it has to be heated. Generally, the energy required to heat the water will come from the combustion of fossil fuels (although renewable energy could be used e.g. solar power).
- 6
  - Collect rain water and use in the garden rather than use tap water.
  - Buy toilets that use less water per flush.
  - Wash fruit and vegetables in a bowl, not under a running tap.
  - Use a washing machine and dishwasher only when they have a full load.
  - Have a short shower rather than a bath.
- 7
  - Recycle / reuse water.
  - More efficient irrigation equipment
  - Water crops only when there has not been rain.
  - Design / modify the industrial process so that it uses less water.
- 8a  $1675/190 = 8.8$  times the consumption in Sub-Saharan Africa.
- 8b Lack of water availability, dry climate and lack of infrastructure to distribute water.

## Lesson 3: C10.3 – Analysis and purification of water samples from different source

### Connection

Q1. Is Potable water pure water?

Q2. What should the pH of pure water be?

Q3. How can rain water be collected in the UK?

### Activation

**LI: Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.**

1. [https://www.youtube.com/watch?v=cma\\_FHUXzEA](https://www.youtube.com/watch?v=cma_FHUXzEA)
2. Make a note of the title and the LI
3. Read pages 328-329
4. Define “Distillation, Boiling Point, Purity”
5. Draw figure 10.8



### Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

### Demonstration

Attempt questions 1-14.

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen



### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher



Challenge yourself to answer as many as you can:

Green questions to GCSE Level 3

Blue questions to GCSE Level 6

Purple questions to GCSE Level 9

# Answers: C10.3 - Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation

## Connection

- 1 No. It means safe to drink
- 2 7 (Green)
- 3 Reservoirs

## Demonstration

- 1 A  $(0.5/1.0) \times 30 = 15$  B  $(0.2/1.0) \times 30 = 6$  C  $(0.3/1.0) \times 30 = 9$
- 2 Use a pH meter (universal indicator solution / paper could be used but would not be as accurate). 3 Is there any pollution from the dairy farm e.g. waste from cows, bacteria, antibiotics etc. Are there any lead compounds in the water? Lead is toxic.
- 4 So that the water boils and the gas (steam) can be condensed into the beaker.
- 5 To condense the water after it has boiled in the flask.
- 6 The contents of the flask are heated. The water (solvent) evaporates. It then cools and condenses in the condenser. The dissolved salt does not evaporate.
- 7 To make sure that only water, which boils at 100 °C, is collected.
- 8 The forces between the oppositely charged ions in the salt (which attract) are much greater than the intermolecular force between water molecules. So at 100 °C, the water molecules have sufficient energy to break free of the liquid and become a gas but the salt doesn't.
- 9 The cooling is more effective / the condenser fills more completely / less air bubbles when the water flows from the bottom / greater flow of water.
- 10 All 3 samples were purified by distillation. The 3rd sample is the purest after distillation (closer to 100 °C) and therefore contained the least amount of salt.
- 11 Take more samples overall. Take more samples in sections B and C since they are most likely to be polluted. Sample the water at different times during the day (and night) since pollution may vary.
- 12 Repeat the distillation with the water that was distilled. Keep repeating until the boiling point is (close to) 100 °C. A more accurate thermometer would have allowed purity of the distillate to be judged more accurately. A calibrated pH meter would give the most accurate pH readings.
- 13 Analyse for the presence of: • Bacteria • Ions such as  $\text{Ca}^{2+}$  • Chlorine • Suspended particles • Organic material • Medicines
- 14a Before: 102 °C. After: 101.3 °C.
- 14b Average in this case. It improves accuracy by reducing the effect of random error.
- 14c Separate values. The samples indicate the pH at different locations which is of more interest – the pH may vary considerably depending on conditions. The average value would not give information about specific locations.

## Lesson 4: C10.4 – Waste Water Treatment

### Connection

Q1. Define Potable Water.

Q2. What is the Boiling Point of pure Water

Q3. Name the process used to separate salt from water.

### Activation

**LI: Know how wastewater is treated to provide potable water.**

1. <https://www.youtube.com/watch?v=YW6GBciRHLg>
2. Make a note of the title and the LI
3. Read pages 330-331
4. Define “Sewage, Anaerobic, Aerobic’
5. Draw figure 10.10



### Consolidation

Complete and self assess the relevant past paper question for this topic - From the C10 DIP file

### Demonstration

Attempt questions 1-6.  
In 15 mins answer as many questions as you can.  
Self mark the questions you have done making any necessary corrections in blue pen



### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:  
Green questions to GCSE Level 3  
Blue questions to GCSE Level 6  
Purple questions to GCSE Level 9



