Scheme of work

Combined Science: Synergy
Interactions with the environment

This resource provides guidance for teaching the Interactions with the environment topic from our new GCSE in Combined Science: Synergy (8465). It has been updated from the draft version to reflect the changes made in the accredited specification. There have been no changes to the required practical. However, there have been minor changes in the specification content in sections 4.3.1.6 Human reproductive hormones, 4.3.1.7 Contraception, 4.3.1.8 Treatments for infertility, 4.3.3.1 Spread of communicable diseases, 4.3.3.2 Human communicable diseases, 4.3.3.3 Defences against pathogens, 4.3.3.4 The human immune system and 4.3.3.9 Stem cells.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

4.3 Interactions with the environment

4.3.1 Lifestyle and health

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4.3.1.1	Health can be defined as 'a state of physical, mental and social well-being' and not merely the absence of disease. Factors including diet, stress and life situations can affect both physical and mental health. Diseases have symptoms that stop the body from working as normal. Communicable (infectious) diseases are caused by microorganisms called pathogens. They may infect plants as well as animals and are spread by direct contact, by water or by air. Non-communicable diseases, such as heart disease, cancer and diabetes, are the leading cause of death in the world.	Explain how diet, stress and life situations can affect physical and mental health. Give examples of communicable and non-communicable diseases.	1	Discuss factors that can affect health and how to lead a healthy lifestyle. List symptoms of five infectious diseases. Are there any symptoms common to all? Suggest and discuss the human and financial cost of these non-communicable diseases on individuals, communities, nations and globally. What do these words have in common – rust, mildew, blight, canker, scab?	Collect, present and analyse data about health risks and diseases, looking for correlations. Take temperatures. Look at thermometer calibrations. Discuss accuracy, measurement error, uncertainty and the range the true value will lie within and how to calculate this. Students research 'St. Anthony's fire' – prevalent in the Middle Ages. Is 'Ash dieback' the only threat to trees in the UK?	AQA – Subject specific vocabulary (Science) PDF bbc.co.uk/news/science-environment-19197660

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4.3.1.2	Risk factors are aspects of a person's lifestyle, or substances present in a person's body or environment, that have been shown to be linked to an increased rate of a disease. For some a causal mechanism has been proven. Examples are: • the effects of diet, smoking and exercise on cardiovascular disease • obesity as a risk factor for Type 2 diabetes • the effect of alcohol on the liver and brain function • the effect of smoking on lung disease and lung cancer • the effects of smoking and alcohol on unborn babies	Describe that many non-communicable human diseases are caused by the interaction of a number of factors. Describe the effects of factors such as diet, smoking, alcohol and exercise on health. Give risk factors associated with cardiovascular disease, Type 2 diabetes, lung diseases and cancers. Explain the effect of lifestyle factors, including exercise, diet, alcohol and smoking, on the incidence of non-communicable disease at local, national and global levels.	2	Carry out research using textbooks and the internet and write a report on the effects of diet, smoking, alcohol and exercise on health, to include risk factors for specific diseases. Discuss how and why the Government encourages people to lead a healthy lifestyle. Carry out a survey of lifestyle habits. Watch the adverts about smoking, alcohol and diet. Analyse the message they are sending and suggest why. Ask what advice do they give and how effective they are and why. What is the NHS and what is its role? Role-play a doctor and patient discussing the benefits and difficulties of one lifestyle	Collect, present and analyse data about health risks and diseases, looking for correlations. Measure height and weight to calculate BMI. Calculate BMI and evaluate the use of this type of measurement. MS 4a Translate information between graphical and numerical forms. MS 2c, 4a Extract and interpret information from charts, graphs and tables. MS 2d Understand the principles of sampling as applied to scientific data in terms of risk factors. MS 2c	Change4Life: Be Food Smart TV ad 2013 British Heart Foundation – heart statistics Public Health England ant-smoking campaign video Change4Life: Alcohol Teachit Science resource (25028) 'Diet, lifestyle and obesity'

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	• carcinogens and ionising radiation as risk factors in cancer.			change, eg smoking, alcohol, diet or exercise. WS 1.5 Interpret data about risk factors, or about differences in the incidence of non-communicable diseases in different parts of the world. WS 1.4 Explain the human and financial cost of these non-communicable diseases to an individual, a local community, a nation or globally.	Construct and interpret frequency tables and diagrams, bar charts and histograms. MS 2g Use a scatter diagram to identify a correlation between two variables.	
4.3.1.3	In coronary heart disease layers of fatty material build up inside the coronary arteries, narrowing them. This reduces the flow of blood through the coronary arteries, resulting in a lack of oxygen for the heart muscle. This can lead to a heart attack.	Describe problems associated with the heart and explain how they can be treated. Evaluate the use of drugs, mechanical devices and transplants to treat heart problems,	1	Watch video clip about coronary heart disease. Discuss the different types of heart problems that can occur and how they are treated – blocked coronary arteries, heart attack, faulty valves, hole in the heart, drugs, transplants, artificial hearts and replacement valves. Produce a	Demo: Calculate the rate of water flow through tubing. Evaluate the use of models to represent blocked arteries. Provide a variety of sources about heart disease to enable students to decide to	BBC Bitesize: Coronary heart disease Artificial heart and valves if available otherwise show illustrations. Demo:

