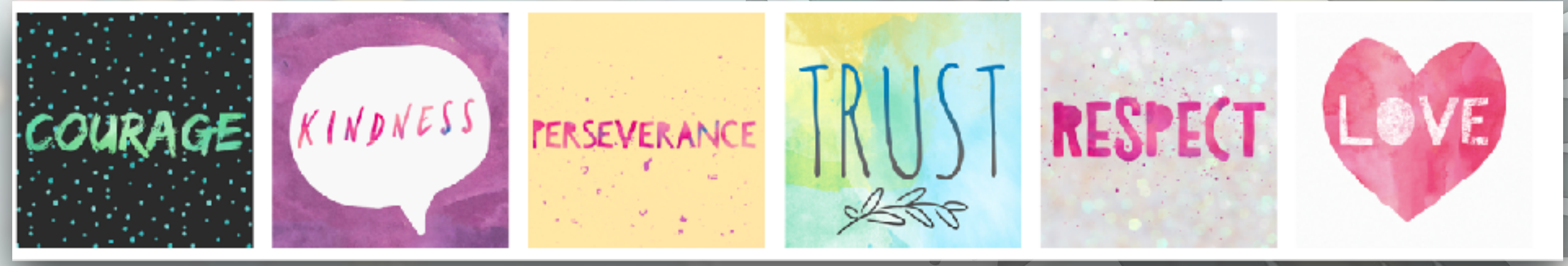
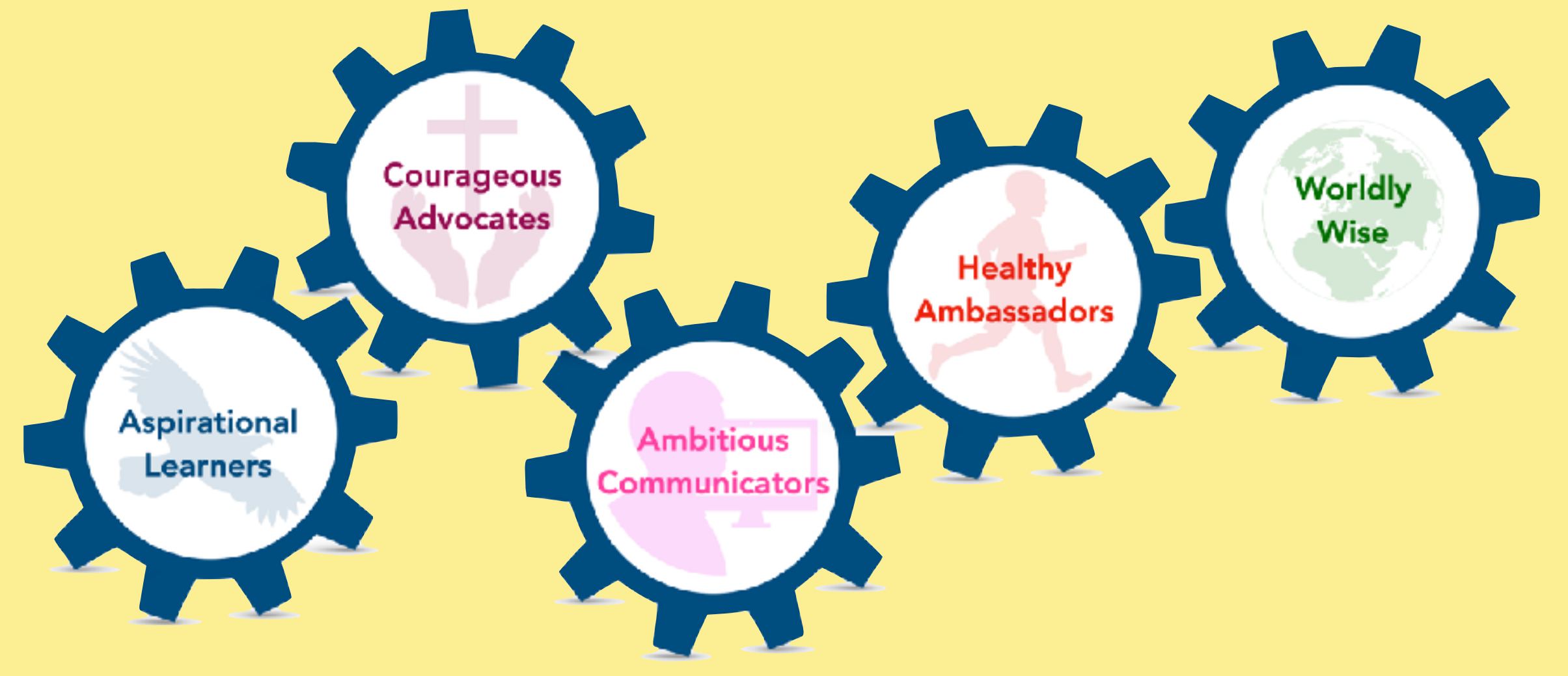
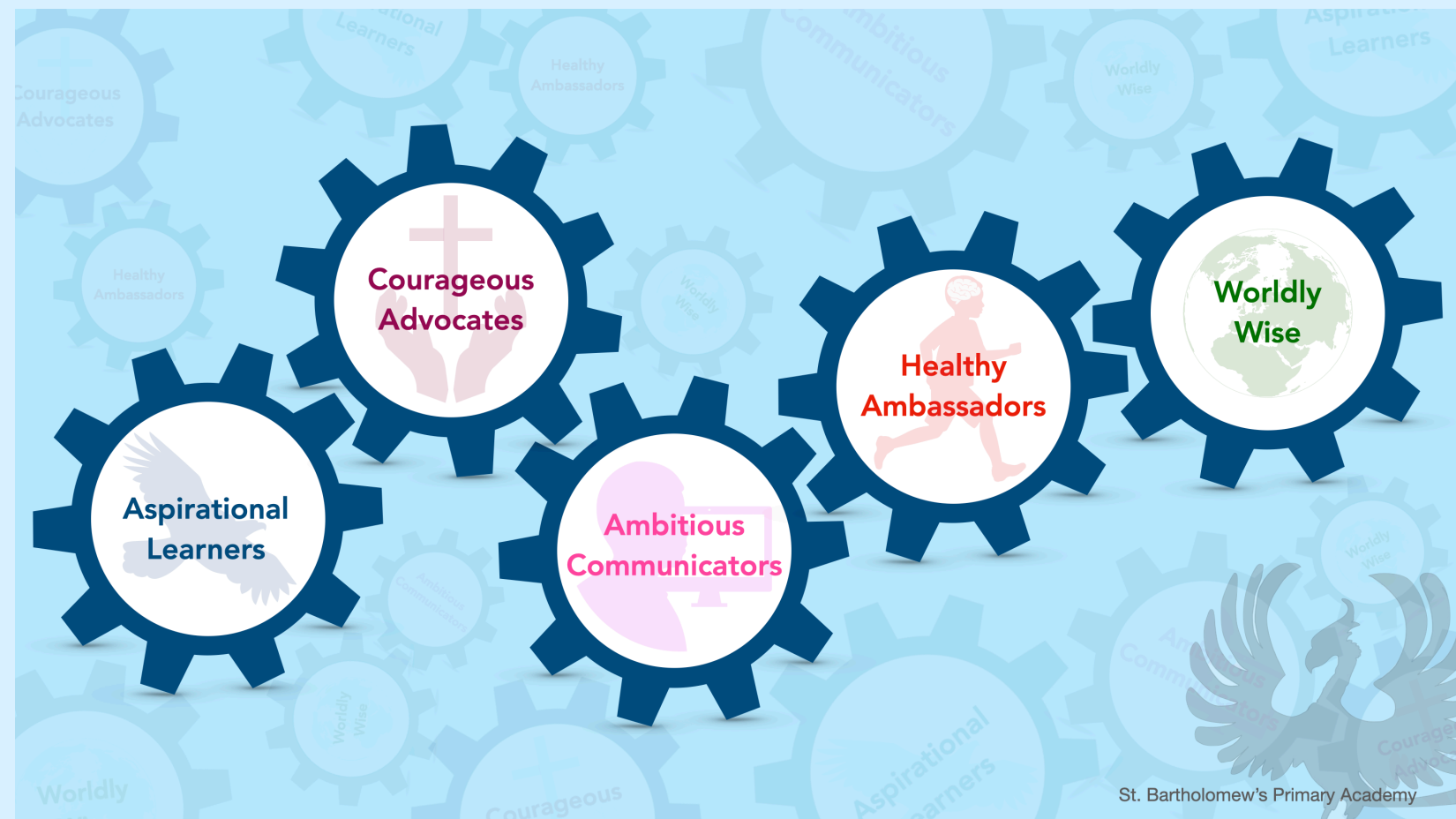


Science Flight Path

Hand in hand we learn, we grow, we soar

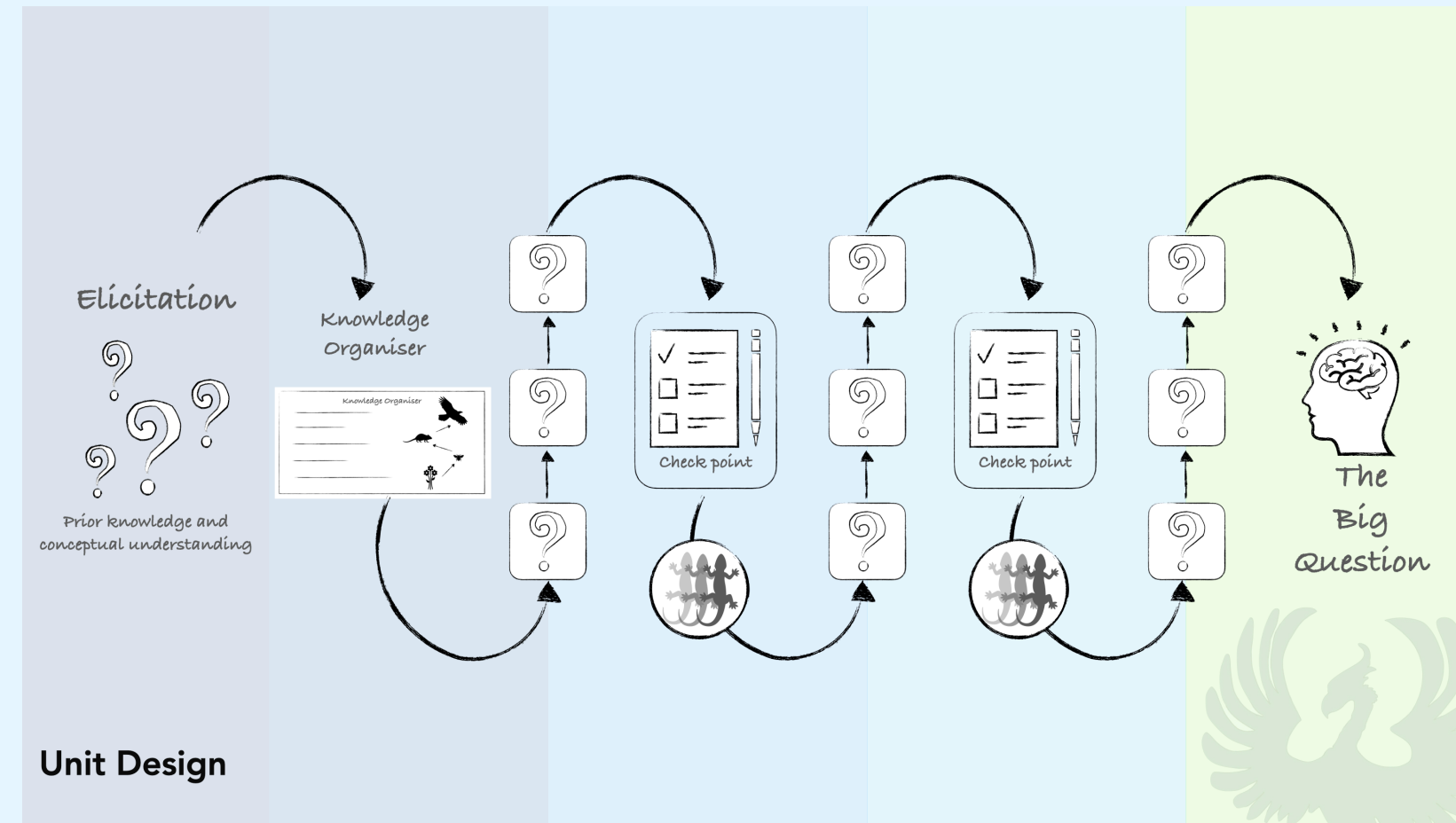


Our Curriculum Drivers



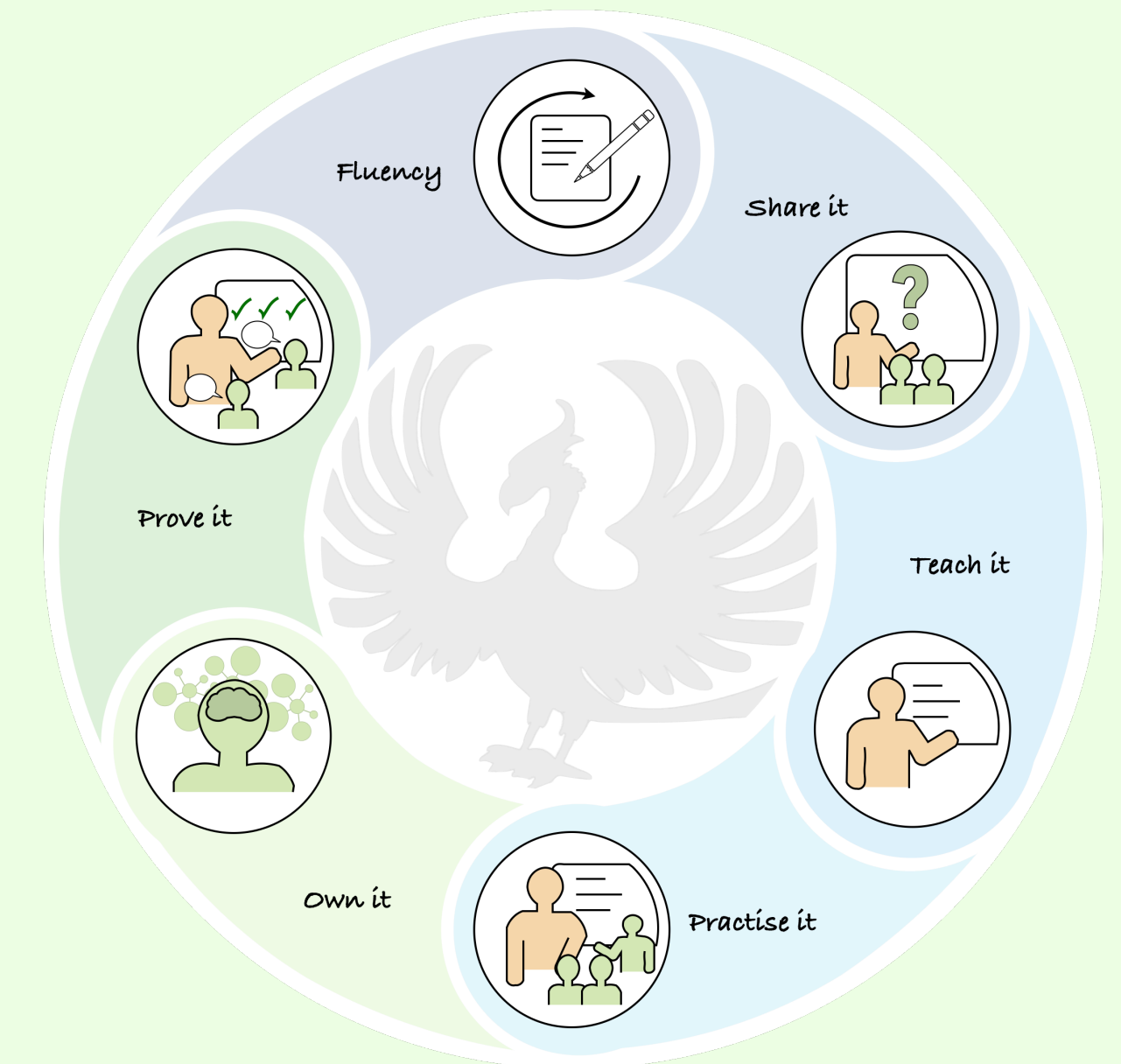
These articulate the ambition of our curriculum and how it will enable children to be confident, successful and ambitious citizens, prepared for life outside of school.

Our Unit Design



These are the principles that teachers adhere to when designing a unit of work, to ensure it builds upon prior learning and leads to secure schema.

Our Lesson Design



This is the structure we follow during lessons to reduce cognitive load and ensure all children are able to succeed.

Science

Science is a body of knowledge and a process that allows us to explain and understand the world around us.

Intent

We believe that a high-quality science education should engage, stimulate and challenge pupils, equipping them with the knowledge and skills to better understand the world around us. Our science curriculum prioritises building knowledge in a meaningful and sequential way, allowing pupils to make links and build on what they already know. Our pupils will learn about, and be inspired by, the work of great scientists. They will develop a growing understanding of the contribution science has made to society, both past and present. Our pupils will develop their enquiry skills through first hand activities that inspire them to deepen their own scientific knowledge and conceptual understanding of biology, chemistry and physics. Our aim is for all pupils to be equipped with the scientific knowledge to understand the uses of science today and in the future. We aim to build strong schema by using a concept based approach.

Implementation

Science is taught weekly at St Bartholomew's. We have used 'The 10 Big Ideas of Science Education' (<https://thescienceteacher.co.uk/big-ideas/>) alongside 'Developing Experts' (<https://www.developingexperts.com/>) and the National Curriculum to design our bespoke science curriculum. Our carefully planned units of study build on what the children already know. The sequence of lessons within each unit aims to develop children's scientific knowledge and understanding of increasingly complex scientific phenomena and processes. Our science curriculum, unit design and mastery lesson approach encourage children to make links, frequently revisit past learning and deepen their growing understanding of the world around us. Scientific vocabulary is mapped and taught rigorously to ensure that children can recognise, understand and use scientific vocabulary accurately and confidently. Opportunities to revisit and remember key knowledge and practise key skills are imbedded throughout our curriculum.

Impact

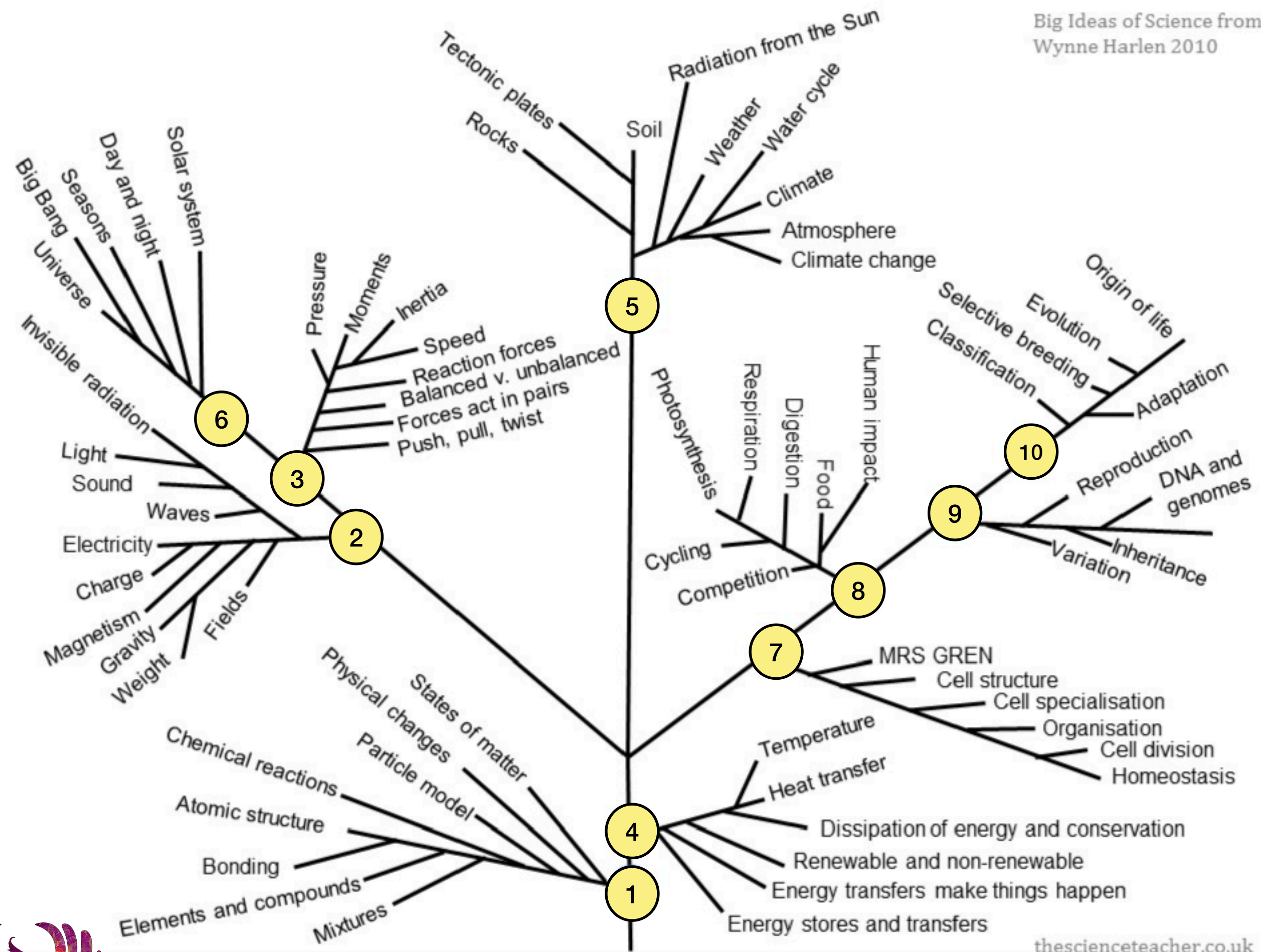
Children at St Bartholomew's will:

- Demonstrate their growing scientific knowledge by completing regular 'checkpoint' assessments and by answering 'big questions', using the correct scientific vocabulary to describe and explain the phenomena and processes they have observed.
- Make predictions and links backed up by their own scientific understanding.
- Plan and carry out scientific investigations both individually and as a group, using a range of equipment to make accurate measurements, and explaining the meaning and importance of a 'fair test' (KS2).
- Use a range of methods to communicate scientific information and present it in a systematic, scientific manner, including ICT, diagrams, graphs and charts.
- Develop an understanding of the work of great scientist and how scientific discoveries have shaped our understanding of the world around us.



The 10 Big Ideas of Science Education

'Knowledge with meaning leads to 'Big Idea' thinking'



<https://thescienceteacher.co.uk/big-ideas/>

'Thinking well requires knowing facts. When we organise facts, they become something broader - knowledge. Organised knowledge with lots of connections is more likely to support successful recall.'

(Why Don't Students Like School?, Daniel Willingham)

The 10 Big ideas of Science Education

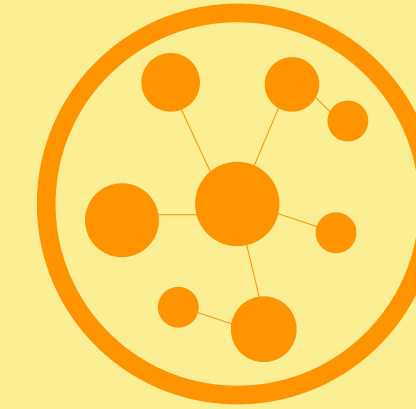
1. All matter in the universe is made up of very small particles.
2. Objects can affect other objects at a distance.
3. Changing the movement of an object requires a net force to be acting on it.
4. The total amount of energy in the universe is always the same but can be transferred from one energy source to another during an event.
5. The composition of the earth and its atmosphere, and the processes occurring within them, shape the earth's surface and its climate.
6. Our solar system is a very small part of one of billions of galaxies in our universe.
7. Organisms are organised on a cellular basis and have finite life span.
8. Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms.
9. Genetic information is passed down from one generation of organisms to the next.
10. The diversity of organisms, living and extinct, is the result of evolution.





Information

Isolated facts that can have no organisational basis or links



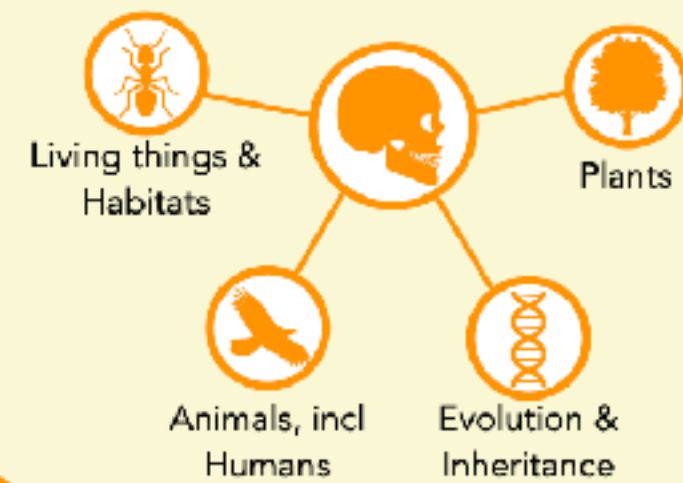
Schema

Knowledge organised in a meaningful way - memories (emotional), concepts, knowledge

Key Concepts

Key concepts identify the content or focus areas of study

Biology



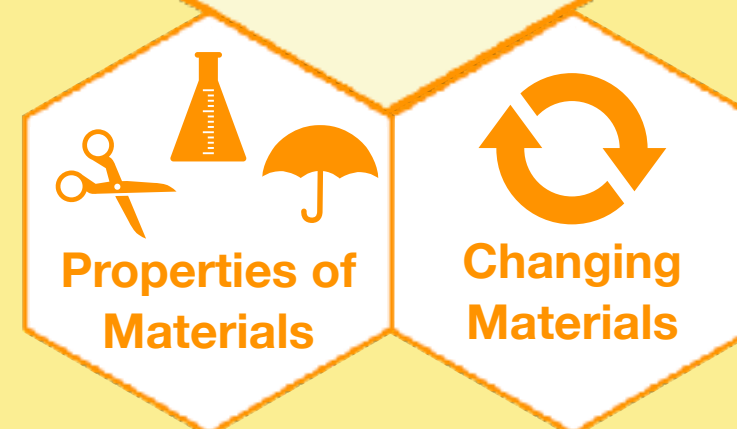
Chemistry



Physics

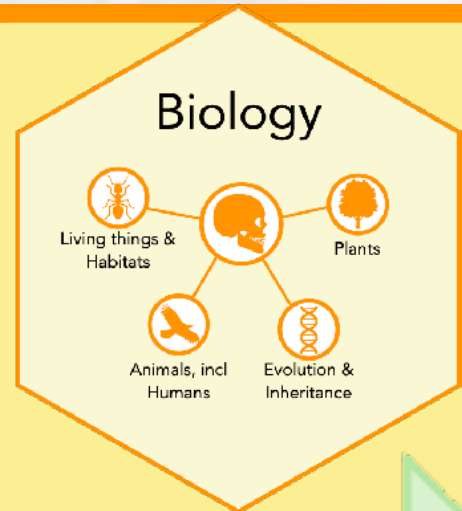


Working Scientifically



Second Order Concepts

Second-order concepts: these shape the key questions asked in a subject and organise the subject knowledge



Big Idea

Organisms are organised on a cellular basis and have a finite life span

Big Idea

Organisms require a supply of energy and materials for which they often depend on, or compete

Big Idea

Genetic information is passed down from one generation of organisms to another

Big Idea

The diversity of organisms, living and extinct, is the result of evolution

What does it mean to be alive?



Alive

Structure & function

Living things have a structure which enables a living function

How to stay alive?

Survive & Thrive



Living things need energy to power those functions to survive and thrive.

How to ensure species stays alive?

Reproduction



As living things age and grow, they pass through stages in which structure and functions develop enabling reproduction. This allows species to continue to thrive and survive.

How to ensure species survive?

Diversity

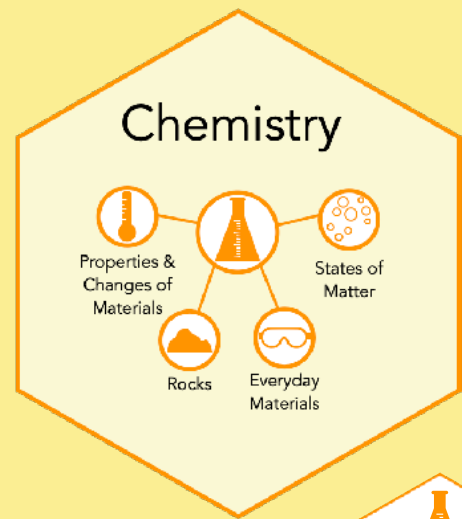


Living things adapt and evolve their structure and function over many years to ensure longevity of species surviving and thriving.

The structure and function of living things and materials have similarities and differences. These enable us to group them and identify individual types.

Big Idea

All matter in the Universe is made of very small particles.



Properties of Materials
Structure and function

Materials have properties which enables function and therefore a use.

Changing Materials
Properties

If you change the material's properties (structure) you change its use (function)

Objects have mass

Big Idea

Objects can affect other objects at a distance

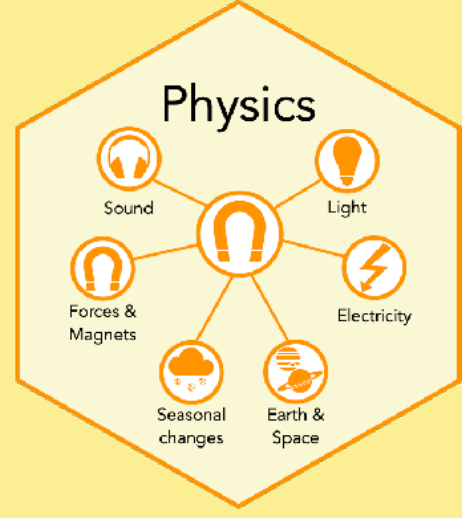
Forces describe how objects affect each other

Big Idea

Changing the movement of an object requires a net force to be acting on it

Big Idea

The total amount of energy in the universe is always the same but can be transferred from one energy store to another during an event



Forces
Non-contact

Non-contact forces attract and repel

Forces
Contact

Contact forces oppose each other (resist)

Changing the quantity of energy can affect the work done

Force causing movement

Work done

An unbalanced force causes a change in movement

Energy is the capacity to do work

Energy enables things to function and transforms from one form to another

The Story of Science
How do the 'Big Ideas' and concepts link together?





Science

Science is a body of knowledge and a process that allows us to explain and understand the world around us.

Biology

Chemistry

Physics

Substantive knowledge in key concepts

Alive
Function and Structure

Thrive and Survive
Nutrition and Growth

Reproduction

Diversity

Properties of Materials

Changing Materials

Forces

Energy

Plants
Animals

Plants
Animals

Plants
Animals

Plants & Animals

Non-contact

Contact

Identify species
Identify parts and their function
Life processes

Conditions for healthy growth
Habitats
Food chains

Life cycles

Evolution and adaptation

Objects
Materials
Properties
Suitability
States of matter

Physical changes
Fossils
Soils
Changing state
Water cycle

Magnetism
Gravity
Solar System
Movement of Earth

Twist, push, pull
Friction resistance
Gearing

Seasonal changes
Light
Sound
Electricity

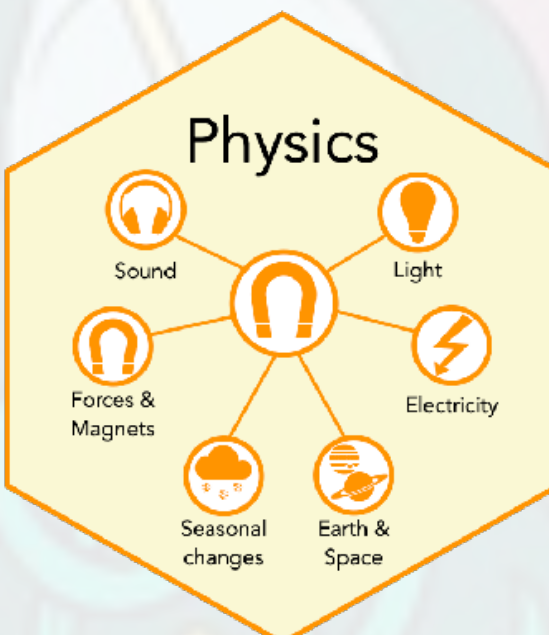
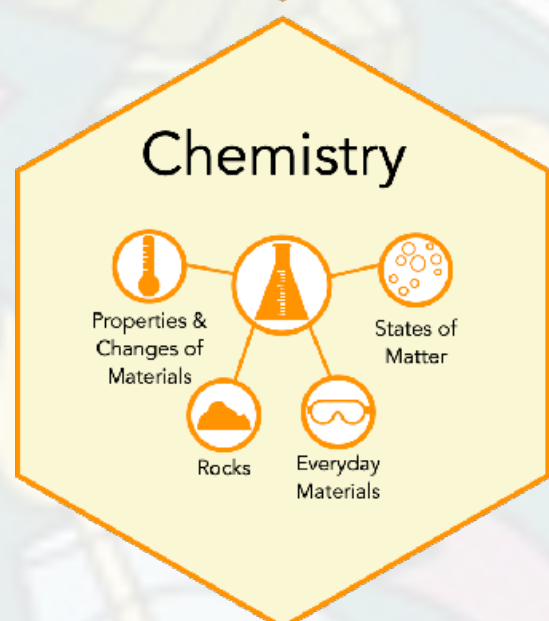
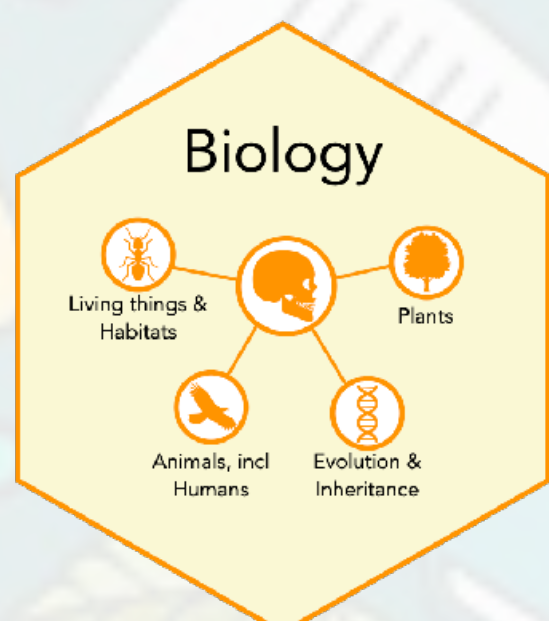


Coverage of Key Concepts



The units during which each key concept is featured.

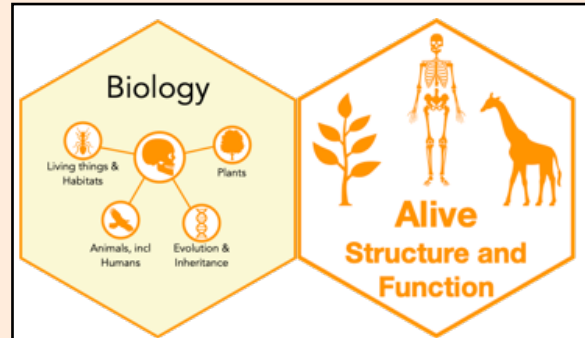
Ongoing
(Every Term)



EYFS	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
All About Me Plants Animals	Plants Animals, including Humans	Living Things and their Habitats Plants Animals including Humans	Plants Animals including Humans	Living Things and their Habitats Animals including Humans	Living Things and their Habitats Animals including Humans	Living Things and their Habitats Animals including Humans Evolution and Inheritance
Materials	Everyday Materials	Uses of Everyday Materials	Rocks	States of Matter	Properties and changes to Materials	
Forces	Seasonal Changes		Light Forces and Magnets	Sound Electricity	Earth and Space Forces	Light Electricity

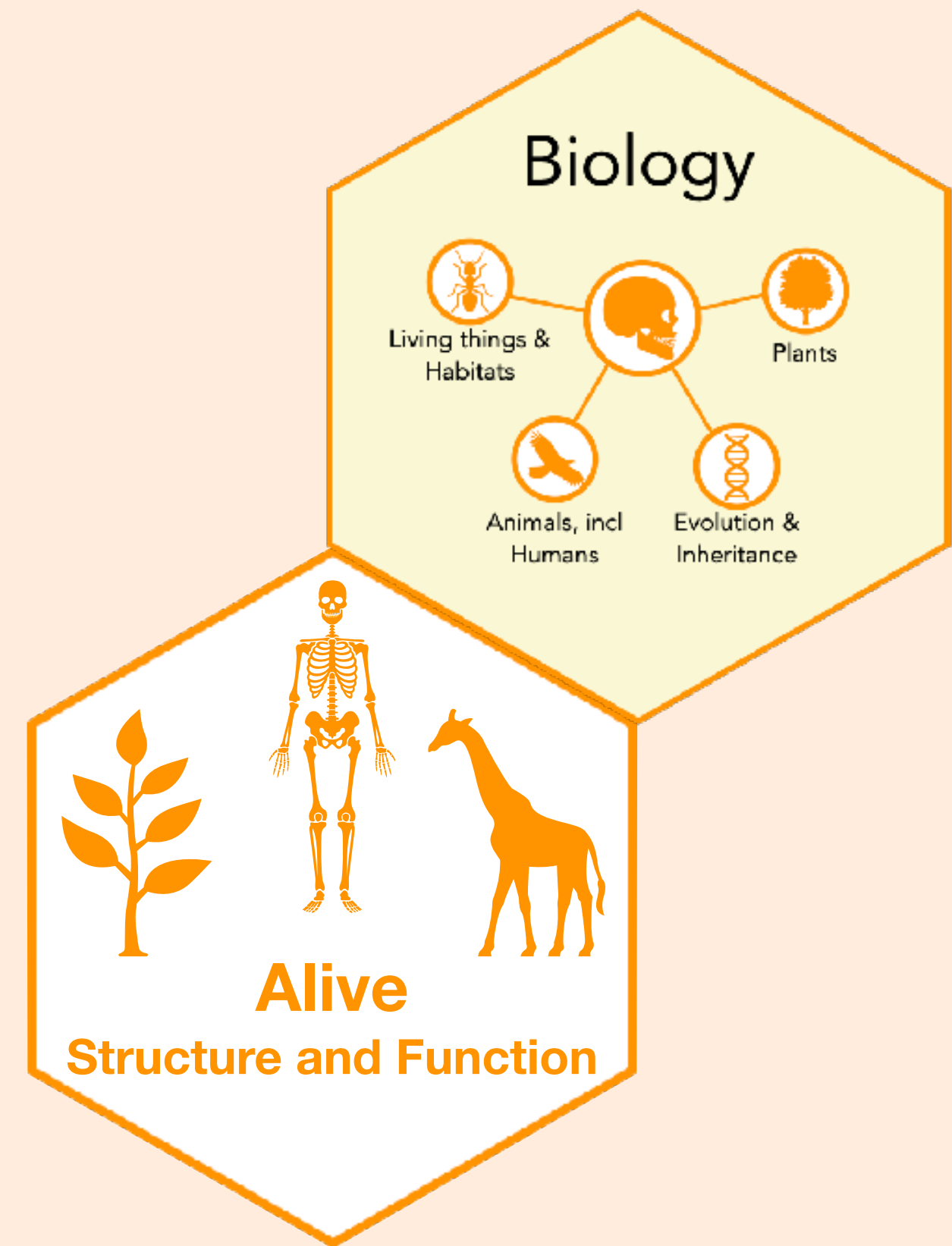
Second Order Concepts

How the concept of **Alive** is built up over time (Page 1/2)



Biology Key Concept: Alive (structure)	
<u>Organisms are organised on a cellular basis and have a finite life span</u>	
<ul style="list-style-type: none"> All organisms comprise one or more cells. Multi-cellular organisms have cells that are differentiated according to their function. 	<ul style="list-style-type: none"> All the basic functions of life are the result of what happens inside the cells that make up an organism. Growth is the result of multiple cell divisions.

National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
EY	<ul style="list-style-type: none"> Know that a plant is a living thing and can grow. Know that picking a flower / pulling a plant out of the ground will cause it to die Know that chopping a tree down means it is no longer living Know that a seed grows into a plant Know that leaves from different plants and trees look different Know that a woodland is made up of trees. 	<ul style="list-style-type: none"> Know that a body is made up of different parts. Notice animals move, eat, sleep, drink, reproduce Know that some animals have different body parts to humans Notice and comment some of the similarities and differences between animals Know that people live in family groups. Know that farms produce food for us to eat. 	<p><i>Examples of provision:</i></p> <ul style="list-style-type: none"> Visit a woodland Seasonal walks Know that they can use different parts of their bodies to explore Sensory opportunities linked to plants (herbs etc) 	<ul style="list-style-type: none"> Alive dead Plant flower seed tree grow leaf/leaves woodland Fruit Vegetable Animal Body 	<ul style="list-style-type: none"> Hands Shoulders Knees Toes Head Back Arms Feet Same Different Family Farms Teeth
<p>Year 1 NC</p> <ul style="list-style-type: none"> identify and name a variety of common wild and garden plants, including deciduous and evergreen trees identify and describe the basic structure of a variety of common flowering plants, including trees identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals identify and name a variety of common animals that are carnivores, herbivores and omnivores describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals including pets) identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense 	<ul style="list-style-type: none"> Know difference between a plant and a tree Know the difference between common and wild plants Know the difference between evergreen and Deciduous Know and identify leaf, stem, root, flower, petal, branch, trunk, blossom Know the names of wild and garden plants. Know the names of deciduous and evergreen trees. 	<ul style="list-style-type: none"> Know that a fish lives in the water and fins and name some examples. Know that a bird has feathers and lays eggs and name some examples. Know that a reptile has scaly skin and name some examples Know that amphibians can live in water and on land and name some examples. Know that mammals give birth to live young that look like them and name some examples. Know that carnivores eat only meat and name some examples Know that omnivore eat meat and vegetations and name some examples. Know that herbivores only eat vegetation and name some examples. Know that humans have eyes so they can see Know that humans have ears to hear Know that humans have a tongue to taste Know that humans have skin to feel Know that humans have a nose to smell Know that humans use their sense to learn about the world. 	<ul style="list-style-type: none"> Common plants Wild plants Evergreen Deciduous Stem Root Petal Branch Trunk Blossom Bark 	<ul style="list-style-type: none"> Fingers Nose Skin Tongue Stomach Senses – taste, touch, smell, see, hear Fish Fin Bird Feathers Eggs Reptile Scaly Amphibians Mammals Carnivore Omnivore Herbivore 	

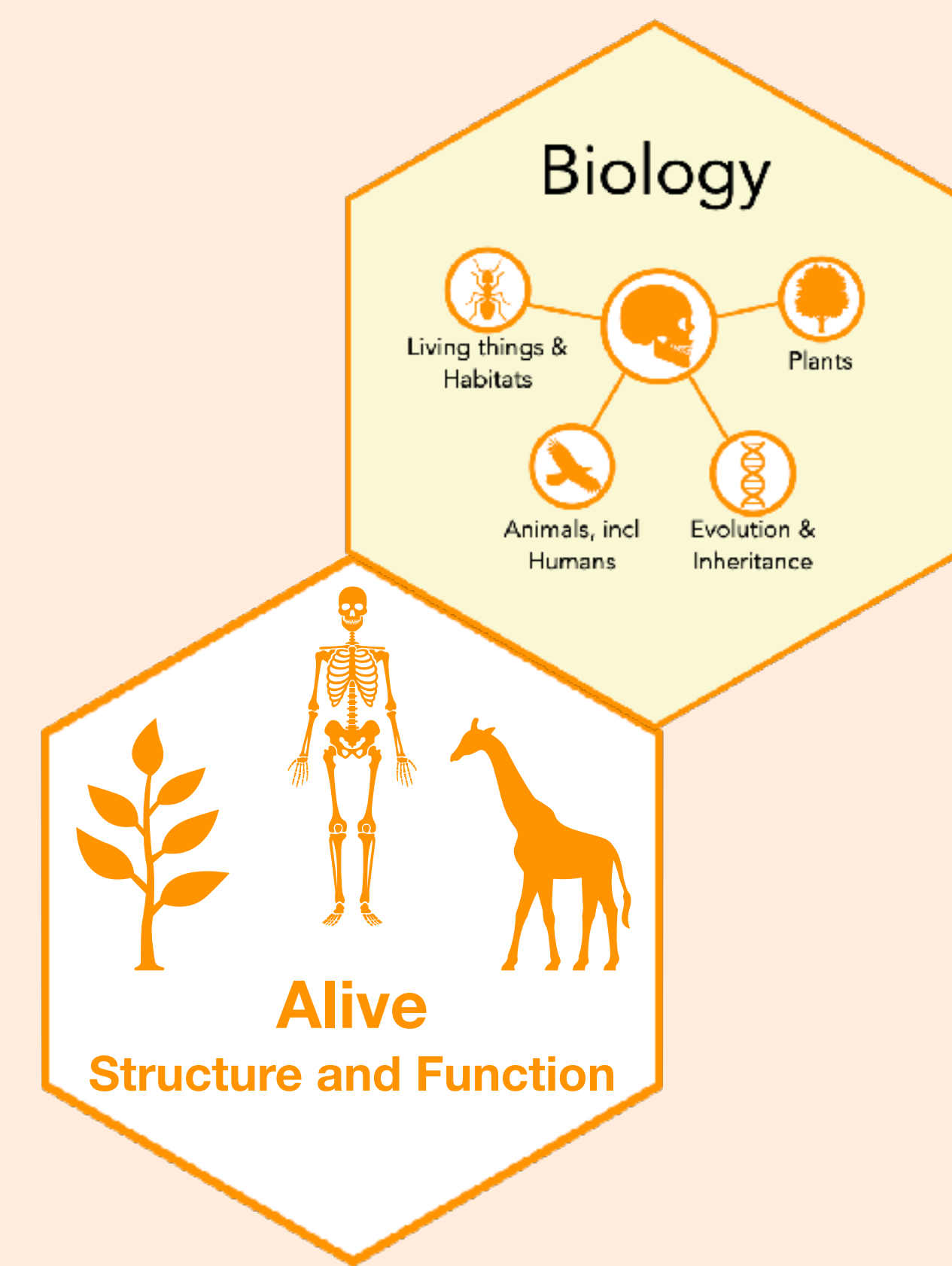


How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Alive** is built up over time (Page 2/2)

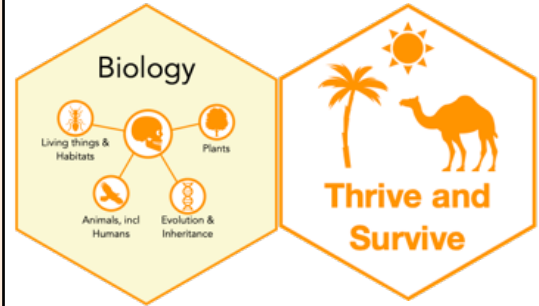
National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
Year 2 NC <ul style="list-style-type: none"> observe and describe how seeds and bulbs grow into mature plants explore and compare the differences between things that are living, dead, and things that have never been alive 	<ul style="list-style-type: none"> Know the difference between a seed and a bulb Know the difference between a seedling, young plant and mature plant 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Know that something that is living has to have 7 life processes (MRS NERG) Know that a living thing is dead if it no longer has all 7. Know that it has never been alive if it has never had all 7.. 	<ul style="list-style-type: none"> Seed Bulb Seedling Young Mature Living thing Life processes 	<ul style="list-style-type: none"> Nutrition Growth Reproduction Respiration Sensitivity Excretion Movement
Year 3 NC <ul style="list-style-type: none"> identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers identify that humans and some other animals have skeletons and muscles for support, protection and movement 	<ul style="list-style-type: none"> Know that a stem/trunk provides support and transport water Know that the leaf captures energy from the sun. Know that flowers attract insects. 	<ul style="list-style-type: none"> Know that humans and animals have skeletons to: <ul style="list-style-type: none"> protect their vital organs support the structure of their body allow movement Know that humans and animals have muscles which work in pairs to allow movement 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Transport Support Function Energy Store Capture Attract Insects 	<ul style="list-style-type: none"> Skeleton Protect Organs Structure Muscles Joint Bones Human
Year 4 NC					
Year 5 NC <ul style="list-style-type: none"> describe the changes as humans develop to old age 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Know that babies are dependent upon an adult Know that a toddler can move around their world. Know that children grow rapidly Know that adolescents experience puberty which enables them to reproduce Know that adults are fully grown human Know as humans age, their bodies begin to change 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Dependence Toddler Adolescent Puberty Ageing Rapid 	
Year 6 NC <ul style="list-style-type: none"> identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood describe the ways in which nutrients and water are transported within animals, including humans. describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals give reasons for classifying plants and animals based on specific characteristics. 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Know that the function of the heart is to pump blood around the body. Know that the function of the lungs is to bring oxygen into the body and excrete carbon dioxide Know that carbon dioxide is waste product Know that blood vessels transport the blood to all areas of the body. Know that blood carries oxygen, CO2, water and nutrients. 	<ul style="list-style-type: none"> Know the difference between a plant, micro-organisms and an animal Know that a microorganism is a bacteria or a virus that can be helpful or harmful Know the difference between flowering plants and non-flowering plants Know the difference between vertebrates and invertebrates Know the 5 classifications of vertebrates: mammals, birds, fish, amphibians and reptiles. Know that invertebrates can be worms, insects and spiders describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals give reasons for classifying plants and animals based on specific characteristics. 	<ul style="list-style-type: none"> Heart Blood Blood vessels Arteries Veins Pump Lungs Oxygen Carbon dioxide Toxic / waste product Nutrients (Respiration) 	<ul style="list-style-type: none"> Micro-organism Bacteria Virus Vertebrate Invertebrate Classification Characteristics



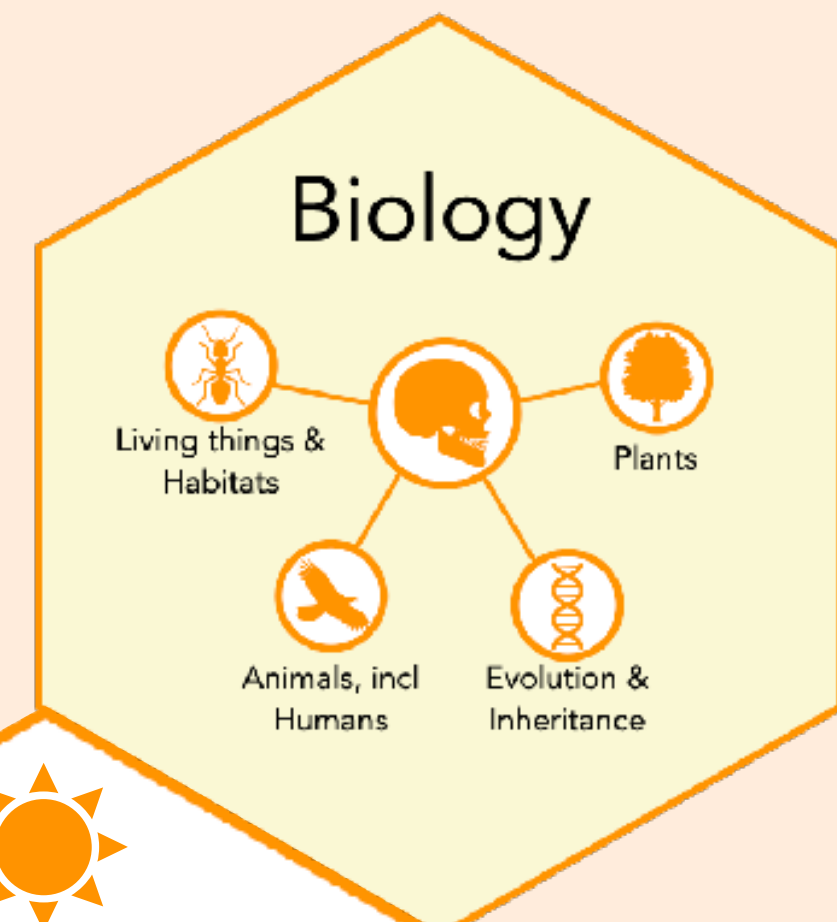
How **substantive knowledge** is built up over time.