# Answers: C10.4 – Waste Water Treatment

## Connection

- 1 Water that is safe to drink
- 2 100 Degrees Celsius
- 3 Evaporation

## Demonstration

- 1 Water from the oceans evaporates into the atmosphere. Then it condenses to form clouds. Clouds move and rain falls into rivers, lakes, and aquifers (an aquifer is an underground layer of water bearing rock).
- 2 There is a low population density in rural areas. It is not economical to pipe sewage to a treatment plant. So each house has a septic tank to deal with waste water.
- 3 Particles of sediment sink to the bottom of the water. However not all particles sink to the bottom. Some remain suspended.
- 4 Large population densities in urban areas produce large quantities of waste water and sewage. Waste water may contain pollutants that need to be removed. This cannot be dealt with "locally" due to shortage of space. So the sewerage system has been designed to treat waste water at convenient locations.
- 5 Australia is one of the driest continents on Earth. Australia has a large water footprint. Most of it is used for agriculture. Therefore it will be difficult for Australia to reduce its water footprint.
- 6 Groundwater: Relatively easy. Can be easily extracted and does not need much treatment. Waste water: Difficult. Contains a variety of solid waste and pollutants. Removal of these is a difficult process requiring several stages. Saltwater: It is not difficult to distill salt water for instance. However it is expensive in terms of energy and difficult to meet demand for fresh water using this method.

## Lesson 5: C10.5 – Alternative Methods of Metal Extraction

### Connection

Q1. How is waste water collected in rural areas?

Q2. Why is sewage water treated?

Q3. What is an aquifer?

### Activation

**LI: Know how phytomining and bioleaching can be used to extract copper from low grade ores, and be able to evaluate alternative methods of metal extraction.**

1. <https://www.youtube.com/watch?v=XF399zN36LE>
2. Make a note of the title and the LI
3. Read pages 332-333
4. Define “phytomining & Bioleaching”



### Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

### Demonstration

Attempt questions 1-6

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen



### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher



Challenge yourself to answer as many as you can:

Green questions to GCSE Level 3

Blue questions to GCSE Level 6

Purple questions to GCSE Level 9

# Answers: C10.5 – Alternative Methods of Metal Extraction

## Connection

- 1 Septic Tank
- 2 to make it safe for the waterways
- 3 underground layer of water bearing rock

## Demonstration

- 1 • Copper ores are becoming scarce so new ways of extracting copper from low grade ores is needed.
  - Demand for copper is high.
  - Traditional mining is damaging to the environment.
- 2 Some plant roots selectively absorb compounds containing metals e.g. copper compounds. These plants are then harvested and burned. Their ash contains the metal compound.
- 3 Bacteria are used to produce a leachate solution containing copper compounds. Then the copper compound can be reacted with scrap iron. Iron is more reactive than copper and displaces it from the copper compound.
- 4 The fact that it is slow makes bioleaching less economical. The sulfuric acid may cause environmental problems e.g. leak into the ground or surface water and make it acidic.
- 5 Bioleaching costs are high and the process is quite slow. So it is often not economic for a company to use this method on a large scale in remote areas. Mining has adverse environmental consequences. However, it is capable of producing large quantities of the metal rapidly. So it is more economic.
- 6  $1.9 \times 10^7 \times 0.2 \times 0.9 = 3.42 \times 10^6$  tonnes of copper.

## Lesson 6: C10.6 – Life Cycle Assessment and Recycling

### Connection

Q1. What is bioleaching?

Q2. What is phytomining?

Q3. What is a displacement reaction?

### Activation

**LI: Interpret and carry out simple life cycle assessments for objects such as shopping bags.**

1. [https://www.youtube.com/watch?v=ScY\\_Yb1V8AY](https://www.youtube.com/watch?v=ScY_Yb1V8AY)
2. Make a note of the title and the LI
3. Read pages 334-335
4. Define "Life Cycle Assessment & Extraction"
5. Draw and label fig 10.17



### Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

### Demonstration

Attempt questions 1-7

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen



### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher



Challenge yourself to answer as many as you can:

Green questions to GCSE Level 3

Blue questions to GCSE Level 6

Purple questions to GCSE Level 9

# Answers: C10.6 – Life Cycle Assessment and Recycling

## Connection

- 1 process that uses bacteria to leach metal compounds from rocks
- 2 process that uses plants to extract metals
- 3 chemical reaction where an element takes the place of or ‘pushes out’ another element from a compound

## Demonstration

- 1 Paper is renewable (trees can be grown in tens of years). Plastic comes from non-renewable crude oil. So paper as a raw material is more sustainable in this case.
- 2 Both paper and plastic can be recycled. Paper is biodegradable - it breaks down quite quickly in landfill sites. Plastic can take hundreds of years to break down. So paper is easiest to dispose of.
- 3 It is the assessment of the environmental impact at every stage including the recycling of the product into a new product.
- 4a Qualitative and subjective.
- 4b Quantitative and objective.
- 5 The students do not have any quantitative data to make objective statements about CO<sub>2</sub> produced. So their LCA will have to be based on subjective opinion. There opposing viewpoints may lead them to different conclusions.
- 6 Manufacturing: They use totally different processes. Use and operation: Plastic bags potentially last longer since paper bags tend to rip. However much plastic bag use is once only. Disposal: Both paper and plastic bags can be re-used. However, plastic bags are stronger and can be reused more often. Both paper and plastic can be recycled. Transport: Paper bags are bulkier and heavier than the equivalent plastic bags. Therefore transport costs for paper bags will be higher. Emissions and waste: The carbon footprint for a plastic bag is less than for a paper bag. Both cause environmental problems. Waste paper is biodegradable but plastic is often non-biodegradable and can last for hundreds of years in landfill sites.
- 7a This data is an average. As such, it is not necessarily directly applicable to all situations.
- 7b Cost. The manufacturer has to take into account cost and this may influence which materials and methods are used. Cost also influences the consumer.

