

Science Checklist: Core

Knowledge

Biology

Cell Biology

Use the terms 'eukaryotic' and 'prokaryotic' to describe types of cells
Describe the features of bacterial (prokaryotic) cells
Recall the structures found in animal and plant (eukaryotic) cells inc algal cells
Describe the functions of the structures in animal and plant (eukaryotic) cells
Describe what a specialised cell is, including examples for plants and animals
Describe what differentiation is, including differences between animals and plants
Describe how genetic information is stored in the nucleus of a cell (inc genes & chromosomes)
Describe the processes that happen during the cell cycle, including mitosis (inc recognise and describe where mitosis occurs)
Describe how genetic information is stored in the nucleus of a cell (inc genes & chromosomes)
Describe the processes that happen during the cell cycle, including mitosis (inc recognise and describe where mitosis occurs)
Describe the process of diffusion, including examples
Explain how diffusion is affected by different factors
Define and explain "surface area to volume ratio", and how this relates to single-celled and multicellular organisms (inc calculations)
Explain how the effectiveness of an exchange surface can be increased, inc examples of adaptations for small intestines, lungs, gills roots & leaves
Describe the process of osmosis (inc calculation of water uptake & percentage gain and loss of mass of plant tissue)
<i>Required practical 3: investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue</i>
Describe the process of active transport, including examples - gut and roots
Explain the differences between diffusion, osmosis and active transport

Bioenergetics

Describe what happens in photosynthesis, including using a word equation and recognise the chemical formulas for carbon dioxide, water, oxygen & glucose
Explain why photosynthesis is an endothermic reaction
Recall the limiting factors of photosynthesis
Explain how limiting factors affect the rate of photosynthesis, including graphical interpretation (limited to one factor)
<i>Required practical 6: investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed</i>
Describe how the glucose produced in photosynthesis is used by plants
Describe what happens in respiration including using a word equation and recognise the chemical formulas for carbon dioxide, water, oxygen & glucose
Describe aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred
Recognise the equations for aerobic respiration, anaerobic respiration in muscles and anaerobic respiration in plants and yeast cells.
Recall what type of respiration fermentation is and its economic importance.
Describe what happens to heart rate, breathing rate and breath volume during exercise and why these changes occur
Explain what happens when muscles do not have enough oxygen and define the term oxygen debt
Explain what metabolism is, including examples
Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids

Infection and Response

Explain what a pathogen is and how pathogens are spread (inc how viruses, bacteria, protists and fungi are spread in animals and plants)
Explain how pathogenic bacteria and viruses cause damage in the body
Explain how the spread of diseases can be reduced or prevented
Describe measles, HIV and tobacco mosaic virus as examples of viral pathogens
Describe salmonella food poisoning and gonorrhoea as examples of bacterial pathogens
Describe salmonella food poisoning and gonorrhoea as examples of bacterial pathogens
Describe the symptoms, transmission and control of malaria, including knowledge of the mosquito vector as an example of a protists pathogen
Describe defences that stop pathogens entering the human body (inc skin, nose, trachea & windpipe, stomach)
Recall the role of the immune system
Describe how white blood cells destroy pathogens
Describe how vaccination works, including at the population level
Explain how antibiotics and painkillers are used to treat diseases, including their limitations
Describe how sources for drugs have changed over time and give some examples
Describe how new drugs are tested, including pre-clinical testing and clinical trials (inc double blind trials and placebos)

Homeostasis and Response

State the function of the nervous system and name its important components
Describe how information passes through the nervous system
Describe what happens in a reflex action and why reflex actions are important
Explain how features of the nervous system are adapted to their function, including a reflex arc (inc all types of neurone and the synapse)
<i>Required practical 7: plan and carry out an investigation into the effect of a factor on human reaction time</i>

Describe the endocrine system, including the location of the pituitary, pancreas, thyroid, adrenal gland, ovary and testis and the role of hormones

State that blood glucose concentration is monitored and controlled by the pancreas

Describe the body's response when blood glucose concentration is too high

Explain what type 1 and type 2 diabetes are and how they are treated

HT ONLY: Describe the body's response when blood glucose concentration is too low

HT ONLY: Explain how glucagon interacts with insulin to control blood glucose levels in the body

Describe how water, ions and urea are lost from the body

Describe the consequences of losing or gaining too much water for body cells

HT ONLY: Recall that protein digestion leads to excess amino acids inside the body and describe what happens to these