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	Statins are widely used to reduce blood cholesterol levels, which slows down the rate of fatty material deposit. Stents are used to keep the coronary arteries open. In some people heart valves may become faulty, preventing the valve from opening fully, or the heart valve might develop a leak. Faulty heart valves can be replaced using biological or mechanical valves. In the case of heart failure, a donor heart, or heart and lungs, can be transplanted. Artificial hearts are occasionally used to keep patients alive whilst waiting for a heart transplant, or to allow the heart to rest as an aid to recovery.	including religious and ethical issues.		report or PowerPoint presentation. Debate/discuss having defibrillators in every school. Where should they be kept? Observe illustrations of artificial hearts and replacement valves. Demonstrate effect of blockage in tube on rate of water flow. Observe video of heart and lung transplant. BBC animation and quiz about heart disease. Research the first heart transplant. WS 1.4 Evaluate given information about the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant.	what degree the opinions expressed are based on scientific data.	• rigid, transparent tubing – one left open and the other partially blocked with wax • funnel • measured volumes of water • timer. BBC Bitesize: Heart and lungs transplant BBC Bitesize: The circulatory system

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				WS 1.3 Evaluate methods of treatment bearing in mind the benefits and risks associated with the treatment.		
4.3.1.4	Homeostasis is the regulation of the internal conditions of a cell or organism to maintain optimum conditions for function in response to internal and external changes. Homeostasis is important because it maintains optimal conditions for enzyme action and all cell functions. Control of blood glucose concentration, control of body temperature and control of water levels in the human body are examples of homeostasis. An organism maintains homeostasis by monitoring its internal conditions and	Explain what homeostasis is and why it is important. Describe examples of conditions that need to be controlled. Describe the roles of the nervous system and the endocrine system in homeostasis. Describe the main components of a control system and their functions.	1	Discussion starters: 'What would happen if…' eg 'you didn't drink enough water, ate too many sweets.' Use examples of diseases that can be controlled, eg diabetes, dehydration, gout. Draw a flow diagram to show the main components of a control system and label with the function of each component. Colour code and annotate given diagrams of body with functions related to homeostasis.	Students make a model to demonstrate maintaining equilibrium, eg a mobile with suspended figures which can be moved to balance the arms. Research and discuss: • What is the role of the brain in homeostasis? • What is the temperature of your skin? • Which organs and organ systems are involved in homeostasis?	Teachit Science resource (24263) 'Homeostasis staying in balance' Teachit Science resource (25127) 'Blood glucose control – dominoes' Exampro user guide PowerPoint

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	responding appropriately when these conditions deviate from their optimal state. These automatic control systems may involve nervous responses or chemical responses. Many of the processes are coordinated by hormones.					
4.3.1.5	Blood glucose concentration is monitored and controlled by the pancreas. If the blood glucose concentration is too high, the pancreas produces the hormone insulin, which causes glucose to move from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen for storage. (HT only) If the blood glucose concentration is too low, the pancreas produces glucagon, which causes	Describe how blood glucose concentration is monitored and controlled. Explain when insulin is produced and how it helps to control blood glucose levels. Describe glycogen as a stored carbohydrate. (HT only) Explain when glucagon is produced by the pancreas and its effect on blood glucose levels.	1	What disease can cause glucose in urine? Research and produce a report to explain the cause, effects, treatment and problems associated with Type 1 diabetes. diabetes.org.uk is a good resource. Interpret data on glucose tolerance tests in healthy people and diabetics. Research the work of Banting and Best. Watch video clip about Banting and Best.	Class practical – investigating sugar levels in urine. Demo: how doctors used to diagnose diabetes by tasting fake urine, then test with Benedict's solution and glucose test strips. Evaluate the methods.	Demo materials: • weak tea samples with and without glucose • glucose test strips • Benedict's solution • water bath. BBC Bitesize: Homeostasis Insulin and blood sugar control

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	glycogen to be converted into glucose and released into the blood.	(HT only) Explain how insulin and glucagon work together to control blood glucose levels.		Research how treatment of diabetes has developed including use of human insulin produced by bacteria, current research into pancreas cell transplants and stem cell research (links with 4.3.3.9 Stem cells).		Banting and Best: Diabetes – a cure
4.3.1.5 cont.	Type 1 diabetes is a disorder in which the pancreas fails to produce sufficient insulin. It is characterised by uncontrolled high blood glucose levels and is normally treated with insulin injections. In Type 2 diabetes the body cells no longer respond to insulin produced by the pancreas. A carbohydrate controlled diet and an exercise regime are common treatments. Obesity is a risk factor for Type 2 diabetes.	Explain the cause, effects, treatment and problems associated with Type 1 diabetes. Interpret glucose tolerance test results. Evaluate modern methods of treating diabetes. Explain the cause, treatment and problems associated with Type 2 diabetes. Compare the causes, and treatments of Type 1 and Type 2 diabetes.	1	Discuss the causes, treatment and problems associated with Type 2 diabetes. Compare Type 1 and Type 2 diabetes and present the information in a suitable format. Watch a video animation about Type 1 and Type 2 diabetes.		'Explaining diabetes' animation

