

Curriculum Links

Activity 2A – Plant material testing

The Department for Education is conducting a review of the primary and secondary National Curriculum. The links below relate to the statutory programmes of study for science in the National Curriculum, 2007 and specific sections of common science qualifications offered in UK schools.

Key stage 3

1.1 Scientific thinking

b. critically analysing and evaluating evidence from observations and experiments.

1.2 Applications and implications of science

a. exploring how the creative application of scientific ideas can bring about technological developments and consequent changes in the way people think and behave.

2.1 Practical and enquiry skills

Pupils should be able to:

- use a range of scientific methods and techniques to develop and test ideas and explanations
- assess risk and work safely in the laboratory, field and workplace
- plan and carry out practical and investigative activities, both individually and in groups.

3.3 Organisms, behaviour and health

a. life processes are supported by the organisation of cells into tissues, organs and body systems

d. all living things show variation, can be classified and are interdependent, interacting with each other and their environment

3.4 The environment, Earth and universe

c. human activity and natural processes can lead to changes in the environment.

Key stage 4

1 How science works

1.1 Data, evidence, theories and explanations

Pupils should be taught:
b. how interpretation of data, using creative thought, provides evidence to test ideas and develop theories

1.2 Practical and enquiry skills

Pupils should be taught to:

- a. plan to test a scientific idea, answer a scientific question, or solve a scientific problem
c. work accurately and safely, individually and with others, when collecting first-hand data

1.4 Applications and implications of science

Pupils should be taught:

- a. about the use of contemporary scientific and technological developments and their benefits, drawbacks and risks
b. to consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions

2.1 Organisms and health

In their study of science, the following should be covered:

- a. organisms are interdependent and adapted to their environments
b. variation within species can lead to evolutionary changes and similarities and differences between species can be measured and classified
c. the ways in which organisms function are related to the genes in their cells

2.2 Chemical and material behaviour

In their study of science, the following should be covered:

- c. new materials are made from natural resources by chemical reactions
d. the properties of a material determine its uses.

2.3 Energy, electricity and radiations

In their study of science, the following should be covered:

- a. energy transfers can be measured and their efficiency calculated, which is important in considering the economic costs and environmental effects of energy use

2.4 Environment, Earth and universe

In their study of science, the following should be covered:

- a. the effects of human activity on the environment can be assessed using living and non-living indicators
b. the surface and the atmosphere of the Earth have changed since the Earth's origin and are changing at present

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AQA Chemistry and Science A GCSE

Unit C1.4 Crude oil and Fuels C1.4.3 Hydrocarbon fuels

e) Biofuels, including biodiesel and ethanol, are produced from plant material. There are economic, ethical and environmental issues surrounding their use.

AQA Biology and Science GCSE

B1.5.1 Energy in biomass

a) Radiation from the Sun is the source of energy for most communities of living organisms. Green plants and algae absorb a small amount of the light that reaches them. The transfer from light energy to chemical energy occurs during photosynthesis. This energy is stored in the substances that make up the cells of the plants.

B1.6.2 The carbon cycle

a) The constant cycling of carbon is called the carbon cycle.

In the carbon cycle:

- carbon dioxide is removed from the environment by green plants and algae for photosynthesis
- the carbon from the carbon dioxide is used to make carbohydrates, fats and proteins, which make up the body of plants and algae
- when green plants and algae respire, some of this carbon becomes carbon dioxide and is released into the atmosphere

AQA Biology, Science and Additional Science GCSE

B2.3 Photosynthesis

Green plants and algae use light energy to make their own food. They obtain the raw materials they need to make this food from the air and the soil.

B2.3.1 Photosynthesis

a) Photosynthesis is summarised by the equation:

light energy

carbon dioxide + water → glucose + oxygen

b) During photosynthesis:

- light energy is absorbed by a green substance called chlorophyll, which is found in chloroplasts in some plant cells and algae
- this energy is used by converting carbon dioxide (from the air) and water (from the soil) into sugar (glucose)
- oxygen is released as a by-product.

f) Some glucose in plants and algae is used: ■ to produce cellulose, which strengthens the cell wall

AQA Science B

3.3.2.3 The importance of carbon

Candidates need to understand that:

Carbon is the basis of all organic molecules and is the major element within our bodies. The carbon cycle is the process through which carbon is cycled through the air, ground, plants, animals, and fossil fuels. Large amounts of carbon exist in the atmosphere as carbon dioxide (CO₂). Carbon dioxide is cycled by green plants and algae during photosynthesis to make organic molecules. Decomposers break down dead organic matter, and release carbon dioxide into the air. Carbon is also 'locked away' in fossil fuels such as coal, petroleum and natural gas.