## Lesson 7 C10.7 – Ways of reducing the use of Resources

### Connection

Q1. Name a renewable resource?

Q2. Name a non-renewable resource?

Q3. Where is waste taken to that is deemed non-renewable?

### Activation

**LI: Describe ways of recycling and reusing materials and explain why these are needed. Evaluate ways of reducing the use of a limited resource.**

1. Make a note of the title and the LI
2. <https://www.youtube.com/watch?v=ARBqPuvYq0c>
3. <https://www.youtube.com/watch?v=LxNumOifkT0>
4. Read pages 336-337
5. Define 'Recycling, Reduction and Reuse'
6. List three things that can be recycled



### Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

### Demonstration

Attempt questions 1-9

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen



### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:

Green questions to GCSE Level 3

Blue questions to GCSE Level 6

Purple questions to GCSE Level 9



# Answers: C10.7 – Ways of reducing the use of Resources

## Connection

- 1 Paper
- 2 oil
- 3 Landfill sites

## Demonstration

- 1 • Quarrying may result in extra noise and heavy traffic.
  - There may be air pollution e.g. dust.
  - The quarry has a visual impact and may disfigure the local environment.
  - There may be damage to plant and animal life
- 2 Metal and glass are produced from a limited supply of raw materials. Extracting these raw materials has a negative environmental impact e.g. in the energy consumed. If metal and glass is recycled (or reused) it conserves the Earth's resources and has less of an environmental impact.
- 3 Reusing a product requires less energy and resources than recycling. For instance, if a plastic bag is recycled, it must be broken down and remade into another product.
- 4 Crude oil is a finite, non-renewable resource. Crude oil fractions are used as fuel, for making plastics and chemicals and in many other processes. So the use of crude oil needs to be limited.
- 5 Use cotton for clothes and fabrics rather than polymers such as polyester and nylon. Make furniture out of wood rather than plastic. Use paper cups rather than plastic cups.
- 6 Reduce: Cars consume energy, cause pollution and use valuable resources. These could be reduced by car sharing, walking, cycling, taking public transport or not buying a car in the first place. Reuse: Parts of cars can be reused e.g. for spare parts for cars of the same model. Recycle: The metal and some of the plastics in cars can be recycled.
- 7 It will save resources if they are manufactured near to the market. Cars are large and heavy. It requires much energy to transport cars long distances (fuel for ships, car transporters etc.).
- 8 Recycle any waste metal from the process back into the production line or use it for other purposes. Make sure that the assembly runs on the minimum amount of energy or use renewable energy.
- 9a Reduction in use of energy since 80% less bags are being manufactured. Reduction in use of crude oil since plastic is derived from substances that are derived from crude oil. Reduction in waste in landfill sites. Reduction in energy needed to recycle the bags.
- 9b  $1.52 \times 10^9$

## Lesson 8: C10.8 – Corrosion and it's Prevention

### Connection

Q1. What is the benefit of reusing a product?

Q2. What are the disadvantages of using a car?

Q3. How could you reduce car use?

### Activation

**LI: Describe and interpret experiments on rusting and explain methods of preventing corrosion.**

1. <https://www.youtube.com/watch?v=q0CAfXV-YdY>
2. Make a note of the title and the LI
3. Read pages 338-339
4. Draw figure 10.25



### Consolidation

Complete and self assess the relevant past paper question for this topic -  
From the C10 DIP file

### Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

### Demonstration

Attempt questions 1-7

In 15 mins answer as many questions as you can.

Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:

- Green questions to GCSE Level 3
- Blue questions to GCSE Level 6
- Purple questions to GCSE Level 9



# Answers: C10.8 – Corrosion and it's Prevention

## Connection

- 1 Less energy used to produce a new one
- 2 Use of energy and pollution
- 3 Walk, Drive share, Bus, Bike

## Demonstration

- 1 The desert is dry with low humidity whereas the UK has lots of rain. Without water, rusting cannot occur.
- 2 Dissolved oxygen is present in shallow water. Rusting requires both water and oxygen.
- 3 It prevents water (and oxygen) from coming into contact with the iron.
- 4 If the paint is scratched or comes off, then oxygen and water will come into contact with the iron again and it will rust.
- 5 Magnesium is more reactive than zinc so offers better protection to the iron.
- 6 Paint. Prevents water (and oxygen) from coming into contact with iron.  
Galvanising. Prevents water (and oxygen) from coming into contact with iron. Zinc is more reactive than iron so it also provides sacrificial protection. When the surface is scratched, the zinc reacts rather than the iron.
- 7a  $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$
- 7b The electrons from the magnesium are accepted by the  $\text{Fe}^{3+}$  ions which are reduced to iron atoms again.
- 7c It dissolves as  $\text{Mg}^{2+}$  is formed.