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4.3.1.6	During puberty reproductive hormones cause secondary sex characteristics to develop. Oestrogen is the main female reproductive hormone produced in the ovary. At puberty eggs begin to mature and one is released approximately every 28 days. This is called ovulation. Testosterone is the main male reproductive hormone produced by the testes and it stimulates sperm production. Several hormones are involved in the menstrual cycle of a woman. • Follicle-stimulating hormone (FSH) causes maturation of an egg in the ovary. • Luteinising hormone (LH) stimulates the release of the egg. • Oestrogen and progesterone are	Describe secondary sexual characteristics of boys and girls. Explain the cause of these changes in boys and girls and their relevance in reproduction. Describe the menstrual cycle and fertility including the role of hormones. Oestrogen is secreted by the ovaries. It inhibits production of FSH and stimulates release of LH. It makes the uterus lining grow again after menstruation. Progesterone is secreted by the empty follicle in the ovary after ovulation. It inhibits FSH and LH production and maintains the lining of	1	Watch BBC video clip about puberty. Describe the changes that occur in boys and girls during puberty and discuss what causes these changes. Watch BBC video clips of ovulation and the menstrual cycle. Discuss how hormones control the changes seen. Use a month calendar page to colour code days according to hormone levels (make a flickbook to show changes). Use a model, eg diagram, chart, animation etc, to show the names, sites of production and effects of FSH, LH, oestrogen and progesterone in the menstrual cycle. Higher Tier will require more detail. Discussion – do male and female hormone levels fluctuate and why? Live science article provides extension material for	Research the effects of testosterone and oestrogen on secondary sexual characteristics in boys and girls. Useful for discussion about the reliability of research, in this case research into hormonal changes in new fathers.	BBC Bitesize: Puberty BBC Bitesize: Ovulation BBC Bitesize: Menstrual cycle PPT B1.2.2 Control in the human body Livescience article 'Fatherhood lowers 'manly' hormone, keeps Dad at home'

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	involved in maintaining the uterus lining.	the uterus during the second half of the cycle. (HT only) explain the interaction between these hormones in the control of the menstrual cycle.		discussion about the reliability of research.		
4.3.1.7	Fertility can be controlled by a variety of hormonal and non-hormonal methods of contraception. These include: • oral contraceptives that contain hormones • injection, implant or skin patch of slow release progesterone • barrier methods such as condoms and diaphragms • intrauterine devices, • spermicidal agents • abstaining from intercourse when an egg may be in the oviduct	Describe hormonal and non-hormonal methods of contraception. Explain how hormonal and non-hormonal contraceptives work. Evaluate the use of each method of contraception.	1	Watch BBC video clip about history of contraception for women (contains distressing scene). Discuss issues raised. Look at an exhibition of hormonal and non-hormonal contraceptives. Complete a table summarising: • method of action • hormone name • how they work • advantages • disadvantages. Produce a report for a teen magazine on the advantages and disadvantages of different types of contraceptives.	Consider personal, social, economic and ethical implications of contraceptive use. Study contraceptives in an exhibition and evaluate the different types.	BBC Bitesize: Development of the contraceptive pill Exhibition materials can be obtained from the Family Planning Association.

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	• surgical methods of male and female sterilisation.			Invite an outside speaker to discuss contraception, eg women's health nurse. WS 1.4 Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.		
4.3.1.8	(HT only) The uses of hormones in controlling fertility include: • giving FSH and LH in a 'fertility drug' to a woman whose own level of FSH is too low • in In Vitro Fertilisation (IVF) treatment, which involves giving a mother FSH and LH to stimulate the maturation of several eggs.	(HT only) Describe the use of fertility drugs in women with low FSH levels. Use a model, eg a flow diagram to explain the process of In Vitro Fertilisation (IVF). Evaluate the use of fertility treatments.	1	Discuss possible causes of infertility in men and women and treatments available. Research the process of IVF and produce a leaflet for a doctor's surgery to describe the main stages involved in IVF treatment. Discuss the implications of IVF treatment for a couple wanting a baby. WS 1.4	UPD8 – apply different ethical approaches to making a decision about non-vital transplants.	NHS website - IVF BBC article – 'I wish IVF had never been invented' UPD8 – Womb transplant

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				Evaluate, from the perspective of patients and doctors, the methods of treating fertility bearing in mind that although fertility treatment gives couples the chance to have a baby of their own it is very emotionally and physically stressful; the success rates are not high and it can lead to multiple births which are a risk to both the babies and the mother.		