Candidates need to:

1. Know that carbon dioxide is removed from the environment by green plants and algae for photosynthesis.
2. Know that the carbon from the carbon dioxide is used to make carbohydrates, fats and proteins, which make up the bodies of plants and algae.
4. Understand that when green plants, algae and animals respire some of this carbon becomes carbon

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dioxide and is released into the atmosphere.

5. Understand that when plants, algae and animals die, some animals and microorganisms feed on their remains and release carbon dioxide into the atmosphere when they respire.

AQA Biology and Science GCSE

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AQA Science B GCSE

3.4.2.3 Generation and distribution of electricity

Candidates need to:

1. Define the terms renewable and non-renewable in the context of energy sources.
2. Know that fossil fuels (natural gas, oil and coal) release energy when they are burned, which can be used to generate electricity for our homes.
3. Explain how nuclear fuels and renewable energy sources (wind, solar, hydroelectric, wave, tidal, biomass and geothermal) may be used as alternatives to fossil fuels.
5. Explain the problems of using nuclear fuels (problems of radioactive emissions, disposal of waste) and of using renewable energy sources (unreliability and possible effects on the environment).

Within this context, candidates should be able to use scientific data and evidence to discuss, evaluate or suggest implications of the following:

- the environmental impact over time of energy production by comparing the advantages and disadvantages of using alternative energy sources
- the economic impact of using alternative energy sources

AQA Environmental Science GCSE

A2.4 What alternative energy technologies are available?

Scientists have developed alternative technologies to harness energy from sources other than fossil fuels. Environmental scientists use their knowledge to assess these alternatives for their efficiency and potential environmental impact.

Scientists have also developed methods of electricity generation from renewable resources that may be used instead of fossil fuels.

Candidates should know and understand that:

- renewable energy resources are usually sustainable:
- not depleted by use including wind power
- capable of rapid replacement including biofuels
- most renewable energy resources:
- use kinetic energy to turn generators, which produce electricity (exceptions include solar water heating, photovoltaics, geothermal and biofuels)
- usually need larger areas than thermal power stations to yield the same amount of energy

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- may be unreliable or cannot provide a constant supply of energy
- may detract from the appearance of a land/seascape (A1)
- may affect wildlife populations or habitat (B1)

Agricultural scientists have developed plant crops, together with the use of animal and plant waste to produce renewable biofuels.

Candidates should know and understand that:

- biofuels, eg biogas, bioethanol, biodiesel, are also renewable and can:
 - be burned to produce heat but release carbon dioxide
 - be used as vehicle fuel
 - be 'carbon neutral' or 'green' as carbon dioxide taken out of the air by photosynthesis when energy crops grow is returned when the fuel is burnt so that no extra is added to the atmosphere (B2)
 - be a waste product eg from sewage plants, poultry farms (A1)
 - be environmentally damaging when land is cleared, and biodiversity (B1) and food-producing farmland are lost (A1)
 - *have a lower energy density than fossil fuel*

Environmental scientists use their knowledge of chemistry, physics and biology to consider both the advantages and disadvantages of various energy resources. They consider a number of factors before making conclusions and recommendations.

Candidates should be able to:

- describe: biofuels
- in terms of:
 - efficiency
 - predictability
 - intermittency
 - energy density*
 - potential environmental impact including:
 - emissions to air/water
 - mining/quarrying land take
 - disturbance to sediment patterns/water flow
 - hazardous waste
 - disruption of wildlife
 - noise/radio disturbance
 - loss of landscape value

Opportunities to investigate using scientific knowledge and skills:

- the amount of energy produced by different vegetable oils/alcohols
- the rise in temperature in a compost heap over time
- public attitudes towards different energy producing technologies

OCR Biology B Gateway GCSE

Module B6: Item B6d: Biofuels

Assessable learning outcomes both tiers: standard demand

Describe different methods of transferring energy from biomass, to include:

- burning fast growing trees

Given data, evaluate different methods of transferring energy from biomass.

Describe the advantages of using biofuels, to include:

- alternative sources to fossil fuels
- no increase in greenhouse gas levels
- no particulates produced.

Assessable learning outcomes Higher Tier only: high demand

Explain why the burning of biofuels does not cause a net increase in greenhouse gas levels if:

- they are burnt at the same rate as the biomass is being produced
- areas of land are not cleared of other vegetation in order to grow crops for biofuels.

Explain how, in some areas, the use of large areas of land to produce biofuels is resulting in:

- habitat loss
- extinction of species.

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OCR Physics and Science A 21st Century GCSE

Module P3: Sustainable energy, P3.1 How much energy do we use?

2. recall the main primary energy sources that humans use: fossil fuels (oil, gas, coal), nuclear fuels, biofuels, wind, waves, and radiation from the Sun

OCR Biology and Additional Science B Gateway GCSE

Module B4: It's A Green World Item B4b: Photosynthesis

Assessable learning outcomes both tiers: standard demand

Describe the conversion of glucose and starch to other substances in plants and their use:

- glucose for energy (respiration)
- cellulose for cell walls
- proteins for growth and repair
- starch, fats and oils for storage.

Assessable learning outcomes Higher Tier only: high demand

Explain why insoluble substances such as starch are used for storage:

- does not move away in solution from storage areas
- does not affect water concentration inside cells.

Edexcel Biology GCSE

Unit B3: Using Biology Topic 3 Biotechnology

3.19 Demonstrate an understanding of the advantages and disadvantages of replacing fossil fuels with biofuels, including the facts that biofuels are renewable and that their production uses carbon dioxide but that growing the crops to make them requires land and may affect the availability of land for growing food.

SQA Standard Grade Biology

Prescribed practical activity: Preparing a microscope slide as a wet mount

Topic 2: The World of Plants Sub topic C - Making food

suggested learning activities

12 Test leaves for starch.

13 Design and carry out investigations on the requirements for photosynthesis (need for chlorophyll, for light energy and for carbondioxide).

Learning outcomes

General level

State that green plants make their own food which may be stored as starch.

State that green plants convert light energy to chemical energy using chlorophyll.

Describe the process of photosynthesis in terms of raw materials and products

Credit level

Describe the fate of carbon dioxide as structural and storage carbohydrates in plants and as energy sources.

Explain what is meant by a limiting factor and describe the main limiting factors in the process of photosynthesis.

SQA Standard Grade Science

Topic 3: Energy and its Uses Renewable Sources of Energy

1 Fossil fuels and nuclear fuels are non-renewable, but waves, wind, hydroelectricity and the sun are renewable sources of energy.

2 As the stocks of fossil fuels are depleted these alternative sources of energy will become more important.

Credit Level

3 Other renewable sources of energy include sugar alcohol and geothermal heat.

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In sugar-growing countries, sugar can be fermented into alcohol which can be used as a fuel.
4 There are advantages and disadvantages in the use of each alternative or renewable energy source, to include: cost, the technology involved, visual pollution, and reliability of the energy source.

SQA Standard Grade Chemistry **Topic 15: Carbohydrates and Related Substances**

Cambridge Biology iGCSE (with significant similarity to Coordinated and Combined Science iGCSE) **Section II: Organisation and maintenance of the organism**

7. Transportation 7.1 Transport in plants

- Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves

Section IV: Relationships of organisms with one another and with their environment

5. Human influences on the ecosystem

5.2 Pollution

- Describe the undesirable effects of pollution to include:
 - air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming

5.3 Conservation

- Describe the need for conservation of:
 - species and their habitats
 - natural resources (limited to water and non-renewable materials including fossil fuels)

Cambridge Physics iGCSE (with significant similarity to Coordinated and Combined Science iGCSE)

1. General physics 1.6 Energy, work and power 1.6 (b) Energy resources

- Distinguish between renewable and non-renewable sources of energy
- Give advantages and disadvantages of each method in terms of cost, reliability, scale and environmental impact

Cambridge Environmental Management iGCSE

5. Action on the lithosphere

5.2 technologies and viability of alternative energy sources

solar, wind, wave, geothermal, hydro-electric, biomass

15. Human activity and the atmosphere

15.5 the environmental, technological, economic and social factors which influence the distribution of different types and systems of farming

15.6 new agricultural techniques which increase yields

irrigation, biological controls, the benefits of chemicals (fertilisers and pesticides),

15.7 the factors which influence the patterns of agricultural output and trade

North-South trade in commodities, cash crops vs food crops

19 Managing agriculture

19.1 strategies for sustainable agriculture

plant breeding, integrated pest control, mixed cropping, gene banks, new crop strains, trickle drip irrigation, organic alternatives to inorganic fertilisers

19.2 harvesting energy from living resources to provide power

biomass, biogas (methane), fuel from organic waste

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Key stage 5

OCR Biology A-level

3.1 AS Unit F211: *Cells, Exchange and Transport* Module 1: Cells

1.1.1 Cell Structure Candidates should be able to:

(c) explain the need for staining samples for use in light microscopy and electron microscopy;

1.1.3 Cell Division, Cell Diversity and Cellular Organisation

To understand how a whole organism functions, it is essential to understand the importance of cooperation between cells, tissues, organs and organ systems.

OCR Chemistry A A-level

How Science Works 6a, 7b:

Desirability of renewable fuels by 'rich' countries may lead to problems of food supply for countries supplying the 'crops for fuel'. (i) the problem of an over-reliance on non-renewable fossil fuel reserves and the importance of developing renewable plant based fuels, ie alcohols and biodiesel (see also 2.4.2)

OCR Chemistry B Salters A-level

Unit F331: *Chemistry for Life Developing Fuels, Applications*

(x) understand the benefits and risks associated with using fossil fuels and alternative fuels (biofuels, hydrogen, nuclear) and discuss the choices involved in making decisions about ensuring a sustainable energy supply.

WJEC Biology A-level

BY2 : *Biodiversity and physiology of Body Systems. Adaptations for Transport*

(d) Structure of the dicotyledon root. Structure and role of endodermis. The structure of xylem. Movement of water from root to leaf.

(e) The structure of phloem as seen by the light and electron microscope.

Suggested Practical Activities: Examination of TS primary stem dicotyledon and root. TS and LS primary xylem and phloem.

AQA Environmental Studies A-level

A2 Unit 3 – ENVS3 *Energy Resources and Environmental Pollution* 3.3.1 Energy

Renewable energy resources

Examples should be used to illustrate the factors affecting the ease of use of renewable energy resources and therefore their likely use in the future

Energy density: biofuels have medium energy densities

Ease of storage: Energy can be stored as potential energy of water in reservoirs and chemical energy in biofuels

Future energy supplies New technologies

New technologies may increase the amount of energy available for use by

- increasing the amount of energy available from existing energy resources
- allowing new resources to be exploited

Atmospheric pollution

- incomplete combustion of fossil fuels and biofuels

AQA Science in Society A-level

Unit 1 AS *Exploring key scientific issues* 3.1.3 *Transport issues*

Technical ways of reducing the impact of transport on local air quality and on greenhouse gases.

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The advantages and disadvantages of different fuels, to include: fossil fuels, bio-fuels, fuel cells and hydrogen.

Fuels are valuable because they are concentrated sources of energy. There is a finite amount of fossil fuel (coal, oil, natural gas) on Earth. Other energy sources (wind, wave, biomass such as wood) are renewable. They can be replaced in the same sort of time scale as they are used.

Unit 3 A2 Exploring key scientific issues 3.3.5 Energy futures The context

The context for this topic is the challenge of reconciling the growing demand for energy resources worldwide, especially the demand for electricity, with the policy imperative to cut down the emission of carbon dioxide and other greenhouse gases. People want the benefits of a readily available supply of electricity but must balance this against the cost of each method of generation and its environmental impact.

Renewable sources of energy are naturally and continually replenished; they include wind, solar power, geothermal, hydropower, and various forms of biomass.