Describe what happens at puberty in males and females, inc knowledge of reproductive hormones

Describe the roles of the hormones involved in the menstrual cycle (FSH, LH and oestrogen)

HT ONLY: Explain how the different hormones interact to control the menstrual cycle and ovulation

Describe how fertility can be controlled by hormonal and non-hormonal methods of contraception (giving specific examples from the spec)

HT ONLY: Explain how hormones are used to treat infertility, inc the steps in IVF

HT ONLY: Evaluate the risks and benefits of fertility treatments

HT ONLY: Describe the functions of adrenaline and thyroxine in the body, and recall where they are produced

HT ONLY: Explain the roles of thyroxine and adrenaline in the body as negative feedback systems

Chemistry

Atomic Structure and the Periodic table

State that everything is made of atoms and recall what they are
Describe what elements and compounds are
State that elements and compounds are represented by symbols; and use chemical symbols and formulae to represent elements and compounds
Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols
State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom
State the relative masses of protons, neutrons and electrons and describe the distribution of mass in an atom
Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number
Describe isotopes as atoms of the same element with different numbers of neutrons
Define the term relative atomic mass and why it takes into account the abundance of isotopes of the element
Calculate the relative atomic mass of an element given the percentage abundance of its isotopes
Describe how electrons fill energy levels in atoms, and represent the electron structure of elements using diagrams and numbers
Recall how the elements in the periodic table are arranged
Describe how elements with similar properties are placed in the periodic table
Explain why elements in the same group have similar properties and how to use the periodic table to predict the reactivity of elements
Describe the early attempts to classify elements
Identify metals and non-metals on the periodic table, compare and contrast their properties
Explain how the atomic structure of metals and non-metals relates to their position in the periodic table
Describe noble gases (group 0) and explain their lack of reactivity

Describe the properties of noble gases, including boiling points, predict trends down the group and describe how their properties depend on the outer shell of electrons

Describe the reactivity and properties of group 1 alkali metals with reference to their electron arrangement and predict their reactions

Describe the properties of group 7 halogens and how their properties relate to their electron arrangement, including trends in molecular mass, melting and boiling points and reactivity

Describe the reactions of group 7 halogens with metals and non-metals

Bonding, Structure and the Periodic table

Describe the three main types of bonds: ionic bonds, covalent bonds and metallic bonds in terms of electrostatic forces and the transfer or sharing of electrons

Describe how the ions produced by elements in some groups have the electronic structure of a noble gas and explain how the charge of an ion relates to its group number

Describe the structure of ionic compounds, including the electrostatic forces of attraction, and represent ionic compounds using dot and cross diagrams

Describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure

Describe covalent bonds and identify different types of covalently bonded substances, such as small molecules, large molecules and substances with giant covalent structures

Represent covalent bonds between small molecules, repeating units of polymers and parts of giant covalent structures using diagrams

Draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane

Deduce the molecular formula of a substance from a given model or diagram in these forms showing the atoms and bonds in the molecule

Explain how the structure of giant covalent structures affects their properties

Explain the properties of graphite, diamond and graphene in terms of their structure and bonding

Describe the structure of fullerenes, and their uses, including Buckminsterfullerene and carbon nanotubes

The rate and extent of chemical change

Calculate the rate of a chemical reaction over time, using either the quantity of reactant used or the quantity of product formed, measured in g/s, cm³/s or mol/s

Draw and interpret graphs showing the quantity of product formed or reactant used up against time and use the tangent to the graph as a measure of the rate of reaction

Describe how different factors affect the rate of a chemical reaction, including the concentration, pressure, surface area, temperature and presence of catalysts

Required practical 11: investigate how changes in concentration affect the rates of reactions by a method involving measuring the volume of a gas produced, change in colour or turbidity

Use collision theory to explain changes in the rate of reaction, including discussing activation energy

Describe the role of a catalyst in a chemical reaction and state that enzymes are catalysts in biological systems

Draw and interpret reaction profiles for catalysed reactions

Explain what a reversible reaction is, including how the direction can be changed and represent it using symbols: $A + B \rightleftharpoons C + D$

Explain that, for reversible reactions, if a reaction is endothermic in one direction, it is exothermic in the other direction

Describe the State of dynamic equilibrium of a reaction as the point when the forward and reverse reactions occur at exactly the same rate

HT ONLY: Explain that the position of equilibrium depends on the conditions of the reaction and the equilibrium will change to counteract any changes to conditions