4.3.2 Radiation and risk

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4.3.2.1	When atoms gain energy by heating, from electricity, or by absorbing electromagnetic radiation, some electrons jump to higher energy levels. Electromagnetic radiation is given out when the electrons drop back to lower levels. The frequency of the radiation depends on the size of the energy jump. Atoms of elements such as neon and sodium give out light in the visible region of the spectrum. Other atoms, such as mercury atoms, give out light in the ultraviolet region.	Describe how electrons behave when an atom gains or loses energy. Explain that electromagnetic radiation that is being emitted from a source comes from the activity of electrons.	1	What is another name for 'electron shells'? Why are there different colours of visible light? Describe the relationship between light, electrons and energy levels. Link the statement 'what goes up must come down' to electrons and light emission. Why do substances emit specific colours of light? How is this connected to energy levels? Describe how the relationship between electrons and light is used in astronomy. Why is the emission spectrum of a substance like a human fingerprint?	Display various light sources, eg glowing metal, torch, electric lamp, the sun. What is the source of energy for each example? Demonstrate or class practical flame tests. Research the chemistry of fireworks.	Use a periodic table which shows atomic emission spectra. RSC practical – flame tests using metal salts American Chemical Society PDF 'Fireworks' http://www.bbc.co.uk/science/space/universe/questions_and_ideas/spectroscopy
4.3.2.2	The nuclear radiation emitted may be:	Describe the composition of each type of radiation and, where relevant, give	1	WS 1.2, MS 1b, 1c, 3c Refer to a copy of the periodic table and use the names and	Use plasticine to model the changes in an atom	Teachit Science resource (19981) 'Particular particle

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	• an alpha particle (α) – this consists of two neutrons and two protons; it is identical to the nucleus of a helium atom • a beta particle (β) – a high-speed electron ejected from the nucleus as a neutron turns into a proton • a gamma ray (γ) – electromagnetic radiation from the nucleus • a neutron (n). Nuclear equations are used to represent radioactive decay. In a nuclear equation an alpha particle may be represented by the symbol: $^{4}_{2}\mathrm{He}$ and a beta particle by the symbol: $^{0}_{1}\mathrm{e}$	the particle that the type of radiation is identical to, eg an alpha particle is a helium nucleus. Describe how in beta emission a neutron decays into a proton and an electron, with the electron then being ejected from the nucleus at high speed. Describe gamma rays as being part of the electromagnetic spectrum as well as a type of nuclear radiation. State the composition of alpha and beta particles and recall that an alpha particle is: $^{4}_{2}\mathrm{He}$ and a beta particle is:		symbols of common nuclei and particles to write balanced equations that show single alpha (α) and beta (β) decay. This is limited to balancing the atomic numbers and mass numbers.	when it undergoes alpha or beta decay. Use the models to form a 2D equation of the alpha and beta decay of an imaginary atom (as radioactive atoms have large nuclei). Label the picture with the correct initial and subsequent mass and atomic numbers.	knowledge – radioactivity' http://www.bbc.co.uk/learningzone/clips/a-comparison-of-alpha-beta-and-gamma/10680.html

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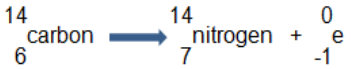
	The emission of the different types of ionising radiation may cause a change in the mass and/or the charge of the nucleus. For example:  Alpha decay causes the atomic number to decrease by two units and the mass number by four units.  There is no change in mass number during beta decay but the atomic number increases by one unit. Students are not required to recall these two examples. The emission of a gamma ray does not cause the mass or the charge of the nucleus to change.	$^{0}_{1}e$ Describe how the nucleus of an atom and charges change when it undergoes alpha and beta decay.				
4.3.2.3	Radioactive decay is random, so it is not possible to predict which individual	Describe the process of radioactive decay as being a random event	1	Plot a graph of throw against decay.	Students can use Skittles or M&Ms to calculate the half-life.	Teachit Science resource (23325)

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	nucleus will decay next. But with a large enough number of nuclei it is possible to predict how many will decay in a certain amount of time. The half-life of a radioactive isotope is the average time it takes for the number of nuclei of the isotope in a sample to halve, or the average time it takes for the count rate from a sample containing a radioactive isotope to fall to half its initial level.	analogous to flipping lots of coins – not knowing which coins will fall on heads but knowing about half of them will on any given throw. Define the term half-life.		Use the graph to calculate the half-life of the Skittles. MS 4a Determine the half-life of a radioactive isotope from given information. MS 1c, 3d (HT only) Calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives.	Ask students to throw out a cupful of sweets and count the ones with the letter uppermost. Count and remove these. Throw the remaining ones until none are left.	'Uses of radiation – half-life' Ask students to calculate the half-life of a radioactive source from a decay curve of a radioactive element.
4.3.2.4	Alpha particles are absorbed by just a few millimetres of air or by a thin sheet of paper. Beta particles can pass through air and paper but are completely absorbed by a sheet of metal just a few millimetres thick. Gamma rays pass through most materials easily but are	Compare the penetration of the different types of nuclear radiation and their ionising power.	1	Draw a diagram to illustrate the penetration of the different types of nuclear radiation and their ionising power. Discuss the alleged alpha (polonium) radiation poisoning of Alexander Litvinenko.	Demonstrate the radioactive sources and their penetration into different materials.	Teachit Science resource (22581) 'Ionising radiation – questions' Teachit Science resource (22580) 'Ionising radiation – jigsaw'

