

Bluecoat Primary Academy Science Progression Document 2020

**Bluecoat Primary Academy Science Intent Statement**

At Bluecoat Primary Academy we believe a high-quality science education provides the foundations for understanding the world, by promoting experiences of exploring and investigating scientific phenomena in a range of contexts leading to a development of natural curiosity. Children will be encouraged to build their knowledge and understanding through asking questions, taking risks, experimenting, reflecting, making and learning from mistakes; whereby they acquire and apply core skills equipping them for an ever-changing diverse world.

**Science Progression Document Guide**

Key Ideas: provides an overview of the key ideas and procedural knowledge pupils should know by the end of the year.

Working scientifically: specifies the understanding of the nature, processes and methods of science for each year group and should be taught continuously encouraging pupils to use features of scientific enquiry to answer relevant scientific questions. These types of scientific enquiry should include: observing over time; pattern seeking; identifying, classifying and grouping; comparative and fair testing (controlled investigations); and researching using secondary sources. Pupils should seek answers to questions through collecting, analysing and presenting data

Vocabulary: The quality and variety of language that pupils hear and speak are key factors in developing their scientific vocabulary and articulating scientific concepts clearly and precisely. Pupils should be encouraged to use this during lessons and refer back to in retrieval lessons.

Types of Working Scientifically:

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| **Identifying and Classifying** | **Comparative testing** | **Fair tests** | **Pattern seeking** | **Research** | **Ideas over time** |
| Increased focus on measuring and using data to answer ‘Big Questions’.Continue to build on their observational skills, becoming more independent in identifying, through the use of increasingly complex tools, as well as developing higher order skills in reasoning and justification when explaining how they have chosen to group things. Design simple tests to help them classify materials, as well as independently using a range of secondary sources to support them in identifying a range of living things. | Use an increasingly wide range of equipment to make measurements.Learn what it means to measure accurately and check for reliability.Learn to independently plan how to record and analyse the data, using tables, pictograms, and bar charts to compare the measurements they make.Use bar charts to draw conclusions about what they have found out to be the answer to their ‘Big Question’.Evaluate the procedure they used and the quality of their data, suggesting ways they could improve their test. | Plan their own tests to collect data. Through fair testing learn to understand the different types of variables:* The dependent variable that they will change in their test,
* The independent variable that they are going to measure so that they can find out how the dependent variable affects it,
* The control variables which the children will need to keep the same so that they don’t affect the results.

Measure and record data that can be displayed in a scatter or line graph. Use their data to draw conclusions that identify a relationship. Become more systematic in how they approach fair tests more independently. Written conclusions to become more focussed on scientific explanations. Focus on their skills in evaluating their enquiries. | Decide what they should measure and observe.Choose equipment that are appropriate to collect data.Use a data logger to collect accurate data.Using data analysis techniques to spot patterns.Use data and graphs to support their explanations. Use their findings to form and justify their own predictions, then propose further investigations to test predictions. | Reading for information and note-taking.Learn to interpret information they find and critically consider its relevance.Use a range of secondary sources, including books, websites and video.Listen to professionals/experts to get information, ask questions/ interviews or send letters/emails.Create questionnaires and interviews to collect data.Evaluate the quality of information they have found and how well it has enabled them to draw conclusions and answer their ‘Big Question’. | Explore and talk about their own and other people’s scientific ideas.Begin to recognise how scientific ideas change and develop over time.Use a range of secondary sources of informationDevelop their use of scientific language.Explain ideas using their scientific knowledge and understanding.Evaluate the significance, strengths and weaknesses of different scientists’ ideas. |

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| **Living Things and Their Habitats** |
| **National curriculum objectives:*** describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird
* describe the life process of reproduction in some plants and animals.

Pupils should study and raise questions about their local environment throughout the year. They should observe life-cycle changes in a variety of living things, for example, plants in the vegetable garden or flower border, and animals in the local environment. They should find out about the work of naturalists and animal behaviourists, for example, ***David Attenborough and Jane Goodall***. Pupils should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals. Pupils might work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around the world (in the rainforest, in the oceans, in desert areas and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences. They might try to grow new plants from different parts of the parent plant, for example, seeds, stem and root cuttings, tubers, bulbs. They might observe changes in an animal over a period of time (for example, by hatching and rearing chicks), comparing how different animals reproduce and grow.  | **Key ideas:**1. Some organisms reproduce sexually where offspring inherit information from both parents.
2. Some organisms reproduce sexually by making a copy of a single parent.
3. Environmental change can affect how well an organism is suited to its environment.
4. Different types of organisms have different lifecycles.
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| **Prior Learning** |  | **Vocabulary** |
| **In Year 4:**- recognise that living things can be grouped in a variety of ways- explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment- recognise that environments can change and that this can sometimes pose dangers to living things.  | All living things have a lifecycle. These lifecycles are different. Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty**. (see school guidance for teaching)**Pupils could work scientifically by researching the gestation periods of other animals and comparing them with humans; by finding out and recording the length and mass of a baby as it grows.Lifecycles have similarities and differences. | Plant lifecycles:* Plants reproduce in different ways.
* A plant life cycle is dependent on pollinators.
* Bulbs reproduce asexually.

Children should have opportunities to examine the flowers of a variety of plants closely, perhaps using digital microscopes, to see how they are adapted to maximise the chance of pollination – this can be for both insect pollinated and wind pollinated plants. | Environmental impact:Pupils need to learn how the environment changes through the seasons. They need to consider how changes to habitats affect organisms within them. For example, how the amount and variation of organisms change in a pond through the year and how different parts of the pond might be affected differently. Pupils need to consider how humans can affect the local environment through pollution, building, new planting (planting a bush next to a pond), introducing or removing certain organisms. | Previous vocabulary Y4,Life cycle, reproduce, fertilises, egg, live young, metamorphosis, asexual, plantlets,runners, bulbs, cuttings, pregnancy, pollination, gestation, metamorphosis,embryo |
| **Common Misconceptions:** | **Some children may think:**Some children may think:• all plants start out as seeds• all plants have flowers• plants that grow from bulbs do not have seeds• only birds lay eggs. |
| **Working scientifically opportunities:**  Revisit KS1 skills: focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. |
| **Identifying and Classifying** | Compare a collection of animals based on similarities and differences in their lifecycle |  |  |  |
| **Comparative testing** |  | Compare different plant lifecycles – explore the different process of reproduction in these. |  |
| **Fair tests** |  |  | Observe a pair of old shoes (leave outside for topic) look at how minibeasts begin habituating spaces.* Would this be different if we placed the shoe elsewhere? How can this be proven?
* What does this information tell us?
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| **Pattern seeking** | Is there a relationship between a mammal’s size and its gestation period? |  |  |
| **Research** | What are the differences between the life cycle of an insect and a mammal?Scientist focus and research project:  ***David Attenborough and Jane Goodall*** | Invite children to select an animal they have an interest in. How has it adapted? What are the issues surrounding its survival? How does global warming affect animals like polar bears? |
| **Ideas over time** | How did the experiments and ideas of Jan Ingenhousz help improve our understanding of plants? |
| **In Year 6:*** Classify living things into broad groups according to observable characteristics and based on similarities and differences.
* Give reasons for classifying plants and animals based on specific characteristics.
* Know how animals and plants are adapted to suit their environment.
* Know about reproduction and offspring (recognising offspring normally vary and are not identical to their parents).
* Know the ways in which nutrients and water are transported in animals, including humans.
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| **Animals including Humans –** combined with SRE see school guidance. |
| **National curriculum objectives:*** Describe the changes as humans develop to old age.

Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty. Pupils could work scientifically by researching the gestation periods of other animals and comparing them with humans; by finding out and recording the length and mass of a baby as it grows.  | **Key ideas:**1. **Different animals mature at different ages.**
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| **Prior Learning** | **Lifecycles**  | **Vocabulary** |
| **In Year 4:**-describe the simple functions of the basic parts of the digestive system in humans- identify the different types of teeth in humans and their simple functions- construct and interpret a variety of food chains, identifying producers, predators and prey. |  | Foetus, Embryo, Womb, Gestation, Baby, Toddler, Teenager, Elderly, Growth, Development, Puberty |
| **Common Misconceptions:** | **Some children may think:*** A baby is ‘made’
* Babies grow in mothers stomach.
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| **Working scientifically opportunities:**  Revisit KS1 skills: focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. |
| **Identifying and Classifying** |  |  |  |
| **Comparative testing** |  |  |
| **Fair tests** |  |  |
| **Pattern seeking** |  |  |
| **Research** |  |  |
| **Ideas over time** |  |
| **In Year 6:*** Identify and name the main parts of the human circulatory system and describe the functions of the heart, blood vessels and blood.
* Recognise the impact of diet, drugs and lifestyle on the way their bodies function.
* Describe the ways in which nutrients and water are transported within animals, including humans.
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| **Forces** |
| **National curriculum objectives:*** explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
* identify the effects of air resistance, water resistance and friction, that act between moving surfaces
* recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

Pupils should explore falling objects and raise questions about the effects of air resistance. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists, for example, Galileo Galilei and Isaac Newton helped to develop the theory of gravitation. Pupils might work scientifically by: exploring falling paper cones or cup-cake cases, and designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore resistance in water by making and testing boats of different shapes. They might design and make products that use levers, pulleys, gears and/or springs and explore their effects.  | **Key ideas:**1. Air resistance and water resistance are forces against motion caused by objects having to move air and water out of their way.
2. Friction is a force against motion caused by two surfaces rubbing against each other.
3. Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.
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| **Prior Learning** |  | **Vocabulary** |
| **In Year 3:**-compare how things move on different surfacesnotice that some [forces](http://primaryscienceonline.org.uk/glossary-of-terms/forces/) need contact between 2 objects, but magnetic [forces](http://primaryscienceonline.org.uk/glossary-of-terms/forces/) can act at a distance-observe how [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) attract or repel each other and attract some [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/) and not others-compare and group together a variety of -everyday [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/) on the basis of whether they are attracted to a magnet, and identify some magnetic [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/)-describe [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) as having 2 poles-predict whether 2 [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) will attract or repel each other, depending on which poles are facing | **Water and air resistance.**When objects move through air and water they have to push it out of the way. The water and air push back with forces called water resistance. The harder it is to push the material out of the way the greater the resistance.Gases weigh less than liquids and so water resistance is greater than air resistance. | **Friction**Friction is a force against motion caused by two surfaces rubbing against each other. It occurs because no surfaces are perfectly smooth; they have bumps and undulations that can interlock when placed on top of each other.To move one interlocking over another one of three must happens:* The surfaces must rise slightly.
* The bumps on the surface must bend.
* The bumps on the surface must break.

All of these actions requires a force, this is what causes friction. | **Managing forces**Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move.(These are particularly complex ideas. It might be better to teach them through a design technology project where children make toys using cogs, pulleys and levers). | Air resistance, Water resistance, Friction, Gravity, Newton, Gears, Pulleys, Force, Push, Pull, Opposing, Streamline, Brake, Mechanism, Lever, Cog, Machine |
| **Common Misconceptions:** | **Some children may think:*** the heavier the object the faster it falls, because it has more gravity acting on it
* forces always act in pairs which are equal and opposite
* smooth surfaces have no friction
* objects always travel better on smooth surfaces
* a moving object has a force which is pushing it forwards and it stops when the pushing force wears out
* a non-moving object has no forces acting on it
* heavy objects sink and light objects float.
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| **Working scientifically opportunities:**  Revisit KS1 skills: focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. |
| **Identifying and Classifying** | Can you label and name all the forces acting on the objects in each situation? | Explore how levers, pulleys and gears work. |  |
| **Comparative testing** | How does the length of a paper helicopter’s wings affect the time it takes to fall? |  |  |
| **Fair tests** | How does the saltiness (salinity) of water affect water resistance?How does changing the shape of a piece of plasticene affect water resistance?How does adding holes to a parachute affect the time it takes to fall? | How does the amount/ depth of tread affect the friction between a shoe and a surface (model this with a material they can change the tread on rather than a real shoe). Is the same conclusion reached if the surface is rough or smooth? | Make a product that involves a lever, pulley or gear. |
| **Pattern seeking** |  |  |  |
| **Research** | How do submarines sink if they are full of air? |
| **Ideas over time** |  |
| **In KS3:*** Opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface.
* Forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only).
* Change depending on direction of force and its size.
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| **Earth and Space** |
| **National curriculum objectives:*** describe the movement of the Earth, and other planets, relative to the Sun in the solar system
* describe the movement of the Moon relative to the Earth
* describe the Sun, Earth and Moon as approximately spherical bodies
* use the idea of the Earth’s rotation to explain day and night and the apparent movement of the sun across the sky.

Pupils should be introduced to a model of the Sun and Earth that enables them to explain day and night. Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a ‘dwarf planet’ in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones). Pupils should be warned that it is not safe to look directly at the Sun, even when wearing dark glasses. Pupils should find out about the way that ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus. Pupils might work scientifically by: comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; finding out why some people think that structures such as Stonehenge might have been used as astronomical clocks.  | **Key ideas:**1. stars, planets and moons have so much mass they attract other things, including each other due to a force called gravity. Gravity works over distance.
2. Objects with larger masses exert bigger gravitational forces.
3. Objects like planets, moons and stars spin.
4. Smaller mass objects like planets orbit large mass objects like stars.
5. Stars produce vast amounts of heat and light. All other objects are lumps of rock, metal or ice and can be seen because they reflect the light of stars.
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| **Prior Learning** | **Earth and space** | **Vocabulary** |
| **In Year 3:**-compare how things move on different surfacesnotice that some [forces](http://primaryscienceonline.org.uk/glossary-of-terms/forces/) need contact between 2 objects, but magnetic [forces](http://primaryscienceonline.org.uk/glossary-of-terms/forces/) can act at a distance-observe how [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) attract or repel each other and attract some [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/) and not others-compare and group together a variety of -everyday [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/) on the basis of whether they are attracted to a magnet, and identify some magnetic [materials](http://primaryscienceonline.org.uk/glossary-of-terms/materials/)-describe [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) as having 2 poles-predict whether 2 [magnets](http://primaryscienceonline.org.uk/glossary-of-terms/magnets/) will attract or repel each other, depending on which poles are facing. | **Where the Earth is in space.**The universe is vast and contains billions of stars.See the source imageThe solar system is a collection of planets and moons orbiting our nearest star, the sun. It can be represented using a model.All objects in the solar system are spinning as well as orbiting.The time it takes for an object to spin once is called a day.The time it takes a planet to orbit the sun is called a year. | **Stars and other objects**Stars produce vast amounts of heat and light. All other objects are lumps of rock, metal or ice and can be seen because they reflect the light of stars. | **Gravity and its effects.**Gravity is force of attraction between any two things that have mass and bigger masses exert bigger forces.Gravity works over a distance but gets weaker as the distance increases. Stars, planets and moons have so much mass they exert a large gravitational attraction on other things, including each other.Differences in gravity result in smaller mass objects like planets or moons orbiting lager mass objects like stars or planets. | Earth, Sun, Moon, Axis, Rotation, Day, Night, Phases of the Moon, waxing, waning, crescent, gibbous, star, constellation Mercury, Jupiter, Saturn, Venus, Mars, Uranus, Neptune, spherical, solar system,rotates, star, orbit, planets |
| **Common Misconceptions:** | **Some children may think:**• the Earth is flat• the Sun is a planet• the Sun rotates around the Earth• the Sun moves across the sky during the day• the Sun rises in the morning and sets in the evening• the Moon appears only at night• night is caused by the Moon getting in the way of the Sun or the Sun moving further away from the Earth. |
| **Working scientifically opportunities:**  Revisit KS1 skills: focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. |
| **Identifying and Classifying** | How could you organise all the objects in the solar system into groups?Can you observe and identify all the phases in the cycle of the Moon? |  |  |  |
| **Comparative testing** | How does the length of daylight hours change in each season? |  |  |
| **Fair tests** |  |  | Investigate moon craters. How does the speed/ size of a meteorite affect the size of a moon crater formed?If the moon became heavier as a result of meteorite collisions what would happen to its position relative to the Earth? |
| **Pattern seeking** |  |  |  |
| **Research** | How have our ideas about the solar system changed over time? What unusual objects did Jocelyn Bell Burnell discover? |
| **Ideas over time** | How is astronomer and planetary scientist Sara Seagar changing our ideas about the universe? |
| **In KS3:*** Gravity force, weight = mass x gravitational field strength (g), on Earth g=10N/kg, different on other planets and stars; gravity forces between Earth and Moon and between Earth and Sun.
* Our sun as a star, other stars in our galaxy, other galaxies.
* The seasons and the Earth’s tilt, day length at different times of year, in different hemispheres The light year as a unit of astronomical distance.
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| **Changing Materials** |
| **National curriculum objectives:*** compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets
* know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
* use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating
* give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
* demonstrate that dissolving, mixing and changes of state are reversible changes
* explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda.

Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton. Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, for example, burning, rusting and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.  | **Key ideas:**1. All matter(including gas) has mass.
2. Sometimes mixed substances react to make a new substance. These changes are usually irreversible.
3. Heating can sometimes cause materials to change permanently. When this happens a new substance is made. These changes are not reversible.
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| **Prior Learning** |  | **Vocabulary** |
| **In Year 4:**-compare and group materials together, according to whether they are solids, liquids or gases- observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)- identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature. | **It is possible to change materials into completely different ones. This is very important because new substances might have different properties to materials we currently have. E.g. plastics can be moulded into intricate shapes, are waterproof, strong and electrical insulators.****When materials are heated or mixed with other materials they sometimes can be made to turn into new materials. The question is how would we know if it was a new material or the same material mixed differently.****Indicators that something new has been made are:*** **The properties of the material are different (colour, state, texture, hardness, smell, temperature)**

**If it is not possible to get the material back easily it is likely that it is not there any more and something new has been made (irreversible).** | Hardness, Solubility, Transparency, Conductivity, Magnetic, Filter, Evaporation, Dissolving, Mixing, Material, Conductor, dissolve, insoluble, suspension, chemical, physical, irreversible, solution, reversible, separate, mixture, insulator, transparent, flexible, permeable, soluble, property, magnetic, hard |
| **Common Misconceptions:** | **Some children may think:**Lots of misconceptions exist around reversible and irreversible changes, including around the permanence or impermanence of the change. There isconfusion between physical/chemical changes and reversible and irreversible changes. They do not correlate simply. Chemical changes result in a newmaterial being formed. These are mostly irreversible. Physical changes are often reversible but may be permanent. These do not result in new materials e.g.cutting a loaf of bread. It is still bread, but it is no longer a loaf. The shape, but not the material, has been changed.Some children may think:• thermal insulators keep cold in or out• thermal insulators warm things up• solids dissolved in liquids have vanished and so you cannot get them back• lit candles only melt, which is a reversible change. |
| **Working scientifically opportunities:**  Revisit KS1 skills: focus on asking questions about the similarities and differences between things. Go outside to explore the world around them at all times of the year. |
| **Identifying and Classifying** | Can you group these materials based on whether they are transparent or not?Have we made a new substance? Reversible/irreversible* Add baking soda to vinegar (new gas)
* Add sugar to fizzy pop
* Flour and water etc.
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| **Comparative testing** | Which type of sugar dissolves the fastest?Which shoe is the slippiest? |
| **Fair tests** | How does the temperature of tea affect how long it takes for a sugar cube to dissolve? |
| **Pattern seeking** | Do all stretchy materials stretch in the same way? |
| **Research** | What are microplastics and why are they harming the planet? |
| **Ideas over time** |  |
| **In KS3:*** The concept of a pure substance.
* Mixtures, including dissolving.
* Diffusion in terms of the particle model.
* Simple techniques for separating mixtures; filtration, evaporation, distillation and chromatography.
* The identification of pure substances.
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