## KS3 Science Mastery Criteria – Information for staff

| Emerging | Developing |
|---|---|
| • Students will be able to use simple practical scientific techniques to investigate a prediction, produce results and be able to say whether the results support or refute the prediction.<br>• Students will have a basic understanding of the key ideas of Science and be able to use this with some success to explain their observations. They will be able to spot simple patterns in data and recognise obvious anomalies.<br>• Students will be able to recall important scientific facts such as key practical equipment, units for measurements, common chemical symbols or parts of cells. | I can:<br>• Students will be able to use a range of scientific techniques with confidence and will be able to select an appropriate technique to produce useful data. They will be critical of the data they produce and will be able to explain whether or not a set of data or an investigative strategy will produce reliable data. They will be able to suggest improvements to produce better quality data.<br>• Students will be able to describe with confidence whether results support or refute a simple prediction and take into account anomalous results.<br>• Students will be able to explain their observations using key scientific ideas and make a judgement about the extent to which data supports a conclusion.<br>• Students will be able to recall scientific ideas and apply these in new situations. They will begin to be able to generalise and use simple models to explain ideas and observations. |
| Mastery | Ambitious |
| • Students will be able to use a range of scientific techniques with confidence and make judgements about the best technique to produce the best quality data. They will be critical of an investigative strategy and will recognise how to amend a strategy to produce reliable data. They will be able to consider issues of accuracy and precision in their analysis of data.<br>• Students will be able to describe with confidence the extent to which results support a prediction.<br>• Students will be able to explain observations using more complex scientific ideas and incorporate ideas from more than one source into more complex models.<br>• They will be able to predict outcomes in a variety of unfamiliar situations, using models to justify their ideas. | • Students will be able to use a range of scientific techniques with confidence and make judgements about the best technique to be used to produce the best quality data. They will be highly critical of the data that an investigative strategy is likely to produce and will amend their strategy accordingly to ultimately produce reliable data. They will be able to consider issues of accuracy and precision in their choices of technique and their analysis of data.<br>• Students will be able to describe with confidence the extent to which results support a prediction, and evaluate the success of an investigation.<br>• Students will be able to explain observations using more complex scientific ideas, analyse similarities and differences in data from different sources and use competing ideas to develop complex models.<br>• They will be able to apply complex ideas in a variety of unfamiliar situations and suggest and justify outcomes. |

**B1 Cells and Organisation**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Multicellular organisms are composed of cells which are organised into tissues, organs and systems to carry out life processes. There are many types of cell. Each has a different structure or feature so it can do a specific job<br>• How to use a light microscope to observe and draw cells.<br>• The parts of the human skeleton work as a system for support, protection, movement and the production of new blood cells. | I know:<br><br>• Both plant and animal cells have a cell membrane, nucleus, cytoplasm and mitochondria.<br>• Plant cells also have a cell wall, chloroplasts and usually a permanent vacuole.<br>• Antagonistic pairs of muscles create movement when one contracts and the other relaxes. |
| Mastery<br><br>I am able to:<br><br>• Explain why multi-cellular organisms need organ systems to keep their cells alive. Suggest what kind of tissue or organism a cell is part of, based on its features.<br>• Explain how to use a microscope to identify and compare different types of cells.<br>• Explain how uni-cellular organisms are adapted to carry out functions that in multi-cellular organisms are done by different types of cell.<br>• Explain how a physical property of part of the skeleton relates to its function. Explain why some organs contain muscle tissue. Explain how antagonistic muscles produce movement around a joint. Use a diagram to predict the result of a muscle contraction or relaxation | Ambitious<br><br>I am able to:<br><br>• Make deductions about how medical treatments work based on cells, tissues, organs and systems.<br>• Suggest how damage to, or failure of, an organ would affect other body systems.<br>• Deduce general patterns about how the structure of different cells is related to their function.<br>• Find out how recreational drugs might affect different body systems<br>• Predict the consequences of damage to a joint, bone or muscle.<br>• Suggest factors that affect the force exerted by different muscles.<br>• Consider the benefits and risks of a technology for improving human movement. |

**B2 Reproduction and Variation**

| Emerging | Developing |
|---|---|
| I know:<br><br>• There is variation between individuals of the same species. Some variation is inherited, some is caused by the environment and some is a combination.<br>• Plants have adaptations to disperse seeds using wind, water or animals.<br>• Flowers contain the plant's reproductive organs. | I know:<br><br>• The menstrual cycle prepares the female for pregnancy and stops if the egg is fertilised by a sperm.<br>• The developing foetus relies on the mother to provide it with oxygen and nutrients, to remove waste and protect it against harmful substances.<br>• Plants reproduce sexually to produce seeds, which are formed following fertilisation in the ovary.<br>• Pollen can be carried by the wind, pollinating insects or other animals. |
| Mastery<br><br>I am able to:<br><br>• Explain whether substances are passed from the mother to the foetus or not.<br>• Use a diagram to show stages in development of a foetus from the production of sex cells to birth.<br>• Identify key events on a diagram of the menstrual cycle.<br>• Identify parts of the flower and link their structure to their function.<br>• Suggest how a plant carried out seed dispersal based on the features of its fruit or seed.<br>• Explain why seed dispersal is important to survival of the parent plant and its offspring. | Ambitious<br><br>I am able to:<br><br>• Explain why pregnancy is more or less likely at certain stages of the menstrual cycle.<br>• Make deductions about how contraception and fertility treatments work.<br>• Describe similarities and differences between the structures of wind pollinated and insect pollinated plants |

**B3 Ecology**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Organisms in a food web (decomposers, producers and consumers) depend on each other for nutrients. So, a change in one population leads to changes in others.<br>• Natural selection is a theory that explains how species evolve and why extinction occurs. | I know:<br><br>• The population of a species is affected by the number of its predators and prey, disease, pollution and competition between individuals for limited resources such as water and nutrients. |
| Mastery | Ambitious |
| I am able to:<br><br>• Describe how a species' population changes as its predator or prey population changes.<br>• Explain effects of environmental changes and toxic materials on a species' population.<br>• Combine food chains to form a food web.<br>• Use evidence to explain why a species has become extinct or adapted to changing conditions.<br>• Evaluate whether evidence for a species changing over time supports natural selection. | I am able to:<br><br>• Suggest what might happen when an unfamiliar species is introduced into a food web.<br>• Develop an argument about how toxic substances can accumulate in human food.<br>• Make a deduction based on data about what caused a change in the population of a species<br>• Predict and explain the changes in a population over time due to natural selection. Suggest an explanation, based on data, for how a particular evolutionary change occurred. |

**B4 Digestion and Gas Exchange**

| Emerging | Developing |
|---|---|
| I know:<br><br>• The body needs a balanced diet with carbohydrates, lipids, proteins, vitamins, minerals, dietary fibre and water, for its cells' energy, growth and maintenance.<br>• In gas exchange, oxygen and carbon dioxide move between alveoli and the blood. Oxygen is transported to cells for aerobic respiration and carbon dioxide, a waste product of respiration, is removed from the body. | I know:<br><br>• Organs of the digestive system are adapted to break large food molecules into small ones which can travel in the blood to cells and are used for life processes.<br>• Breathing occurs through the action of muscles in the ribcage and diaphragm. The amount of oxygen required by body cells determines the rate of breathing. |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Describe possible health effects of unbalanced diets from data provided.<br>• Calculate food requirements for a healthy diet, using information provided.<br>• Describe how organs and tissues involved in digestion are adapted for their role.<br>• Describe the events that take place in order to turn a meal into simple food molecules inside a cell.<br>• Explain how exercise, smoking and asthma affect the gas exchange system.<br>• Explain how the parts of the gas exchange system are adapted to their function.<br>• Explain observations about changes to breathing rate and volume.<br>• Explain how changes in volume and pressure inside the chest move gases in and out of the lungs. | I am able to:<br><br>• Design a diet for a person with specific dietary needs.<br>• Critique claims for a food product or diet by analysing nutritional information<br>• Predict how a change in the gas exchange system could affect other processes in the body.<br>• Evaluate a model for showing the mechanism of breathing. |

**B5 Bioenergetics**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Plants and algae do not eat, but use energy from light, together with carbon dioxide and water to make glucose (food) through photosynthesis. They either use the glucose as an energy source, to build new tissue, or store it for later use<br>• Iodine is used to test for the presence of starch.<br>• Respiration is a series of chemical reactions, in cells, that breaks down glucose to provide energy and form new molecules. Most living things use aerobic respiration but switch to anaerobic respiration, which provides less energy, when oxygen is unavailable. | I know:<br><br>• Plants have specially-adapted organs that allow them to obtain resources needed for photosynthesis.<br>• The word equations to describe aerobic and anaerobic respiration.<br>• The word equation to describe photosynthesis in plants and algae. |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Describe ways in which plants obtain resources for photosynthesis.<br>• Explain why other organisms are dependent on photosynthesis.<br>• Sketch a line graph to show how the rate of photosynthesis is affected by changing conditions.<br>• Explain how specific activities involve aerobic or anaerobic respiration. | I am able to:<br><br>• Suggest how particular conditions could affect plant growth.<br>• Suggest reasons for particular adaptations of leaves, roots and stems.<br>• Compare the movement of carbon dioxide and oxygen through stomata at different times of day.<br>• Suggest how organisms living in different conditions use respiration to get their energy. Describe similarities and differences between aerobic and anaerobic respiration. |

**B6 Biological Systems and Processes**

| Emerging | Developing |
|---|---|
| I know:<br><br>There is variation between individuals of the same species. Some variation is inherited, some is caused by the environment and some is a combination., when oxygen is unavailable.<br>Inherited characteristics are the result of genetic information, in the form of sections of DNA called genes, being transferred from parents to offspring during reproduction. | I know:<br><br>• Variation between individuals is important for the survival of a species, helping it to avoid extinction in an always changing environment.<br>• Chromosomes are long pieces of DNA which contain many genes. Gametes, carrying half the total number of chromosomes of each parent, combine during fertilisation |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Explain whether characteristics are inherited, environmental or both.<br>• Plot bar charts or line graphs to show discontinuous or continuous variation data.<br>• Explain how variation helps a particular species in a changing environment.<br>• Explain how characteristics of a species are adapted to particular environmental conditions.<br>• Use a diagram to show the relationship between DNA, chromosomes and genes.<br>• Use a diagram to show how genes are inherited.<br>• Explain how a change in the DNA (mutation) may affect an organism and its future offspring.<br>• Explain why offspring from the same parents look similar but are not usually identical. | I am able to:<br><br>• Use the ideas of variation to explain why one species may adapt better than another to environmental change.<br>• Critique a claim that a particular characteristic is inherited or environmental<br>• Suggest arguments for and against genetic modification.<br>• Suggest benefits from scientists knowing all the genes in the human genome.<br>• Determine how the number of chromosomes changes during cell division, production of sex cells and fertilisation. |

**C1 Particles and Separation**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Properties of solids, liquids and gases can be described in terms of particles in motion but with differences in the arrangement and movement of these same particles: closely spaced and vibrating (solid), in random motion but in contact (liquid), or in random motion and widely spaced (gas).<br>• A substance is a solid below its melting point, a liquid above it, and a gas above its boiling point.<br>• A pure substance consists of only one type of element or compound and has a fixed melting and boiling point. Mixtures may be separated due to differences in their physical properties. | I know:<br><br>• Observations where substances change temperature or state can be described in terms of particles gaining or losing energy.<br>• The method chosen to separate a mixture depends on which physical properties of the individual substances are different. |
| Mastery<br><br>I am able to:<br><br>• Explain unfamiliar observations about gas pressure in terms of particles.<br>• Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles.<br>• Explain changes in states in terms of changes to the energy of particles.<br>• Draw before and after diagrams of particles to explain observations about changes of state, gas pressure and diffusion.<br>• Explain how substances dissolve using the particle model.<br>• Use evidence from chromatography to identify unknown substances in mixtures.<br>• Choose the most suitable technique to separate out a mixture of substances. | Ambitious<br><br>I am able to:<br><br>• Argue for how to classify substances which behave unusually as solids, liquids or gases.<br>• Evaluate observations that provide evidence for the existence of particles.<br>• Suggest a combination of methods to separate a complex mixture and justify the choices |

## C2 Chemical Reactions

| Emerging | Developing |
|---|---|
| I know:<br><br>• Some metals react with acids to produce salts and hydrogen.<br>• The pH of a solution depends on the strength of the acid: strong acids have lower pH values than weak acids.<br>• Chemical changes can be described by a model where atoms and molecules in reactants rearrange to make the products and the total number of atoms is conserved. | I can:<br><br>• Describe an oxidation, displacement, or metalacid reaction with a word equation<br>• Mixing an acid and alkali produces a chemical reaction, neutralisation, forming a chemical called a salt and water.<br>• Combustion is a reaction with oxygen in which energy is transferred to the surroundings as heat and light.<br>• Thermal decomposition is a reaction where a single reactant is broken down into simpler products by heating. |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Use particle diagrams to represent oxidation, displacement and metal-acid reactions<br>• Identify the best indicator to distinguish between solutions of different pH, using data provided.<br>• Use data and observations to determine the pH of a solution and explain what this shows.<br>• Explain how neutralisation reactions are used in a range of situations.<br>• Describe a method for how to make a neutral solution from an acid and alkali.<br>• Explain why a reaction is an example of combustion or thermal decomposition.<br>• Predict the products of the combustion or thermal decomposition of a given reactant and show the reaction as a word equation.<br>• Explain observations about mass in a chemical or physical change.<br>• Use particle diagrams to show what happens in a reaction. | I am able to:<br><br>• Deduce the physical or chemical changes a metal has undergone from its appearance<br>• Given the names of an acid and an alkali, work out the name of the salt produced when they react.<br>• Deduce the hazards of different alkalis and acids using data about their concentration and pH.<br>• Use known masses of reactants or products to calculate unknown masses of the remaining reactant or product.<br>• Devise a general rule for how a set of compounds reacts with oxygen or thermally decomposes.<br>• Balance a symbol equation. |

**C3 The Periodic Table**

| Emerging | Developing |
|---|---|
| I know:<br><br>• The elements in a group all react in a similar way and sometimes show a pattern in reactivity<br>• Metals are generally found on the left side of the table, non-metals on the right.<br>• Group 1 contains reactive metals called alkali metals.<br>• Group 7 contains non-metals called halogens.<br>• Group 0 contains unreactive gases called noble gases | I know:<br><br>• As you go down a group and across a period the elements show patterns in physical properties. |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Use data to describe a trend in physical properties.<br>• Describe the reaction of an unfamiliar Group 1 or 7 element.<br>• Use data showing a pattern in physical properties to estimate a missing value for an element.<br>• Use observations of a pattern in chemical reactions to predict the behaviour of an element in a group | I am able to:<br><br>• Predict the position of an element in the periodic table based on information about its physical and chemical properties.<br>• Choose elements for different uses from their position in the periodic table.<br>• Use data about the properties of elements to find similarities, patterns and anomalies. |

**C4 Materials and Earth**

| Emerging | Developing |
|---|---|
| I know:<br><br>• The three rock layers inside Earth are the crust, the mantle and the core.<br>• Methane and carbon dioxide are greenhouse gases. Earth's atmosphere contains around 78% nitrogen, 21% oxygen, | I know:<br><br>• Sedimentary, igneous and metamorphic rocks can be inter converted over millions of years through weathering and erosion, heat and pressure, and melting and cooling.<br>• Greenhouse gases reduce the amount of energy lost from the Earth through radiation and therefore the temperature has been rising |
| Mastery | Ambitious |
| I am able to:<br><br>• Explain why a rock has a particular property based on how it was formed.<br>• Identify the causes of weathering and erosion and describe how they occur.<br>• Construct a labelled diagram to identify the processes of the rock cycle.<br>• Use a diagram to show how carbon is recycled in the environment and through living things.<br>• Describe how human activities affect the carbon cycle. | I am able to:<br><br>• Identify circumstances that indicate fast processes of change on Earth and those that indicate slower processes.<br>• Predict planetary conditions from descriptions of rocks on other planets.<br>• Describe similarities and differences between the rock cycle and everyday physical and chemical processes.<br>• Suggest how ceramics might be similar to some types of rock.<br>• Evaluate the implications of a proposal to reduce carbon emissions.<br>• Evaluate claims that human activity is causing global warming or climate change.<br>• Compare the relative effects of human-produced and natural global warming. |

**C5 Reactivity**

| Emerging | Developing |
|---|---|
| I know:<br><br>• During a chemical reaction bonds are broken (requiring energy) and new bonds formed (releasing energy). | I know:<br><br>• If the energy released is greater than the energy required, the reaction is exothermic. If the reverse, it is endothermic<br>• That the rate of a chemical reaction can increase if certain factors are changed. |
| Mastery<br><br>I am able to:<br><br>• Use experimental observations to distinguish exothermic and endothermic reactions. Use a diagram of relative energy levels of particles to explain energy changes observed during a change of state<br>• Explain why increasing the pressure of a gas increases the rate of a reaction<br>• Explain why increasing the temperature increases the rate of reaction<br>• Explain how a catalyst increases the rate of reaction | Ambitious<br><br>I am able to:<br><br>• Predict whether a chemical reaction will be exothermic or endothermic given data on bond strengths.<br>• Use energy data to select a reaction for a chemical hand warmer or cool pack. |

**C6 Organic Chemistry**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Crude oil is a mixture of hydrocarbons and that it is a finite resource<br>• The general formula for alkanes | I know:<br><br>• The formation of crude oil from the remains of ancient biomass that was buried in mud<br>• That fractional distillation is the process used to separate crude oil due to the fractions having different boiling points. |
| Mastery | Ambitious |
| I am able to:<br><br>• Explain how to separate the different fractions of crude oil using fractional distillation<br>• Explain the importance of cracking | I am able to:<br><br>• Deduce a pattern in the formula of similar compounds and use it to suggest formulae for unfamiliar ones.<br>• Suggest ways in which waste products from industrial processes could be reduced.<br>• Evaluate claims that human activity is causing global warming or climate change. |

**P1 Energy**

| Emerging | Developing |
|---|---|
| I know:<br><br>• We can describe how jobs get done using an energy model where energy is transferred from one store at the start to another at the end. | I know:<br><br>• When energy is transferred, the total is conserved, but some energy<br>• Electricity is generated by a combination of resources which each have advantages and disadvantages. |
| Mastery | Ambitious |
| I am able to:<br><br>• Describe how the energy of an object depends on its speed, temperature, height or whether it is stretched or compressed.<br>• Show how energy is transferred between energy stores in a range of real-life examples.<br>• Calculate the useful energy and the amount dissipated, given values of input and output energy.<br>• Explain how energy is dissipated in a range of situations.<br>• Explain the advantages and disadvantages of different energy resources. | I am able to:<br><br>• Compare the percentages of energy wasted by renewable energy sources.<br>• Explain why processes such as swinging pendulums or bouncing balls cannot go on forever, in terms of energy.<br>• Evaluate the social, economic and environmental consequences of using a resource to generate electricity, from data.<br>• Suggest actions a government or communities could take in response to rising energy demand.<br>• Suggest ways to reduce costs, by examining data on a home energy bill. |

**P2 Forces and Motion**

| Emerging | Developing |
|---|---|
| I know:<br><br>• If the overall, resultant force on an object is non-zero, its motion changes and it slows down, speeds up or changes direction.<br>• When the resultant force on an object is zero, it is in equilibrium and does not move, or remains at constant speed in a straight line.<br><br>I can:<br><br>• Use the formula: speed = distance (m)/time (s) or distance-time graphs, to calculate speed. | I know:<br><br>• A straight line on a distance-time graph shows constant speed, a curving line shows acceleration.<br>• The higher the speed of an object, the shorter the time taken for a journey.<br>• One effect of a force is to change an object's form, causing it to be stretched or compressed. In some materials, the change is proportional to the force applied.<br><br>I can:<br>• Sketch the forces acting on an object, and label their size and direction |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Illustrate a journey with changing speed on a distance-time graph, and label changes in motion.<br>• Describe how the speed of an object varies when measured by observers who are not moving, or moving relative to the object<br>• Explain whether an object in an unfamiliar situation is in equilibrium.<br>• Describe factors which affect the size of frictional and drag forces.<br>• Describe how materials behave as they are stretched or squashed.<br>• Describe what happens to the length of a spring when the force on it changes. | I am able to:<br><br>• Suggest how the motion of two objects moving at different speeds in the same direction would appear to the other.<br>• Predict changes in an object's speed when the forces on it change.<br>• Evaluate how well sports or vehicle technology reduces frictional or drag forces.<br>• Describe the effects of drag and other forces on falling or accelerating objects as they move.<br>• Using force and extension data, compare the behaviour of different materials in deformation using the idea of proportionality |

## P3 Electricity and Magnetism

| Emerging | Developing |
|---|---|
| I know:<br><br>• We can model voltage as an electrical push from the battery, or the amount of energy per unit of charge transferred through the electrical pathway. In a series circuit, voltage is shared between each component. In a parallel circuit, voltage is the same across each loop.<br>• Current is a movement of electrons and is the same everywhere in a series circuit. Current divides between loops in a parallel circuit, combines when loops meet, lights up bulbs and makes components work. | I know:<br><br>• Components with resistance reduce the current flowing and shift energy to the surroundings.<br>• Around a charged object, the electric field affects other charged objects, causing them to be attracted or repelled. The field strength decreases with distance.<br>• An electromagnet uses the principle that a current through a wire causes a magnetic field. Its strength depends on the current, the core and the number of coils in the solenoid. |
| **Mastery** | **Ambitious** |
| I am able to:<br><br>• Draw a circuit diagram to show how voltage can be measured in a simple circuit.<br>• Use the idea of energy to explain how voltage and resistance affect the way components work.<br>• Given a table of voltage against current. Use the ratio of voltage to current to determine the resistance.<br>• Describe how current changes in series and parallel circuits when components are changed.<br>• Turn circuit diagrams into real series and parallel circuits, and vice versa.<br>• Describe what happens when charged objects are placed near to each other or touching.<br>• Use a sketch to describe how an object charged positively or negatively became charged up.<br>• Use a diagram to explain how an electromagnet can be made and how to change its strength.<br>• Explain the choice of electromagnets or permanent magnets for a device in terms of their properties. | I am able to:<br><br>• Predict the effect of changing the rating of a battery or a bulb on other components in a series or parallel circuit.<br>• Justify the sizes of voltages in a circuit, using arguments based on energy.<br>• Draw conclusions about safety risks, from data on voltage, resistance and current.<br>• Compare the advantages of series and parallel circuits for particular uses.<br>• Suggest how bells, circuit breakers and loudspeakers work, from diagrams. |

## P4 Waves and Space

| Emerging | Developing |
|---|---|
| I know:<br><br>• Sound consists of vibrations which travel as a longitudinal wave through substances. The denser the medium, the faster sound travels.<br>• Sound does not travel through a vacuum. | I know:<br><br>• The speed of sound in air is 330 m/s, a million times slower than light.<br>• The greater the amplitude of the waveform, the louder the sound. The greater the frequency (and therefore the shorter the wavelength), the higher the pitch.<br>• When a light ray meets a different medium, some of it is absorbed and some reflected. For a mirror, the angle of incidence equals the angle of reflection. The ray model can describe the formation of an image in a mirror and how objects appear different colours.<br>• When light enters a denser medium it bends towards the normal; when it enters a less dense medium it bends away from the normal. Refraction through lenses and prisms can be described using a ray diagram as a model. |
| Mastery<br><br>I am able to:<br><br>• Explain observations where sound is reflected, transmitted or absorbed by different media.<br>• Explain observations of how sound travels using the idea of a longitudinal wave.<br>• Describe the amplitude and frequency of a wave from a diagram or oscilloscope picture.<br>• Use drawings of waves to describe how sound waves change with volume or pitch.<br>• Use ray diagrams of eclipses to describe what is seen by observers in different places.<br>• Explain observations where coloured lights are mixed or objects are viewed in different lights.<br>• Use ray diagrams to describe how light passes through lenses and transparent materials.<br>• Describe how lenses may be used to correct vision | Ambitious<br><br>I am able to:<br><br>• Use diagrams to compare the waveforms a musical instrument makes when playing different pitches or volumes.<br>• Use a ray diagram to predict how an image will change in different situations.<br>• Predict whether light will reflect, refract or scatter when it hits the surface of a given material.<br>• Use ray diagrams to explain how a device with multiple mirrors works.<br>• Suggest what happens when two waves combine |

**P5 Forces**

| Emerging | Developing |
|---|---|
| I can:<br><br>• Sketch the forces acting on an object, and label their size and direction. | I know:<br><br>• One effect of a force is to change an object's form, causing it to be stretched or compressed. In some materials, the change is proportional to the force applied.<br>• Work is done and energy transferred when a force moves an object. The bigger the force or distance, the greater the work. Machines make work easier by reducing the force needed. Levers and pulleys do this by increasing the distance moved, and wheels reduce friction. |
| Mastery<br><br>I am able to:<br><br>• Illustrate a journey with changing speed on a velocity-time graph, and label changes in motion.<br>• Draw a diagram to explain how a lever makes a job easier.<br>• Compare the work needed to move objects different distances | Ambitious<br><br>I am able to:<br><br>• Predict changes in an object's speed when the forces on it change.<br>• Use the formula: work done (J) = force (N) x distance moved (m) to compare energy transferred for objects moving horizontally.<br>• Compare and contrast the advantages of different levers in terms of the forces need and distance moved. |

**P6 Matter**

| Emerging | Developing |
|---|---|
| I know:<br><br>• Pressure acts in a fluid in all directions. It increases with depth due to the increased weight of fluid, and results in an upthrust. Objects sink or float depending on whether the weight of the object is bigger or smaller than the upthrust. | I know:<br><br>• Different stresses on a solid object can be used to explain observations where objects scratch, sink into or break surfaces. |
| Mastery<br><br>I am able to:<br><br>• Use diagrams to explain observations of fluids in terms of unequal pressure.<br>• Explain why objects either sink or float depending upon their weight and the upthrust acting on them.<br>• Explain observations where the effects of forces are different because of differences in the area over which they apply.<br>• Given unfamiliar situations, use the formula to calculate fluid pressure or stress on a surface | Ambitious<br><br>I am able to:<br><br>• Use the idea of pressure changing with depth to explain underwater effects.<br>• Carry out calculations involving pressure, force and area in hydraulics, where the effects of applied forces are increased. |