HT ONLY: Explain and predict the effect of a change in concentration of reactants or products, temperature, or pressure of gases on the equilibrium position of a reaction

Organic Chemistry

Describe what crude oil is and where it comes from, including the basic composition of crude oil and the general chemical formula for the alkanes

State the names of the first four members of the alkanes and recognise substances as alkanes from their formulae

Describe the process of fractional distillation, state the names and uses of fuels that are produced from crude oil by fractional distillation

Describe the process of cracking and state that the products of cracking include alkanes and alkenes and describe the test for alkenes

Balance chemical equations as examples of cracking when given the formulae of the reactants and products

Explain why cracking is useful and why modern life depends on the uses of hydrocarbons

Physics

Energy

Define a system as an object or group of objects and state examples of changes in the way energy is stored in a system
Describe how all the energy changes involved in an energy transfer and calculate relative changes in energy when the heat, work done or flow of charge in a system changes
Use calculations to show on a common scale how energy in a system is redistributed
Calculate the kinetic energy of an object by recalling and applying the equation: $[E_k = \frac{1}{2}mv^2]$
Calculate the amount of gravitational potential energy gained by an object raised above ground level by recalling and applying, the equation: $[E_e = mgh]$
State that energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed and so the total energy in a system does not change
Explain that only some of the energy in a system is usefully transferred, with the rest 'wasted', giving examples of how this wasted energy can be reduced
Explain ways of reducing unwanted energy transfers and the relationship between thermal conductivity and energy transferred
List the main renewable and non-renewable energy resources and define what a renewable energy resource is
Compare ways that different energy resources are used, including uses in transport, electricity generation and heating
Explain why some energy resources are more reliable than others, explaining patterns and trends in their use
Evaluate the use of different energy resources, taking into account any ethical and environmental issues which may arise
Justify the use of energy resources, with reference to both environmental issues and the limitations imposed by political, social, ethical or economic considerations

Electricity

Draw and interpret circuit diagrams, including all common circuit symbols
Define electric current as the rate of flow of electrical charge around a closed circuit
Explain that current is caused by a source of potential difference and it has the same value at any point in a single closed loop of a circuit
Describe and apply the idea that the greater the resistance of a component, the smaller the current for a given potential difference (p.d.) across the component
Calculate current, potential difference or resistance by recalling and applying the equation: [$V = IR$]
<i>Required practical 15: Use circuit diagrams to set up and check circuits to investigate the factors affecting the resistance of electrical circuits</i>
Show by calculation and explanation that components in series have the same current passing through them
Show by calculation and explanation that components connected in parallel have the same the potential difference across each of them
Calculate the total resistance of two components in series as the sum of the resistance of each component using the equation: [$R_{total} = R_1 + R_2$]
Explain qualitatively why adding resistors in series increases the total resistance whilst adding resistors in parallel decreases the total resistance
Solve problems for circuits which include resistors in series using the concept of equivalent resistance

Forces

Identify and describe scalar quantities and vector quantities
Identify and give examples of forces as contact or non-contact forces
Describe the interaction between two objects and the force produced on each as a vector
Describe weight and explain that its magnitude at a point depends on the gravitational field strength

Calculate weight by recalling and using the equation: $[W = mg]$
Represent the weight of an object as acting at a single point which is referred to as the object's 'centre of mass'
Explain the motion of an object moving with a uniform velocity and identify that forces must be in effect if its velocity is changing, by stating and applying Newton's First Law
Define and apply Newton's second law relating to the acceleration of an object
Recall and apply the equation: $[F = ma]$
HT ONLY: Describe what inertia is and give a definition
Apply Newton's Third Law to examples of equilibrium situations

Waves

Describe waves as either transverse or longitudinal, defining these waves in terms of the direction of their oscillation and energy transfer and giving examples of each
Define waves as transfers of energy from one place to another, carrying information
Define amplitude, wavelength, frequency, period and wave speed and Identify them where appropriate on diagrams
State examples of methods of measuring wave speeds in different media and Identify the suitability of apparatus of measuring frequency and wavelength
Calculate wave speed, frequency or wavelength by applying, but not recalling, the equation: $[v = f\lambda]$ and calculate wave period by recalling and applying the equation: $[T = 1/f]$
Identify amplitude and wavelength from given diagrams
Describe a method to measure the speed of sound waves in air
Describe a method to measure the speed of ripples on a water surface
Required practical 20: make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid