**Age Related Expectations in Science**

Age-related expectations identify what is expected of our learners by a specified age, stage or year group. Our curriculum defines these as a set standard of expectations which are defined either as exemplars, descriptors or questions.

**Year 9**

**Biology** Age Related Expectations and Sub grains

| Big Idea | Topic | Age Related Expectations | Subgrains |
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| DNA | Genetics | Genes are made from DNA and code for characteristics | 1. DNA controls many characteristics of organisms<br>2. The genetic material in the nucleus of a cell is composed of a chemical called DNA<br>3. DNA is made of two strands forming a double helix<br>4. DNA has a series of bases which are read as triplets<br>5. DNA is contained in structures called chromosomes<br>6. A gene is a small section of DNA on a chromosome<br>7. Each gene codes for a particular sequence of amino acids<br>8. A sequence of amino acids makes a protein<br>9. Proteins are the building blocks of cells<br>10.Proteins determine certain characteristics |
| | | Genes are inherited from parents and determine the characteristics of an offspring | 1. Genes occur in pairs, one of each is inherited from each parent<br>2. Genes can be either dominant or recessive<br>3. A dominant gene is one that will always be expressed in the offspring<br>4. A recessive gene is one that will only be expressed in the offspring if the other gene is also recessive<br>5. Some characteristics are controlled by a single gene |

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| | | | 6. Most characteristics are a result of multiple genes interacting rather than a single one<br>7. Each gene can have different forms called alleles<br>8. Genotype refers to the genes that are present, e.g. HH, Rr<br>9. Phenotypes refer to the characteristics that are present<br>10.If the two alleles present are the same then the organism is homozygous, e.g. MM, nn<br>11.If the two alleles present are different then the organism is heterozygous, e.g. Rr, Qq<br>12.Genetic crosses can be completed for those characteristics that are controlled by a single gene, and give a percentage chance of each<br>characteristic being seen in the offspring<br>13.The result of a genetic cross is presented as a percentage chance or ratio, but do not show the actual results as it is based on a probability<br>14.Punnett square diagrams are a clear way to represent genetic crosses<br>15.A punnett square diagram can be completed for sex determination<br>16.Of the 23 pairs of chromosomes in a human nucleus, 22 determine characteristics but only one carries the genes that determine sex<br>17.In females the sex chromosomes are the same, XX<br>18.In males the chromosomes are XY<br>19.Each egg cell holds an X chromosome<br>20.Sperm cells contain either an X or a Y chromosome<br>21.A punnett square diagram will show there is a 50% chance of each child being either a boy or a girl |
| | | Selective breeding can be used to select characteristics that are desirable in offspring | 1. Selective breeding, or artificial selection, is the process by which humans breed plants and animals for particular genetic characteristics<br>2. Humans have been doing this for thousands of years (cattle, dogs, crops)<br>3. Selective breeding involves:<br>a. Choosing parents with the desired characteristic from a mixed population<br>b. The parents are bred together<br>c. From the offspring those with the desired characteristic are bred together<br>d. This continues over many generations until all the offspring show the desired characteristic<br>4. Desired characteristics can include resistance from disease, animals with a high yield of milk or meat, domestic dogs with a gentle |

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| | | | nature, large or unusual flowers<br>5. Selective breeding can result in “inbreeding” where some breeds are particularly prone to disease from inherited defects |
| | | Animals and plants can be cloned resulting in genetically identical offspring | 1. A clone is an individual that has been produced asexually or artificially and is genetically identical to the parent<br>2. Animals and plants can be cloned<br>3. Cloning is usually used if an individual has particularly desirable characteristics<br>4. Plants can be cloned by taking a cutting. This process has been used for many years<br>5. A small shoot of the parent plant is cut off, placed in rooting hormone, then put in soil, resulting in the development of an<br>identical plant<br>6. Animals can be cloned using embryo cloning<br>7. Fertilisation takes place between the egg and sperm from the parents with desirable characteristics<br>8. The resulting cluster of cells, which haven’t yet specialised, are split apart and transplanted into surrogate mothers, where they will each grow into a clone of the original cow and bull<br>9. Some people have ethical issues with cloning |
| | | Organisms have changed over time due to their genetic variation | 1. All organisms have evolved from simple single celled organisms over millions of years<br>2. Evolution has occurred due to variation within a species<br>3. Variation can either be continuous or discontinuous<br>4. Variation is a result of either genetics, environment or both<br>5. Darwin found evidence of evolution in the 1830s during his round-the-world journey<br>6. Darwin coined the term “survival of the fittest” to explain his theory of natural selection<br>7. Natural selection suggests the following process:<br>a. Individual organisms within a particular species show a wide range of variation for a characteristic<br>b. Individuals with characteristics most suited to the environment are more likely to survive to breed successfully<br>c. The characteristics that have enabled these individuals to survive are then passed on to the next generation<br>8. Darwin published his ideas in On the Origin of the Species but his ideas were initially rejected by other academics due to existing religious beliefs and a lack of explanation<br>9. The idea of natural selection is now widely accepted<br>10.Further evidence for natural selection has been found since the discovery of the gene |

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| | | | 11.Fossils provide evidence of evolution<br>12.Fossils are the prints or remains of organisms that have been preserved in rock through a process of mineralisation<br>13.Fossil records are often incomplete but allow scientists to understand changes in species over time<br>14.Fossils allow us to identify organisms that are now extinct<br>15.Extinction occurs when there are no remaining individuals of a species still alive<br>16.Human behaviours have increased the rate of extinction as species are unable to adapt rapidly enough to the changes brought about<br>by humans |
| Bioenergetics | Bioenergetics<br>Photosynthesis | Plants use photosynthesis and respiration to release energy and produce biomass | 1. All organisms require energy to survive<br>2. Photosynthesis requires light energy for the energy transfer<br>3. Photosynthesis transfers energy and produces biomass<br>4. The equation for photosynthesis is water + carbon dioxide –(in the presence of light) glucose + oxygen<br>5. The rate of photosynthesis can be affected by temperature, carbon dioxide level and light intensity<br>6. Water enters the plants through the roots<br>7. Carbon dioxide enters the plant through the stomata on the underside of the leaf<br>8. Rate of photosynthesis can be measured by counting bubbles of oxygen given off by pond weed<br>9. In this investigation, variables need to be controlled<br>10.Rate of photosynthesis can be shown on a line graph<br>11.Plants store glucose as starch in their leaves<br>12.Iodine turns blue/black in the presence of starch<br>13.Glucose is used by plant in several different ways; to make fructose, fats and oils, cellulose, starch, proteins, or to be used in respiration to release energy |

**Chemistry** Age Related Expectations and Sub grains

| Big Idea | Topic | Age Related Expectations | Subgrains |
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| Amounts of Substance | Quantitative Chemistry | To understand the conservation of mass<br>- To understand how substances can be represented using symbols from the periodic table<br>- To be able to balance equations<br>- Calculate Ar and Mr<br>-Understand the mole and how it is calculated | 1. Atoms cannot be created or destroyed in chemical reactions, so the mass of the reactants must equal the mass of the products.<br>2. Elements and compounds can be represented using symbols from the periodic table. The symbols are unique to each element, and have a capital letter at the start, sometimes followed by a lower case letter.<br>3. In a chemical formula, the number of each atom of each element is given by a subscript number after that element.<br>4. Because mass is conserved in a reaction, the reactants and products of a reaction must have the same number of atoms of each element present, this is represented by a balanced equation.<br>5. When balancing equations, the number of individual atoms or molecules is indicated by a large number in front of it.<br>6. All elements have a different mass, known as their relative atomic mass, Ar. This is the larger number on their element card on the periodic table<br>7. When elements are in molecules and compounds, the Ar of each atom of each element needs to be added together to calculate the mass of the molecule or compound. This is known as the relative molecular mass, Mr.<br>8. A mole is 6.022x1023 particles of a substance<br>9. The number of moles of a substance can be calculated by dividing the mass of the substance in grams by the relative atomic mass or the relative molecular mass. |
| Bonding | Properties of ionic, covalent and Metallic Structures | Describe the structure and properties of ionic compounds<br>- Describe the structure and properties of giant covalent | 1. Ionic compounds are made of positive metal ions and negative non-metal ions arranged in a three-dimensional, structure called a giant ionic lattice, help together by a strong attraction between the ions.<br>2. Ionic compounds at hard, brittle, have high melting points and conduct electricity when molten or dissolved in water.<br>3.Ionic compounds only conduct electricity when molten or dissolved, because when liquid the ions are free to move and carry a charge.<br>4.Carbon can exist in several different forms. The most common of these are graphite and diamond. These exist as giant covalent structures.<br>5. Carbon usually forms four covalent bonds, in graphite, each carbon atom is only bonded to three others. This leaves |

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| | | compounds<br>- Describe the structure and properties of metals | one<br>unbonded electron. Graphite is made of layers of carbon atoms. The unbonded electron from each carbon atom becomes delocalised, so is free to move throughout the structure, which means graphite conducts electricity. The layers are able to slide over each other, so graphite is soft.<br>6. In diamond, each carbon is attached to four other carbons. They are arranged in a three-dimensional structure which is very hard and has a very high melting point.<br>7. Metals form positively charged ions, which are arranged in regular layers and columns known as a giant metallic lattice. The layers can slide over each other, so metals are malleable. The electrons released from each atom become delocalised and are able to move throughout the metal, so metals conduct electricity and heat. The attraction between each metal ion and the delocalised electrons is very strong, so metals are strong and have a high melting point. |

**Physics** Age Related Expectations and Sub grains

| Big Idea | Topic | Age Related Expectations | Subgrains |
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| Forces | Forces 3 | Define, calculate and explain the use of turning effects (moments). | 1. Describe examples of rotating objects.<br>2. Define the moment of a force by the equation: moment = force x distance.<br>3. Calculate clockwise and anti-clockwise moments on an object from a diagram.<br>4. Define the principle of moments: For an object to be in equilibrium, the clockwise moments must equal the anti-clockwise moments on an object.<br>5. Give examples of forces stretching, bending or compressing objects. |
| | | Define, calculate and explain the use of forces and elasticity. | 1. Define elastic deformation: The object returns to its original form once the force is removed.<br>2. Define inelastic deformation: The object has a permanent deformation once the force is removed.<br>3. Define the spring constant (k) as a measure of the stiffness of a spring.<br>4. Calculate extensions for a spring using the Hooke's law equation: F =ke.<br>5. Plot a graph of force against extension for a spring.<br>6. Understand how the gradient for force - extension graph is affected by the spring constant.<br>7. Be able to label the limit of proportionality on a force - extension graph. |
| Space | Cosmology | Explain the evidence for the Big Bang and other cosmological theories. | 1. The Big Bang theory states that the Universe began as an explosion from a singularity approximately 13.7 years ago<br>2. For some time the Big Bang theory competed with the Steady State Theory<br>3. Since the Big Bang the Universe has been expanding and continues to do so<br>4. Evidence for the expanding Universe is provided by red shift.<br>5. Red shift is where the wavelength of a wave appears to increase due to objects moving apart<br>6. Further evidence for the Big Bang Theory was provided by the cosmic microwave background |
| | | Explain the life cycle of a star. | 1. A star the size of our Sun has a life cycle over 5 stages: nebula, protostar, Main sequence, red giant, white dwarf<br>2. A star is powered by the energy released from nuclear fusion, this is when 2 atoms to make a larger atom<br>3. The life of a star is initiated by the force of gravity on a cloud of gas<br>4. When most of the hydrogen has fused the star cools and expands forming a red giant |

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| | | | 5. The outer layers of the star are lost and what remains is a small, very hot, white dwarf<br>6. The final stage of a star's life will be different if the mass is large a red supergiant will form and this will explode in a supernova<br>7. The star will either form a neutron star or black hole depending on its mass |