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	absorbed by a thick sheet of lead or by several metres of concrete.					
4.3.2.5	Irradiation is the process of exposing an object to radiation from an outside source. Irradiation can be reduced by screening the source or moving the object away from it. The irradiated object does not become radioactive. Radioactive contamination is the unwanted presence of a source of radiation inside, or on the surface of, other materials. It is often difficult to remove the contaminating source so that it continues to add to the radiation dose for as long as it emits radiation.	Describe the process of irradiation. Describe how radioactive contamination can occur.	1	Ask students to work out how they would transport soft fruit for weeks. Describe what happens to strawberries which are irradiated before sending on a long trip. Determine how irradiating fruit affects the cost of goods and whether there are any risks for the workers and consumers of the irradiation food process. Predict and then research the procedures followed by people dealing with radioactive sources reduces the risk of contamination. Describe how decontamination would take place if a person's clothes or skin have been contaminated by a radioactive source.	Depending on the season, have some examples of soft fruit left in a warm cupboard for a week (for raspberries, a couple of days maximum). Students could investigate the length of time soft fruit can survive following various treatments (eg freezing, keeping cold, removing air, etc) and how the fruit survives the treatment. Examine footage from radioactive disasters such as Chernobyl and Fukushima, eg: You Tube – Hiroshima Bomb Detonation (3 mins)	

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				Explain why contamination by a highly active alpha source may be a lot more damaging than a low activity gamma source.	You Tube – A Walk around Chernobyl (8 mins). Students can design protective clothing for use in a nuclear disaster, thinking about types of radiation released and penetration of each type.	
4.3.2.6	Ultraviolet (UV) waves, X-rays, alpha, beta and gamma rays can have hazardous effects on human body tissue. The effects depend on the type of radiation and the size of the dose. Radiation dose (in Sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation. Ultraviolet waves, X-rays, alpha, beta and gamma rays are all examples of ionising radiation. They can turn atoms into ions and break up	Describe and explain the effects that gamma, X-rays and ultraviolet radiation have on the body. Explain how the radiation dose that nuclear industry workers are exposed to is measured. Describe how high energy gamma rays can be used to destroy cancer cells.	1	Explain how the radiation dose that nuclear industry workers are exposed to is measured. Explain how a radiation badge detects radiation. Draw conclusions from given data about the risks and consequences of exposure to radiation. Describe how ultraviolet radiation from the sun can affect the body and in particular the skin. WS 1.5	Is radiation harmful? Does sunbathing cause cancer? Are sunbeds safer than sunbathing? How can I reduce the risk of skin cancer? Do people working in a nuclear power station have a greater risk of cancer? Research the radiation dose level people in various professions are	Dangers of ionising radiation Cyber Physics: The electromagnetic spectrum – the family of light Harmful effects of ultraviolet radiation BBC Bitesize – Tracers and treating cancers

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	molecules. Ionising radiations can change DNA, causing mutation of genes that may lead to cancer. High energy gamma rays can be used to destroy cancer cells.			Interpret simple measures of risk showing the probability of harm from different types of radiation. WS 1.5 Describe precautions that can be taken to reduce the risks from ionising radiation. WS 1.5 Give examples to show that the perceived risk can be very different from the measured risk, especially if the cause of the risk is unfamiliar or invisible.	exposed to (eg nuclear industry, pilot, science teacher). Plan an investigation to find out which sunscreen is the most effective – probes are available for data loggers to measure the intensity of ultraviolet light. Research how exposure to gamma rays, X-rays and ultraviolet light can cause cell mutations. Research the use of gamma rays in treating cancer.	
4.3.2.7	Tumours form when cells start growing and dividing in an uncontrolled way. Some tumours are benign; they stay in the same place and stop growing before they get too large.	Describe some causes of cancer, eg viruses, smoking, alcohol, carcinogens and ionising radiation. Describe the difference between	1	Watch animation about cancer on ABPI site (see resources). Research the causes of cancer and cancer treatment. Explore activities and information on cancer research site.	Analyse data about cancer from cancer research site.	ABPI Resources for Schools – Cell division and cancer Cancer Research UK Lesson plans

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	Cancer is caused by malignant tumours that are able to invade neighbouring tissues and spread to different parts of the body in the blood so that more tumours start to grow in other parts of the body.	benign and malignant tumours. Explain how cancer may spread from one site in the body to form a secondary tumour in another part of the body.		Are benign tumours harmless?		

4.3.3 Preventing, treating and curing diseases

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4.3.3.1	Harmful microorganisms (pathogens) that cause disease can spread: • through the air when people cough or sneeze, • through food that is contaminated with bacteria	Explain how pathogens can be spread to plants or animals and cause infection.	0.5	Prepare advice leaflet for a doctors' surgery explaining how people can reduce their chances of catching diseases. To avoid contracting a disease such as influenza, many people wear face masks. How useful is this method in preventing disease transmission?	Students determine the population of bacteria after a period of time, from given information. Students represent these population figures in powers of 10.	WHO – disease fact sheets

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	• through drinking water that is contaminated with microorganisms • through contact with other people, or surfaces that infected people have touched • by animals that scratch or bite or draw blood .					
4.3.3.2	Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the toxins they secrete. Salmonella bacteria are killed by cooking and pasteurisation. Measles is a viral disease showing symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise. For this reason most young children	Describe the symptoms, mode of transmission, prevention and treatment for measles, HIV/AIDS, Salmonella and gonorrhoea.	1	Small group project using ICT, researching to find out about the symptoms, mode of transmission, prevention and treatment for measles, HIV/AIDS, salmonella and gonorrhoea. Present findings in a table and illustrate with images of these microorganisms. Students prepare class presentations and fill out summary table for all. Students research the history of HIV and produce a timeline. WS 1.4	Carry out research and explain application of science and personal and social implications related to diseases. How can I reduce my risk of contracting food poisoning?	Teachit Science resource (19566) 'Food hygiene' ABPI – Resources for Schools Infectious diseases Microbiology Online | Society for General Microbiology – Downloadable resources

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	are vaccinated against measles. The measles virus is spread by inhalation of droplets from sneezes and coughs. Gonorrhoea is a sexually transmitted disease (STD) with symptoms of a thick yellow or green discharge from the vagina or penis and pain on urinating. It is caused by a bacterium and was easily treated with the antibiotic penicillin until many resistant strains appeared. Gonorrhoea is spread by sexual contact. The spread can be controlled by treatment with antibiotics or the use of a barrier method of contraception such as a condom. HIV (Human Immunodeficiency Virus) initially causes a 'flu like illness'. Unless successfully treated with antiviral drugs the virus enters the lymph			Explain applications of science to prevent the spread of diseases.		

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	nodes and attacks the body's immune cells. Late-stage HIV, or AIDS, occurs when the body's immune system is no longer able to deal with other infections or cancers. HIV is spread by sexual contact or exchange of body fluids such as blood.					
4.3.3.3	The human body defends itself against the entry of pathogens: • the skin is a barrier and produces antimicrobial secretions • the nose catches particles • the trachea and bronchi secrete mucus that is moved by cilia • the stomach produces acid, which kills the majority of pathogens that enter via the mouth.	Describe the body's first-line defences.	0.5	Post-it notes on a body outline to recap KS3. Label a diagram to show how the body defends itself against the entry of pathogens.		
4.3.3.4	If a pathogen enters the body the immune system tries to	Explain how the immune system	1	Watch BBC video clip showing phagocytosis (see resources).	Observe prepared blood smears using a	Blood smears materials:

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	destroy the pathogen. White blood cells are an important part of the immune system. They help to defend against pathogens through: • phagocytosis • producing antibodies • producing antitoxins	defends against disease Describe what white blood cells do. Explain why antibodies are specific for one pathogen/antigen.		Research how white blood cells defend the body. ABPI animations of white blood cell activity. Observe white blood cells under the microscope or bio-viewer. Outline the differences between five key words: antiseptic, antigen, antibiotic, antibody, antitoxin. Draw diagrams or a cartoon strip to show the actions of white blood cells using key words: • ingest • phagocytosis • antibodies • antitoxins. Draw diagrams or use cut-outs to model antibody specificity.	microscope or bio-viewer. Draw the cells. Use models to represent phagocytosis and antibody specificity. Students predict level of antibodies in the blood following vaccination and following a subsequent infection. Represent their prediction in a simple line graph.	• prepared slides • microscopes • bio-viewers. BBC Bitesize video clips – White blood cells BBC Bitesize – Defending against infection activity ABPI – Resources for Schools – White blood cells/response to infection
4.3.3.5	Vaccination involves introducing small quantities of dead or inactive forms of a pathogen into the body to	Describe what a vaccine contains.	1	Watch BBC video about Edward Jenner. Evaluate the method he used in developing	Consider the ethical issues and risks associated with Jenner's method. Discuss how	Jenner Museum – teaching resources

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	stimulate the white blood cells to produce antibodies. If the same pathogen re-enters the body the white blood cells respond quickly to produce antibodies, preventing infection. If a large proportion of the population is immune to a pathogen, the spread of the pathogen is very much reduced. Students do not need to know details of vaccination schedules and side effects associated with specific vaccines.	Explain how vaccines prevent disease. Explain the idea of 'herd immunity'.		the first vaccine and compare with modern methods. Discuss what a vaccine contains and how it works. Use ABPI animation to show how a vaccine works. Role play the level of immunity within a population and its effect on the spread of a pathogen. Interpret graph showing primary and secondary response to a pathogen (ABPI site). Consider the actions of Dr Wakefield and the MMR vaccine. Role play whether to give your child vaccinations. Interpret data about vaccination rates and reported cases of diseases, eg whooping cough, MMR.	methods and theories develop over time. Use a model to explain herd immunity. Interpret graph showing primary and secondary response to a pathogen; explain the responses. Evaluate risk in relation to practical design and data review to avoid bias. Evaluate risks related to vaccinations. Discussion questions: • Why do we need vaccinations when our body has its own immune system? • Should it be made illegal for people to refuse vaccination? Students calculate the percentage of a population that has been vaccinated from given data and compare result	BBC Bitesize video clip – The life and work of Edward Jenner ABPI – Resources for Schools – Vaccination BBC search on MMR debate WHO/Europe – Diphtheria detected in Spain

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				Spain has had its first case of diphtheria in nearly 30 years – additional example.	to data on herd immunity. Has the vaccination programme been effective?	
4.3.3.6	Antibiotics, such as penicillin, are medicines that help to cure bacterial disease by killing infective bacteria inside the body. It is important that specific bacteria should be treated by specific antibiotics. The use of antibiotics has greatly reduced deaths from infectious bacterial diseases. However, the emergence of strains of bacteria resistant to antibiotics is becoming a serious threat. Antibiotics cannot kill viral pathogens. Painkillers and other medicines are used to treat the symptoms of disease. They do not kill pathogens.	Explain how antibiotics treat only bacterial diseases and how this has saved lives. Describe the problems associated with antibiotic resistance. Explain the difficulty in developing drugs that kill viruses without damaging body tissues. Give examples of painkillers and other medicines used to treat symptoms. Interpret data about painkillers and other medicines. Identify formulations given appropriate information. Students	1	This topic links with 4.4.4 (Variation and evolution). Describe the importance of antibiotics and the impact of antibiotic resistance. Explain how this has impacted on cleaning practices in Britain's hospitals. Research MRSA and *C. difficile* infections and treatment. Who is responsible for antibiotic resistance? Should the routine use of antibiotics as growth promoters in farm livestock be banned? Suggest what patients, doctors and scientists should do to ensure we will have effective antibiotics in the future.	Understand how scientific methods and applications develop over time. Evaluate personal, social and economic implications of antibiotics. Understand how scientific methods and applications develop over time. Evaluate personal, social and economic implications of drugs. Interpret data about antibiotics, painkillers and other medicines. How can pain be measured? Students research how Norway avoids using	BBC search on Antibiotic resistance Samples of medicine packaging. Cards of common symptoms. BBC Bitesize – Modern medicine Classroom Resources BBC Four series – Pain, Pus and Poison: The Search for Modern Medicines

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	Most medicines are mixtures. They are formulations made by mixing the ingredients in carefully measured quantities to ensure that the product has the required properties. One or more of the ingredients may be the drug, such as aspirin, but other ingredients make it easier or more pleasant for a patient to take the drug in solution or as a capsule or tablet.	do not need to know the names of components in proprietary products.		Discussion starter – imagine the world we would live in if antibiotics stopped working. Samples of medicine packaging to stimulate discussion. Role play: Pharmacist/patient giving recommendation based on symptoms (cards prepared or students' own ideas). Think-pair-share symptoms of diseases and medicines used to relieve symptoms and treat disease; names of some antibiotics. Define the terms: • mixture • formulation.	antibiotics in aquaculture. Students research how Denmark is tackling antibiotic resistance. Students research the role of a variety of inactive ingredients in pharmaceutical drugs, eg: banana, cellulose, oleic acid, potato starch, wax. What properties do capsules or tablets need to have? Research the composition of a medicine and identify the purpose of each chemical in the formulation. Identify the purpose of each chemical in the formulation.	

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4.3.3.7	When new medical drugs are devised, they have to be extensively tested and trialled before being used. Drugs are tested in a series of stages to find out if they are safe and effective. New drugs are extensively tested for toxicity, efficacy and dose: • in the laboratory, using cells, tissues and live animals • then in clinical trials involving healthy volunteers and patients. Very low doses of the drug are given at the start of the clinical trial. If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug. In double-blind trials, some patients are given a placebo, which does not contain the	Explain why drugs need to be tested before they can be prescribed. Describe the main steps in the development and testing of a new drug. Give reasons for the different stages in drug testing. Explain the terms placebo and double-blind trial.	1	Discuss drug safety and how drugs are tested today. Find information from ABPI and BBC websites. Use cards/cut-outs to sequence the stages in drug testing and trialling and explain the purpose of each stage. Create flow diagram of stages in process. Answer past questions about drug testing. WS 1.6 Explain that the results of testing and trials, like the findings of all scientific research, are published only after evaluation by peer review. This helps to prevent false claims.	Evaluate methods used in the development of a new drug. Use a model to explain the stages in the development of a drug. How would you demonstrate that a particular drug is effective? Do participants who receive a placebo in clinical trials ever report experiencing adverse side effects? Examine graphs which represent the placebo effect. Carry out research to answer the question 'Do all drugs have side effects?' How much evidence is sufficient to give a 'yes' or 'no' answer?	ABPI – Resources for Schools – Developing medicines BBC Bitesize – Drugs and the human body AQA resources: PowerPoint B1.3 Use and abuse of drugs

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	drug. Patients are allocated randomly to groups so that neither the doctors nor the patients know who has received a placebo and who has received the drug until the trial is complete.					
4.3.3.8	New medical products have been produced by genetically modifying bacteria. Insulin for the treatment of Type 1 diabetes is produced by cultivating genetically modified bacteria. Sheep and goats have been genetically modified to produce chemicals in their milk that can be used to treat disease. In one example the milk produced contains a protein needed to treat patients with cystic fibrosis. Research is also exploring the possibility of providing tissues needed for transplants from animals that have been genetically	Evaluate the use of gene technology in medicine. Make informed judgements about the economic, social and ethical issues concerning the use of gene technology in modern medicine. Explain advantages and disadvantages of using gene technology.	0.5	This topic links with 4.4.4.6 (Genetic engineering). Produce a leaflet for a doctor's surgery to explain how human insulin is produced by bacteria and discuss the advantages of this over porcine insulin. Research the use of gene technology in medicine. WS 1.3 Evaluate gene technologies, taking into account benefits risks, and the ethical issues raised by the use of animals in medical research.	Students research GM plants and Hepatitis B vaccines. What are the advantages and disadvantages? Students research GM bacteria and human growth hormone or antibiotic production. Discussion question: What is xenotransplantation?	

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	modified so that the tissues are not rejected by the human immune system.					
4.3.3.9	One medical use of stem cells is well established: this is the use of stem cells in bone marrow for transplants to provide a supply of new blood cells for the person receiving the transplant. This is used to treat leukaemia. Stem cells for research may be based on: • stem cells from embryos that are a few days old • adult stem cells from selected parts of the body such as bone marrow • fetal stem cells taken from blood in the umbilical cord. Embryonic stem cells can develop into any of the many types of cells in the body. Adult stem cells can only give rise to the types of cells	Describe where stem cells can be found in animals. Describe how stem cells could be used to help treat some medical conditions. Evaluate risks and benefits, as well as the social and ethical issues concerning the use of stem cells from embryos in medical research and treatments.	1	Watch the stem cell story at Europe's stem cell website. Provide a circus of different stem cell related articles which cover current uses, potential uses as well as pros and cons. Students circulate to complete a summary table on uses, pros and cons. Students have different roles and must prepare and present their arguments in favour of or against the use of embryonic stem cells (eg doctor, person with diabetes, human rights activist). WS 1.3 Give a simple ethical argument about the rights and wrongs of the uses of stem cells. WS 1.3	Read and discuss article about stem cell research (includes the school report of one of the Nobel Prize recipients). Discusion question: Do plants have stem cells? (Links to 4.2.2, Plants and photosynthesis.)	bbc.co.uk/news/health-19869673 Europe's stem cell hub – Stem cell videos and films Wellcome Trust – Medical uses of stem cells BBC Bitesize –Stem cells National Institute of Health – Stem Cell Information Teachers TV: KS3/4 Science - Stem Cell Research - Resources - TES Daily News Articles - stem cells/The Scientist Magazine®

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	found in the tissues that the adult stem cells come from. Most medical uses of stem cells are still experimental. Treatments based on stem cells are being investigated for treating diseases such as: • heart disease – using the patient's own stem cells from bone marrow • Type 1 diabetes – using embryo or fetal stem cells. The properties of stem cells are not fully understood. Scientists do not yet know how their differentiation is controlled. This means that there is a fear that their ability to proliferate could lead to cancer when they are transplanted into a patient.			Evaluate possible uses of stem cells taking into account benefits, risks and the ethical issues raised by sources of the cells.		Stem cells/Science/ The Guardian
4.3.3.10	Different types of disease may interact. Some examples include:	Describe examples of how diseases may interact.	0.5	Describe the transmission and treatment of Hepatitis B and C and the link to cancer.	Investigate vaccines against HPV. Students collect class data on prevalence of	bbc.co.uk/news/uk-scotland-glasgow-west-34220101

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	• defects in the immune system mean that an individual is more likely to suffer from infectious diseases • viruses living in cells can be the trigger for cancers • immune reactions initially caused by a pathogen can trigger allergies such as skin rashes and asthma • severe physical ill health can lead to depression and other mental illness.			Discussion questions: Can your immune system suffer from disease? • Why is donated blood screened? • What allergies are most common? What is the level of agreement among your sources? Can you find examples of bias? • What is an EpiPen® and how is it used? • Are teenagers able to 'self-regulate' their time spent on social media? The number of prescriptions for antidepressants has increased over the last 30 years, particularly amongst the elderly. Suggest reasons for this.	allergies: types, medication taken (if any) and frequency of use. Data can be used to calculate percentages/ratios. Students carry out a survey of time spent on social media, time spent socialising face to face, time spent sleeping. Use data to calculate mean, median, mode. Plan an investigation into the effects on the physical and mental health of teenagers, of reducing time spent on social media. Include a discussion about quantitative and qualitative data. Students research how to improve mental well-being.	nhs.uk/Conditions/stress-anxiety-depression/Pages/improve-mental-wellbeing.aspx