Second Order Concepts

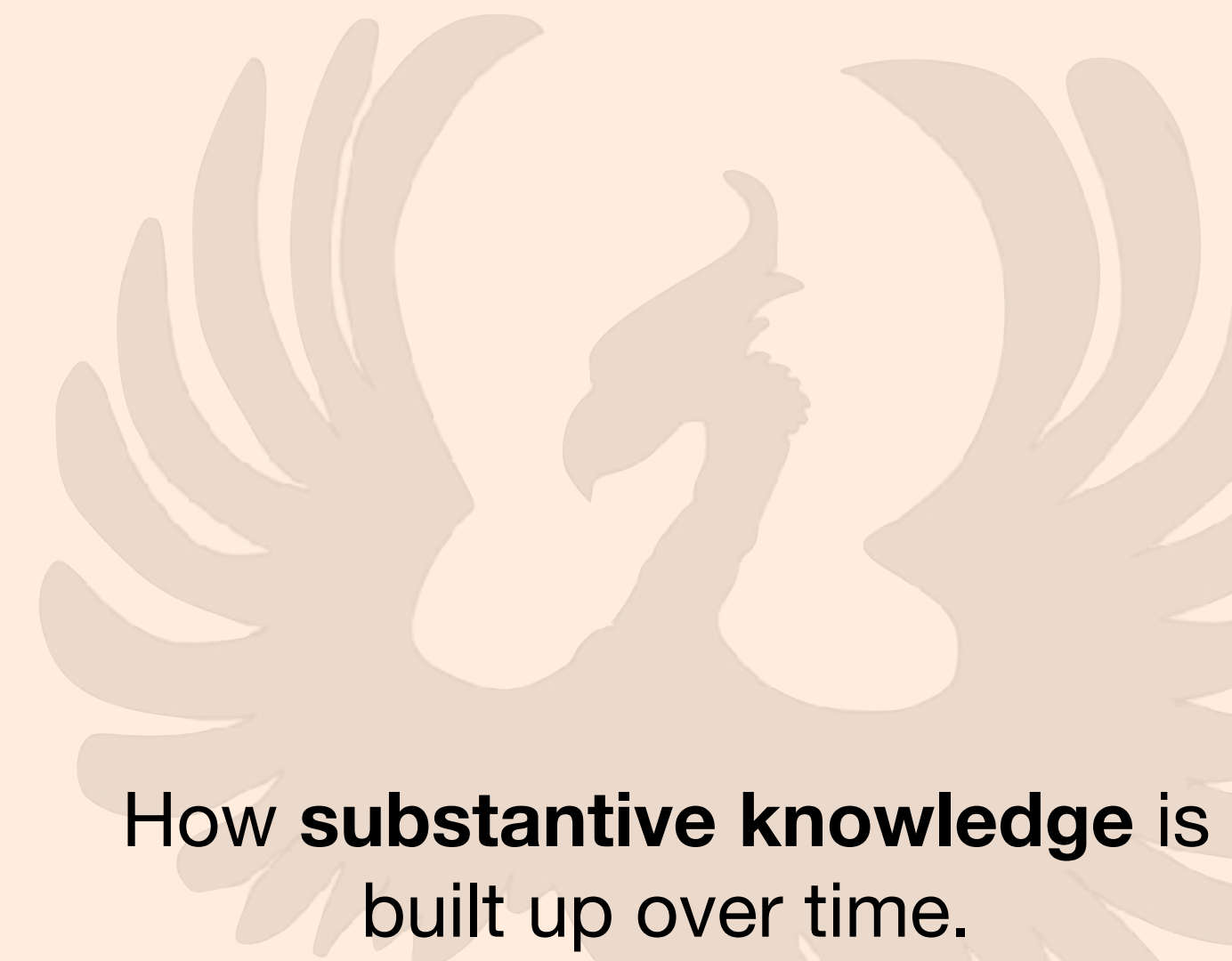
How the concept of **Survive and Thrive** is built up over time (Page 1/2)



Biology Key Concept: Survive and Thrive	
Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms	
<ul style="list-style-type: none"> Food provides materials and energy for organisms to carry out the basic functions of life and to grow. Green plants and some bacteria are able to use energy from the sun to generate complex food molecules. 	<ul style="list-style-type: none"> Animals obtain energy by breaking down complex food molecules and ultimately depend on green plants as their source of energy source. In any ecosystem there is competition among species for the energy resources and materials they need to live and reproduce.



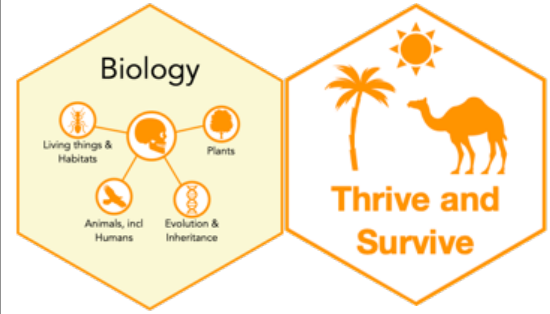
National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
EY	<ul style="list-style-type: none"> To know that plants need water to grow. 	<ul style="list-style-type: none"> Know why we wash our hands before we eat. Know why we have to look after our teeth by brushing them every day. Know that sugar is bad for your teeth. Know that exercise is healthy for our body. Know that their heart beats faster after exercise. <p>Know 2-3 healthy food choices.</p>		<ul style="list-style-type: none"> Wash Hands Eat Clean 	<ul style="list-style-type: none"> Sugar healthy unhealthy exercise
Year 1 NC					
Year 2 NC	<ul style="list-style-type: none"> Know that plants need water and light and the correct temperature to grow and stay healthy. Know that the absence of one or more of these will affect the health and growth of the plant. 	<ul style="list-style-type: none"> Know that animals need water, food and air to survive. Know that humans need exercise to maintain their structure and movement. Know that humans need a balanced diet of carbohydrate, vegetable and protein Know the importance of hygiene for good health. 	<ul style="list-style-type: none"> Know that a habitat is the environment in which an animal or plant usually lives. Explain why previously studied plants and animals live in their habitats. Know that a simple food chain starts with a plant and contains one or more animals Construct a food chain using previously taught animals and plants. Explain how plants and animals depend on each other. 	<ul style="list-style-type: none"> Essential Survive Balanced Diet Carbohydrate Protein Hygiene Habitat microhabitat environment 	<ul style="list-style-type: none"> chain dependence healthy unhealthy
Year 3 NC	<ul style="list-style-type: none"> Know that plants need nutrients from the soil and room to grow Know that different plants need different conditions Know that water is transported in plants from the roots to the stem and excreted through the leaves. 	<ul style="list-style-type: none"> Know the role of carbohydrate, protein, fats and vegetables in maintaining a balanced of diet. Know that nutrition provides the body with energy. 		<ul style="list-style-type: none"> Soil Nutrients Conditions Transportation 	<ul style="list-style-type: none"> Fats and oils energy



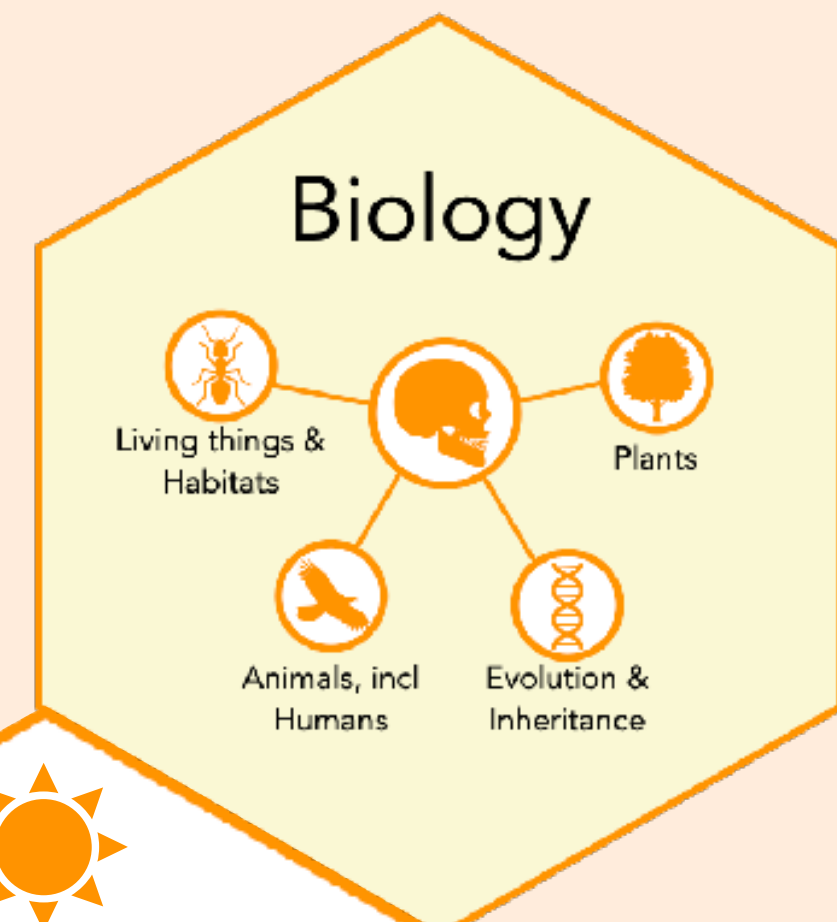
How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Survive and Thrive** is built up over time (Page 2/2)



Biology Key Concept: Survive and Thrive	
Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms	
<ul style="list-style-type: none"> • Food provides materials and energy for organisms to carry out the basic functions of life and to grow. • Green plants and some bacteria are able to use energy from the sun to generate complex food molecules. 	<ul style="list-style-type: none"> • Animals obtain energy by breaking down complex food molecules and ultimately depend on green plants as their source of energy source. • In any ecosystem there is competition among species for the energy resources and materials they need to live and reproduce.

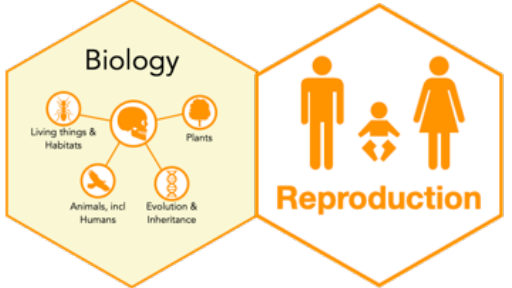


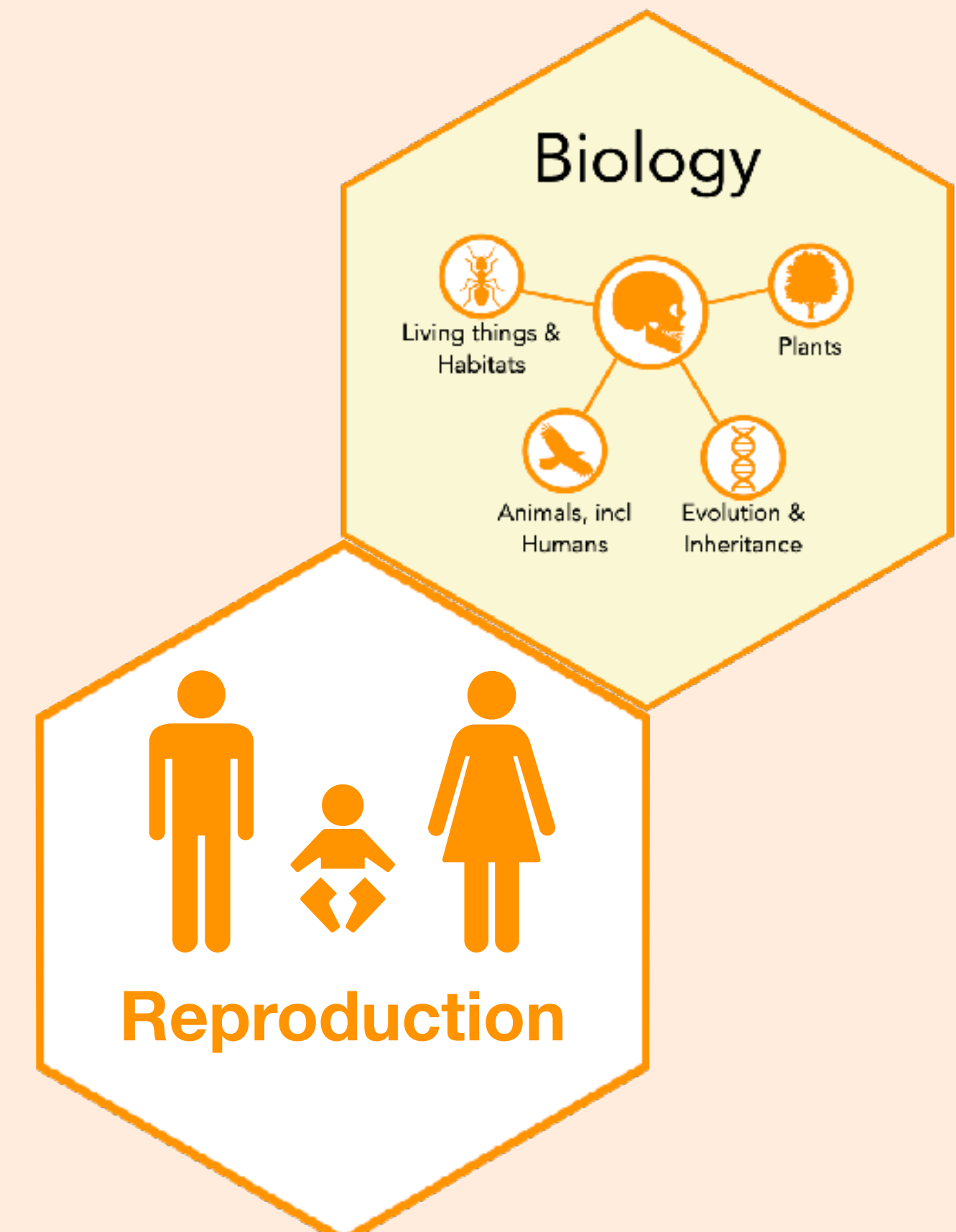
National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
Year 4 NC <ul style="list-style-type: none"> • describe the simple functions of the basic parts of the digestive system in humans • identify the different types of teeth in humans and their simple functions • recognise that environments can change and that this can sometimes pose dangers to living things • construct and interpret a variety of food chains, identifying producers, predators and prey 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Know that teeth break down food into small swallowable pieces. • Know the function of the molars is to grind food. • Know the function of the canines is to rip food • Know the function of the incisors is to cut food. • Know the oesophagus transports chewed food and liquid to the stomach • Know that the stomach breaks down the chewed food into a liquid • Know that the small intestine allows nutrients to be absorbed into the body. • Know that the function of the large intestine is to absorb water. • Know that the anus allows the body to store and excrete waste 	<ul style="list-style-type: none"> • Know that a food chain starts with a producer • Know that a food chain includes predators who feed on prey. • Construct a food chains containing producers predators and prey • Know that environmental change can endanger living things in a habitat. 	<ul style="list-style-type: none"> • Molar • Grind • Canines • Rip • Incisors • Chew • Small intestine • Absorbed • Large intestine • anus 	<ul style="list-style-type: none"> • producer • predator • pre • endanger • environment threat
Year 5 NC					
Year 6 NC <ul style="list-style-type: none"> • recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function 	<ul style="list-style-type: none"> • 	<ul style="list-style-type: none"> • Know that an unbalanced diet leads to poor health • Know that exercise leads to greater well-being both physically and mentally • Know that some drugs can be harmful to the human body. 		<ul style="list-style-type: none"> • Well being • Physical health • Emotional health • Drugs • Medicines 	

How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Reproduction** is built up over time.

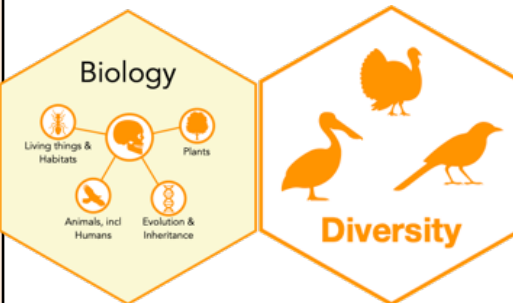
					
Biology Key Concept: Reproduction <u>Genetic information is passed down from one generation of organisms to another</u>					
<ul style="list-style-type: none"> Genetic information in a cell is held in the chemical DNA. Genes determine the development and structure of organisms. 		<ul style="list-style-type: none"> In asexual reproduction all the genes in the offspring come from one parent. In sexual reproduction half of the genes come from each parent. 			
National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
EY	<ul style="list-style-type: none"> Know that when a seed is planted it will grow into an adult plant. Know that some plants produce flowers and/or fruit and vegetables. 	<ul style="list-style-type: none"> Know that animals change as they grow. Humans from baby to adult. 		<ul style="list-style-type: none"> Seed Grow Adult plant 	<ul style="list-style-type: none"> Produce Flower Fruit vegetable
Year 1 NC					
Year 2 NC		<ul style="list-style-type: none"> Know that animals have offspring Know offspring grow into adults Know the names of common animals and their offspring e.g. egg, chick, chicken, spawn, tadpole, froglet, frog, baby, toddler, teenager, adult. 		<ul style="list-style-type: none"> Offspring Chick Spawn Froglet lifecycle 	<ul style="list-style-type: none"> Tadpole Toddler Teenager adult
Year 3 NC	<ul style="list-style-type: none"> Know that plants mature and create flowers and seeds Know that the flower attracts pollinators. Know that pollinators carry pollen from one plant to another causing pollination to occur. Know that a seed forms as a result of pollination Know that seeds disperse by wind, explosion, animals and water. Know that seeds disperse to find room to grow new plants. 			<ul style="list-style-type: none"> Mature Pollinators Attract Pollen 	<ul style="list-style-type: none"> Pollination Disperse Explosion reproduce
Year 4 NC					
Year 5 NC	<ul style="list-style-type: none"> Know that plants that reproduce sexually need pollen from a male and female plant. Know that asexual plants do not require male and female pollen and therefore do not have flowers. Know that seeds germinate and grow into mature plants 	<ul style="list-style-type: none"> Know the life cycle of a mammal (human) Know that mammals require sperm from a male to fertilise an ovary from a female. Know that a fertilised egg grows in the female's uterus until the offspring is ready to be born. Know that a bird's embryo is grown outside of the female within a protective egg, until it is ready to be hatched. Know that an amphibian's embryo is laid as soft spawn in water until they are ready to hatch. Know that amphibian offspring undergo metamorphosis into a mature adult. Know that insects have four stages within their life cycles – egg, larva, pupa and adult. 		<ul style="list-style-type: none"> Fertilisation Fertilise Male Female Germinate Sperm Ovary gestation 	<ul style="list-style-type: none"> Uterus Born Fertilised Embryo Metamorphosis Larva pupa Asexual reproduction Sexual reproduction
Year 6 NC					

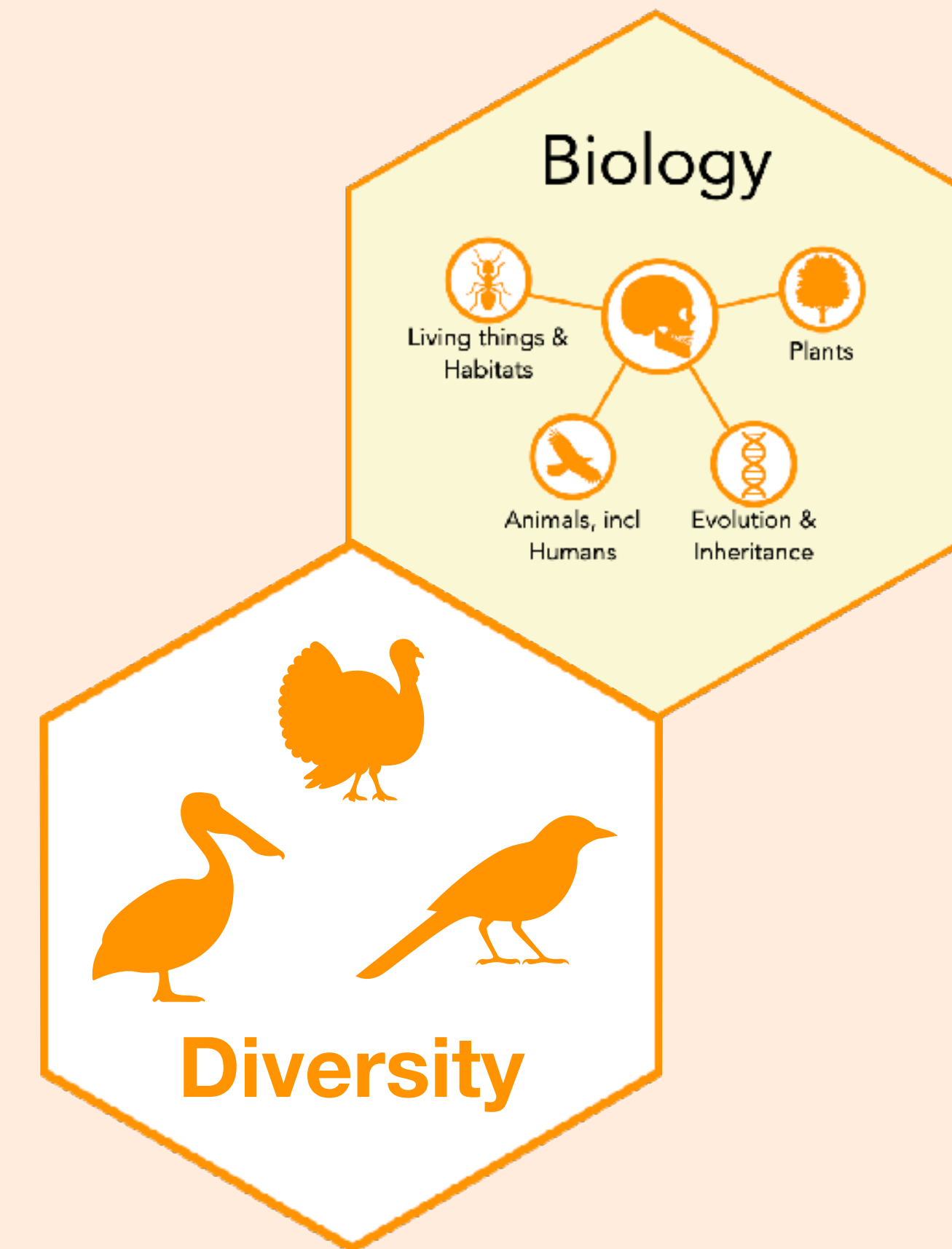


How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Diversity** is built up over time.


Biology Key Concept: Diversity					
		<p><u>The diversity of organisms, living and extinct, is the result of evolution</u></p> <ul style="list-style-type: none"> All life is directly descended from a <u>universal common ancestor</u> that was a simple one-celled organism. Over countless generations changes resulting from <u>natural diversity</u> within a <u>species</u> led to the <u>selection of individuals best suited to survive</u> under certain conditions Species not able to <u>respond sufficiently to changes in their environment</u> become extinct. 			
National Curriculum	Plants Knowledge Progression	Animals Knowledge Progression	Plants and Animals Knowledge Progression	Essential Vocabulary	
EY		<ul style="list-style-type: none"> To know that not all birds in our local environment look the same. To know that not all insects in the garden can fly. To know that all fish in the sea/ocean do not look the same. 		<ul style="list-style-type: none"> Local Environment Insects ocean 	
Year 1 NC					
Year 2 NC					
Year 3 NC					
Year 4 NC <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Classify plants in flowering and non-flowering plants 	<ul style="list-style-type: none"> Classify vertebrates into fish, amphibians, birds, fish and mammals Classify non-vertebrates into insects, arachnids, molluscs. Know invertebrates are animals which do not have a backbone, vertebrates do. 	<ul style="list-style-type: none"> Know that a classification key is a tool for identifying and grouping based on differences 	<ul style="list-style-type: none"> Classification Classification key Classify Identify vertebrates 	<ul style="list-style-type: none"> non-vertebrates arachnids molluscs insects
Year 5 NC					
Year 6 NC <ul style="list-style-type: none"> recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution. 		<ul style="list-style-type: none"> Know that animal offspring are similar to, but not identical to their parents. 	<ul style="list-style-type: none"> Know that fossils are evidence of the plants and animals alive millions of years ago. Know that characteristics are passed to offspring from their mother and father. Know that animals and plants have characteristics that are suited to the habitat in which they live. Know that overtime, animals and plants adapt to suit their environment. Know that adaptations can be passed from offspring to offspring over many years. Know that adaptations passed through many offspring result in permanent change which is called evolution. 	<ul style="list-style-type: none"> Fossils Evidence Characteristics Adaption Evolution Inheritance Breed variation 	

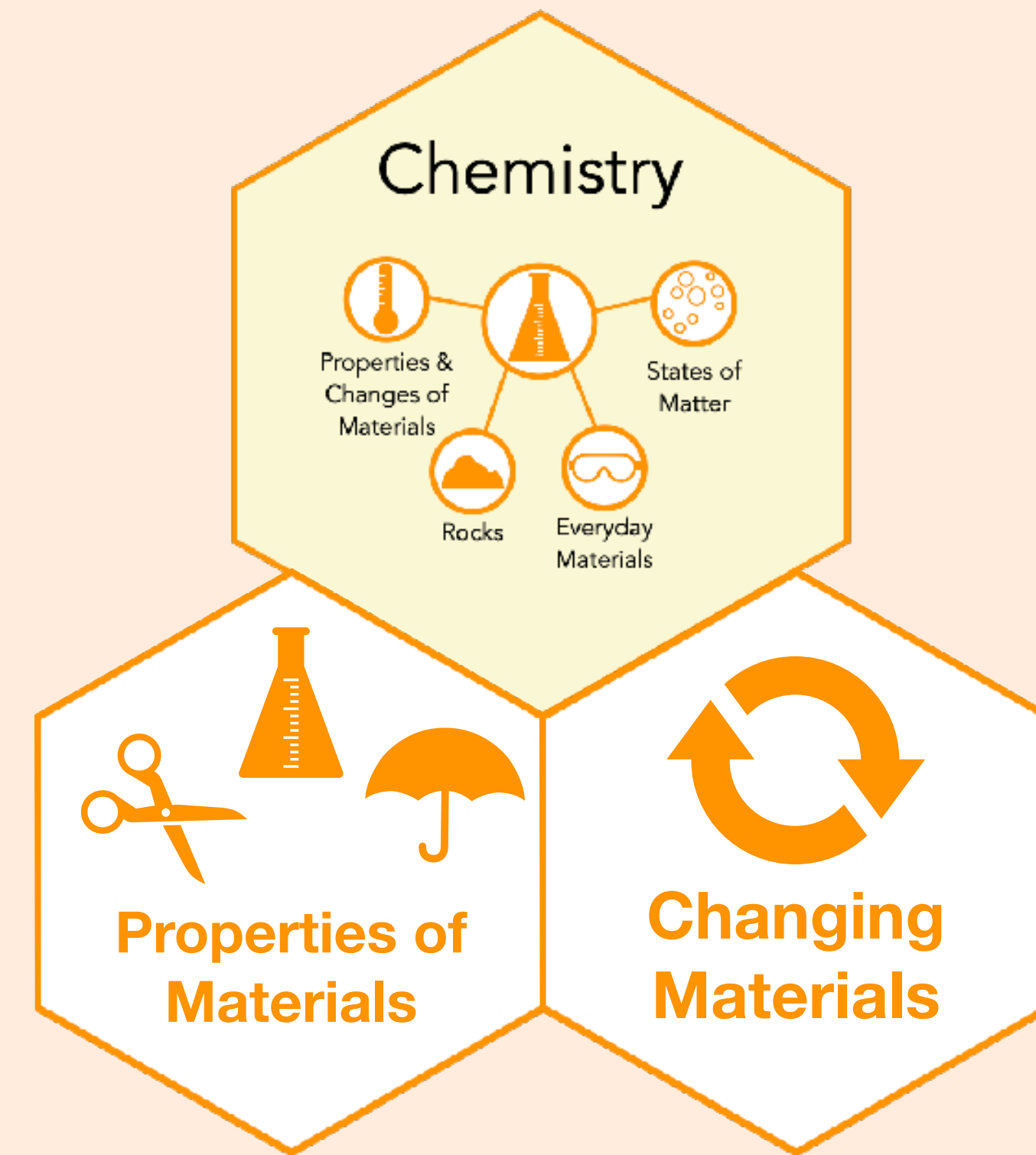


How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Materials** is built up over time (Page 1/2)

Chemistry Key Concept: Properties of Materials AND Changing Materials			
All matter in the Universe is made of very small particles.			
		<ul style="list-style-type: none"> • Atoms are the building blocks of all matter, living and non-living. • The behaviour and arrangement of atoms explains the properties of different materials. • In chemical reactions atoms are rearranged to form new substances. • Each atom has a nucleus containing neutrons and protons, surrounded by electrons. • The opposite electric charges of protons and electrons attract each other, keeping atoms together and accounting for the formation of some compounds. 	
National Curriculum	Properties of Materials Knowledge Progression	Changing Materials Knowledge Progression	Essential New Vocabulary
EY	<ul style="list-style-type: none"> • Know different words for materials (wood, glass, plastic etc) • Know that some materials float and some sink. • Know when to describe something as hard, soft smooth or rough. 	<ul style="list-style-type: none"> • Know that some materials can change their shape. • Know that cooking something gives an outcome that cannot be reversed. 	<ul style="list-style-type: none"> • Wood • Glass • Plastic • Soft • cook • hard • smooth • float • sink • rough
Year 1 NC	<ul style="list-style-type: none"> • Know that there are different materials which can be identified using observations (including fabric, wood, plastic, glass). • Know that an object is made from / of a material. • Know that properties are the words used to describe what a material is like and what it can do. • Know that different materials have different properties. • Know that a soft material can be twisted and squashed and a hard material cannot. • Know that a stretchy material can be pulled • Know that stiff materials are not easy to bend and flexible materials are. • Know that a shiny material reflects light and a dull material does not. • Know that a rough material has an uneven surface and a smooth material has an even surface. • Know waterproof materials do not let water through and absorbent materials do. • Know that opaque materials do not let light pass through and transparent materials do. 		<ul style="list-style-type: none"> • Materials • Fabric • Elastic • rubber • Object • Properties • Twisted • Squashed • Stretch • Stiff • Flexible • Shiny / Dull • Reflect • Uneven /even • Waterproof • Absorbent • Absorb • Opaque • Transparent
Year 2 NC	<ul style="list-style-type: none"> • Know that a material's properties make it suitable for different uses. • Know and apply the properties of plastic to identify objects it is suited and not suited to. • Know and apply the properties of wood to identify objects it is suited and not suited to. • Know and apply the properties of metal to identify objects it is suited and not suited to. • Know and apply the properties of glass to identify objects it is suited and not suited to. • Know and apply the properties of rock to identify objects it is suited and not suited to. • Know and apply the properties of paper to identify objects it is suited and not suited to. • Know and apply the properties of cardboard to identify objects it is suited and not suited to. 	<ul style="list-style-type: none"> • Know that a force is an active power that can change the shape of an object • Know that squashing, bending, twisting and stretching are forces which can be applied to solid objects, causing them to change. • Know that changing the shape of an object can change its suitability for purpose 	<ul style="list-style-type: none"> • Rigid • Strong • Weak • Suitable • Suited • Unsuitable • Purpose • force

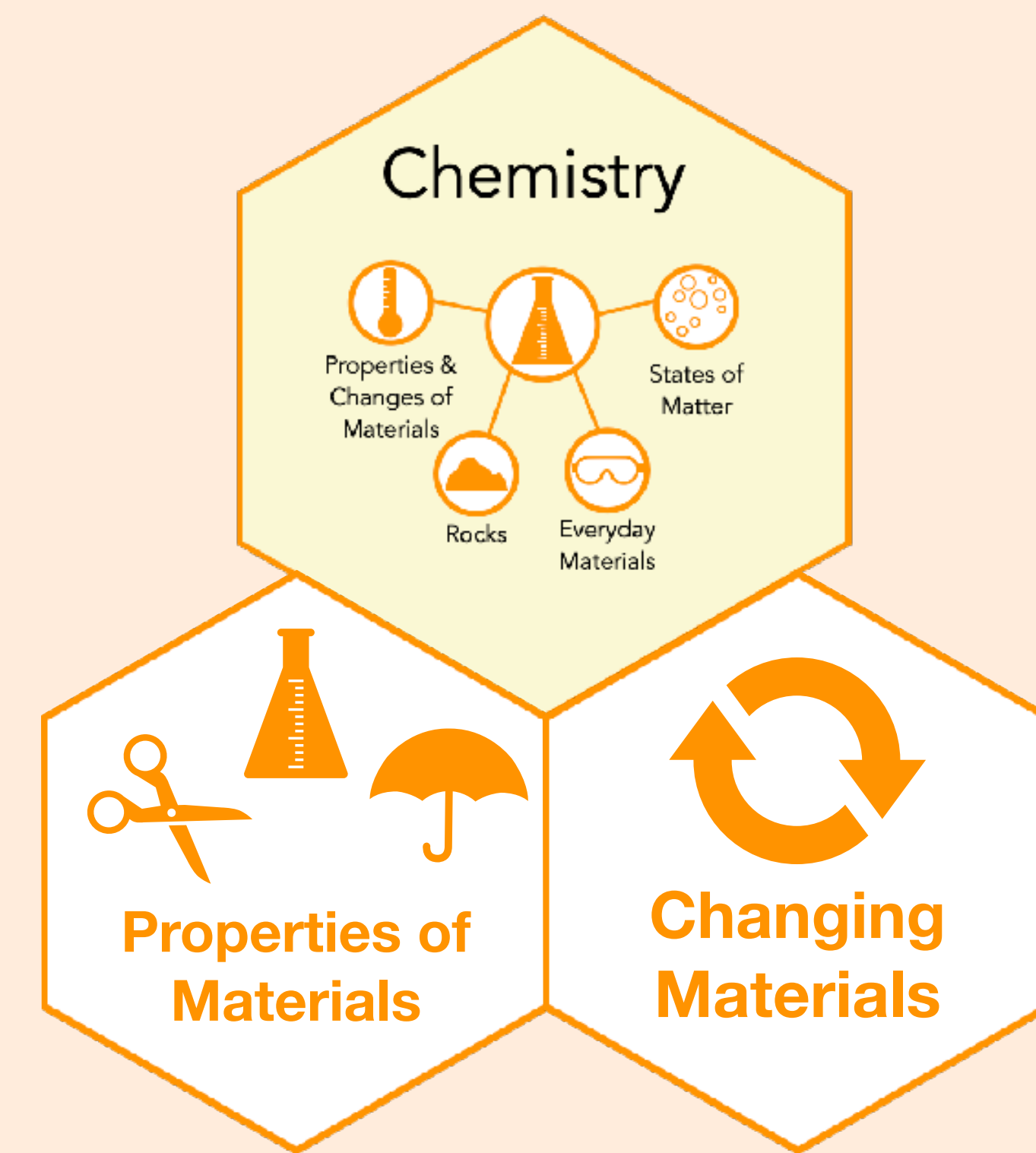


How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Materials** is built up over time (Page 2/2)

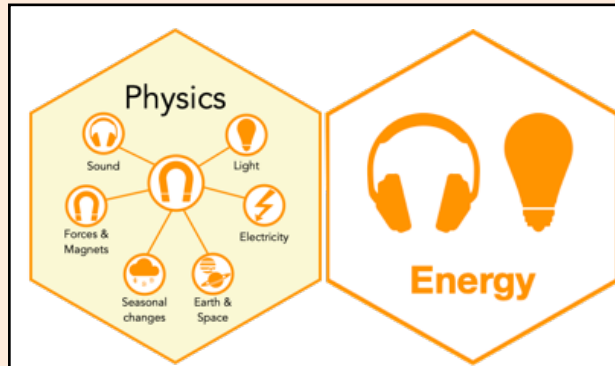
National Curriculum	Properties of Materials Knowledge Progression	Changing Materials Knowledge Progression	Essential New Vocabulary	
Year 3 NC <ul style="list-style-type: none"> compare and group together different kinds of rocks on the basis of their appearance and simple physical properties describe in simple terms how fossils are formed when things that have lived are trapped within rock recognise that soils are made from rocks and organic matter 	<ul style="list-style-type: none"> Know that rocks can be grouped based on what they look like and how they feel. Know that different rocks have different properties. Know that fossils are found in sedimentary rocks Know that sedimentary rocks are formed of layers. 	<ul style="list-style-type: none"> Know that a fossil is the imprint of something that was once living (plants/animals) Know that the fossil is the imprint of the hardest material in the living thing Know that fossils are formed when things that have lived are trapped in layers of rock Know that organic matter is the remains of something that was once living When organic matter is squashed it forms a soil 	<ul style="list-style-type: none"> Rocks Soils Sedimentary Layers Fossils Imprint Organic matter 	<ul style="list-style-type: none"> Grains Crystals
Year 4 NC <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Know that materials are made from matter. Matter is the building blocks of everything. Know that the three states of matter are solids, liquid and gas. Know that a solid is a substance that holds its shape. Know that liquids form a pool not a pile. Know that gas escape from an unsealed container. 	<ul style="list-style-type: none"> Know that temperature is a measure of the amount of heat (Celsius) Know that some materials change state when they are heated or cooled Know that melting is when a solid changes to a liquid and that freezing is when a liquid changes to a solid Know that materials all have a melting and freezing point Know that water freezes at 0 degrees and evaporates at 100 Know that evaporation is when a liquid changes to a gas and that condensation is when a gas changes to a liquid Know that the sun's thermal energy evaporates water from the earth's surface. Know that the water held in clouds cools and condensates back to earth as rain / snow. 	<ul style="list-style-type: none"> Matter States of matter Solid Liquid Gas Temperature Celsius Degrees Melting / melt Freezing /freeze 	<ul style="list-style-type: none"> Evaporating / evaporate Thermal energy Thermal Condensation Water-cycle
Year 5 NC <ul style="list-style-type: none"> compare and group materials together, according to whether they are solids, liquids or gases 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. 	<ul style="list-style-type: none"> Know that materials that do not easily change when forces are applied are hard. Know that materials that allow heat in the form of thermal energy or electrical energy to flow through are conductors. Know that materials that restrict the flow of energy are called insulators. To know that some materials are magnetic. To know that the greater the transparency of the material the more light it lets through. 	<ul style="list-style-type: none"> Know that soluble materials (substance) are able to be dissolved in a liquid. Know that a solution contains a liquid and a soluble material. Know that you can recover a substance from a solution by evaporating off the liquid Know that some changes are reversible Know that some changes are irreversible as a new material is formed. Know that burning a substance is an irreversible change Know that mixtures can be separated in different ways, including filtering, sieving, and evaporating Know that chemical changes which involve acids are irreversible 	<ul style="list-style-type: none"> Conductors Insulators Electrical Thermal Magnetic Transparency Soluble Dissolve Solution Soluble substance 	<ul style="list-style-type: none"> revisable irreversible burning mixtures sieving filtering acid chemical change
Year 6 NC				



How **substantive knowledge** is built up over time.

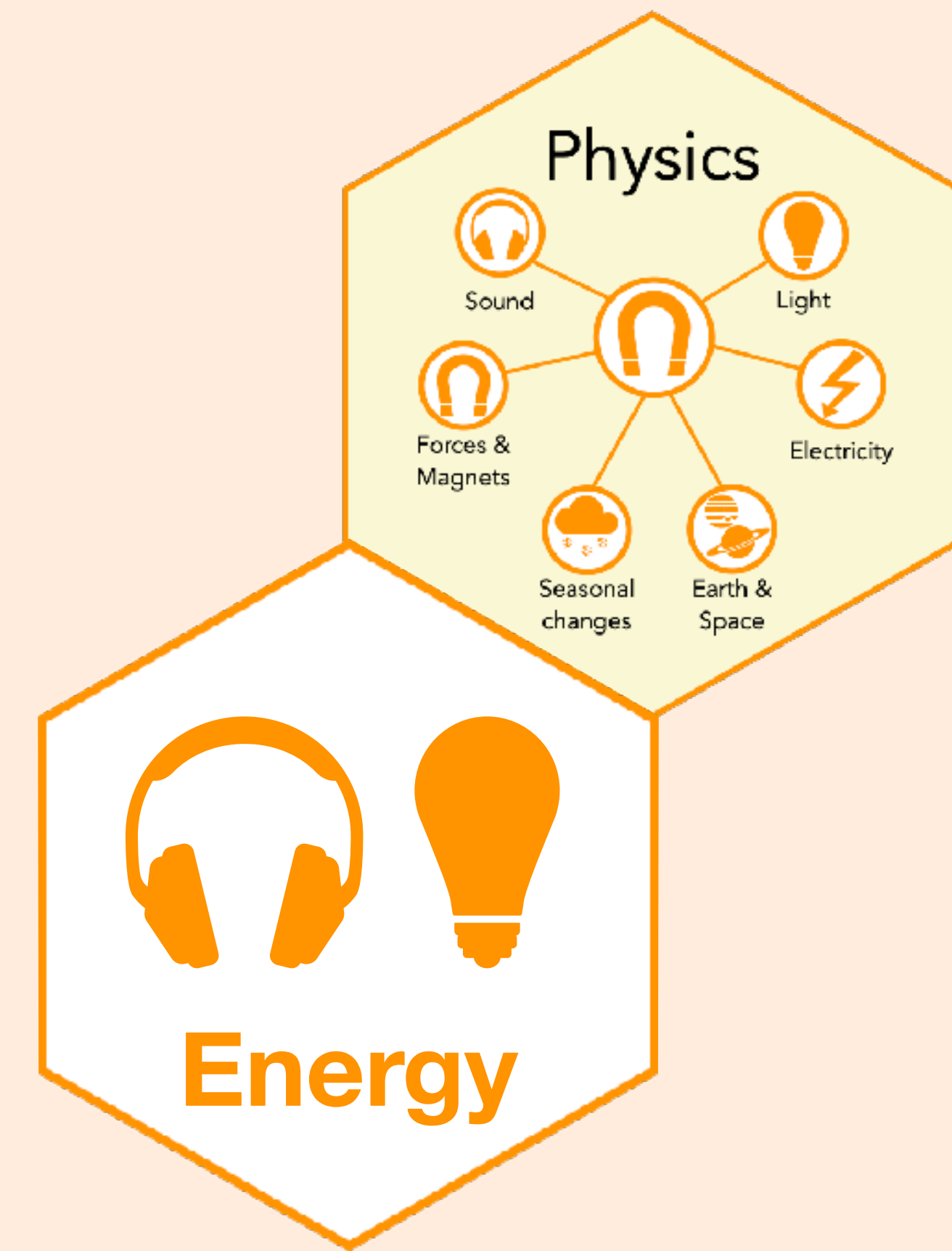
Second Order Concepts

How the concept of **Energy** is built up over time (Page 1/2)



Physics Key Concept: Energy	
<u>The total amount of energy in the universe is always the same but can be transferred from one energy store to another during an event</u>	
<ul style="list-style-type: none"> Many processes or events involve changes and require an energy source to make them happen. Energy can be transferred from one body or group of bodies to another in various ways. In these processes some energy becomes less easy to use. 	<ul style="list-style-type: none"> Energy cannot be created or destroyed. Once energy has been released by <u>burning a fossil fuel with oxygen</u>, some of it is no longer available in a form that is as convenient to use.

National Curriculum	Energy Knowledge Progression	Essential New Vocabulary		
EY	<ul style="list-style-type: none"> To know that Earth is the planet they live on. Know how to regulate their body temperature using clothing 	<ul style="list-style-type: none"> Know it is colder in winter and warmer in the summer. Know some trees lose their leaves in autumn. Know that the amount of daylight is less in the winter and more in the summer. Know there are four seasons 	<ul style="list-style-type: none"> Planet Earth Winter summer 	<ul style="list-style-type: none"> autumn spring season
Year 1 NC <ul style="list-style-type: none"> observe changes across the 4 seasons observe and describe weather associated with the seasons and how day length varies 	Seasonal Changes <ul style="list-style-type: none"> To know that the sun is the main source of light energy and heat energy on earth. To know that there is more daylight in the summer. To know that the Earth experience least light and heat energy in winter and most in summer. To notice the impact of changes in light and heat energy through the seasons. To notice the impact of changes in light and heat energy on the weather. 	<ul style="list-style-type: none"> Light energy Heat energy Seasonal Weather Daylight hours day 	<ul style="list-style-type: none"> night 	
Year 2 NC				
Year 3 NC <ul style="list-style-type: none"> recognise that they need light in order to see things and that dark is the absence of light notice that light is reflected from surfaces recognise that light from the sun can be dangerous and that there are ways to protect their eyes recognise that shadows are formed when the light from a light source is blocked by an opaque object find patterns in the way that the size of shadows change 	Light <ul style="list-style-type: none"> Know that light is needed to see things Know that dark is the absence of light. Know that light reflected from surfaces. Know that looking directly at the sun is dangerous. Know that an opaque object blocks light. Know that shadows are forms when light is blocked. Know that translucent materials allow light through. Know that the close an object to the light source the larger the shadow. 	<ul style="list-style-type: none"> Light Dark Reflection Opaque Shadow Translucent Absence 		

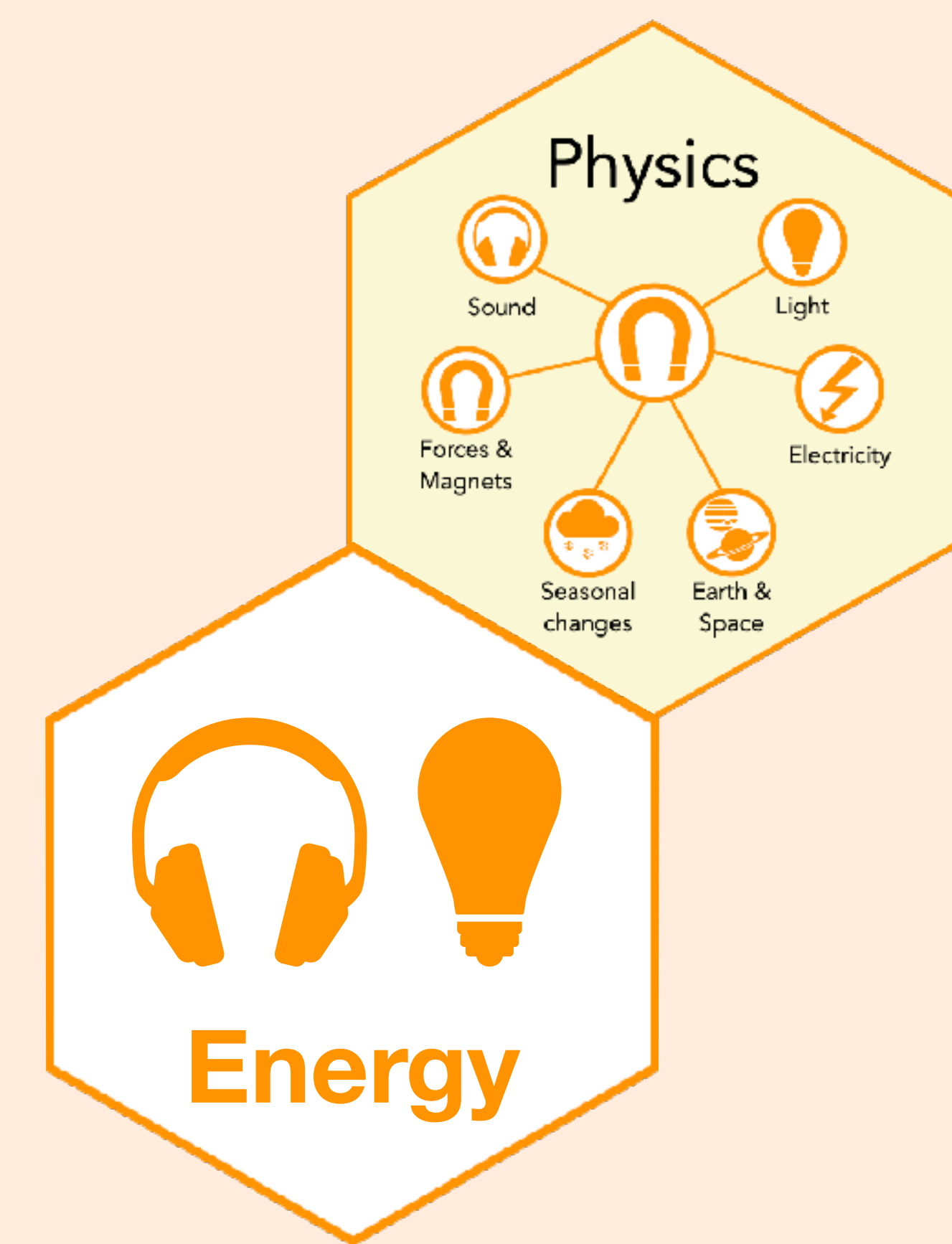


How **substantive knowledge** is built up over time.

Second Order Concepts

How the concept of **Energy** is built up over time (Page 2/2)

National Curriculum	Energy Knowledge Progression		Essential New Vocabulary	
Year 4 NC <ul style="list-style-type: none"> identify how sounds are made, associating some of them with something vibrating recognise that vibrations from sounds travel through a medium to the ear find patterns between the pitch of a sound and features of the object that produced it find patterns between the volume of a sound and the strength of the vibrations that produced it recognise that sounds get fainter as the distance from the sound source increases identify common appliances that run on electricity construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit recognise some common conductors and insulators, and associate metals with being good conductors 	Sound <ul style="list-style-type: none"> To know that sound is a form of energy. To know that sound occurs due to an object vibrating. To know that the vibrations of sound travel through solids, liquids and gases to the ear. To know that the speed of the vibrations changed the pitch. A high-speed vibration causes a higher pitch. To know that strength of a vibrations causes a louder volume. To know that a sound gets fainter as the distance from the sound source increases. 	Electricity <ul style="list-style-type: none"> To know some common appliances that run on electricity. To know the basic parts of a circuit: bulb, cells, switch wire buzzer. To know that a complete circuit is needed to power a component. To know the impact of a complete and open circuit To know that a switch completes and opens a circuit. To know that electrical insulators do not allow electricity to flow through them. To know that electrical conductors do allow electricity to flow through them. To know that metal make good conductors. To know that a series circuit contains elements in a single complete loop. 	<ul style="list-style-type: none"> Sound energy Sound Vibrations Pitch Volume Frequency Fainter Louder Series Appliances 	<ul style="list-style-type: none"> Electricity Bulb Cell Switch Wire Buzzer Circuit Power Component Insulator conductor
Year 5 NC				
Year 6 NC <ul style="list-style-type: none"> recognise that light appears to travel in straight lines use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches use recognised symbols when representing a simple circuit in a diagram. 	Light <ul style="list-style-type: none"> To know that light appears to travel in straight lines To know that light can travel directly to the eye. To know that light can travels from a source to an object and then to the eye. To know that light can be reflected into the eye. To know that shadows are the same shape as objects as light travels in straight lines. 	Electricity <ul style="list-style-type: none"> To know that voltage is an electrical force. To know that the more volts the brighter / louder the component. To know that a cell is 1.5v To know that a battery is multiple cells. To know that in a circuit with a fixed voltage, the more components the quieter, dimmer the component. To know the recognised circuit symbols for switch, cell, bulb, buzzer and switch. 	<ul style="list-style-type: none"> Source Voltage Battery Components 	



How **substantive knowledge** is built up over time.

National Curriculum Programme of Study

Pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:

Key Stage 1

- asking simple questions and recognising that they can be answered in different ways
- observing closely, using simple equipment
- performing simple tests
- identifying and classifying
- using their observations and ideas to suggest answers to questions
- gathering and recording data to help in answering questions

Lower Key Stage 2

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes
- using straightforward scientific evidence to answer questions or to support their findings.

Upper Key Stage 2

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments

Working Scientifically Disciplinary Knowledge



Changes over time

Can you observe any changes over:

- minutes?
- hours?
- days?



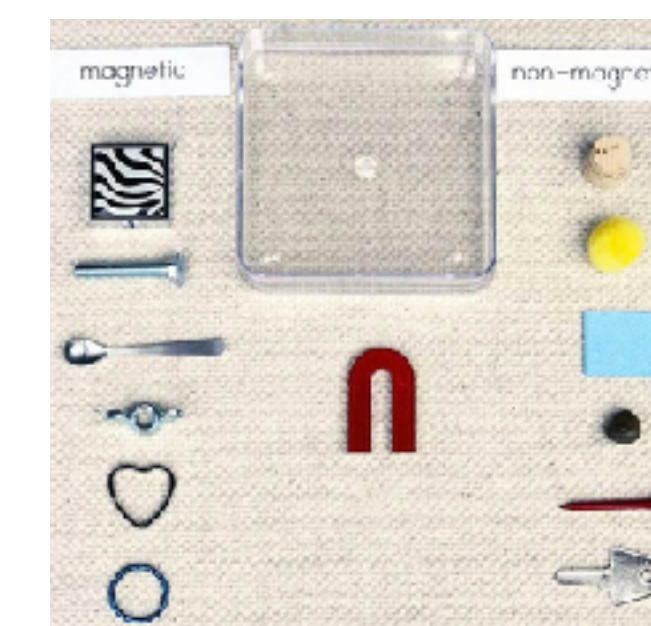
Identify and classify

How can these be grouped?
Can you create a key?



Pattern Seeking

What do your results tell you?
Is there a relationship between...?
Can you draw a graph?



Research

Where could you find the answer?
Do you trust the information?
Is it based on fact or opinion?



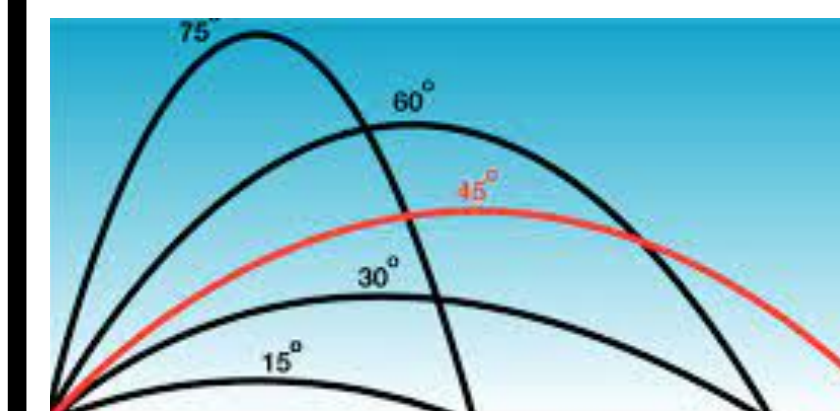
Comparative Testing

What can you measure?
Which variable is continuous?
Which variable is discrete?



Fair Testing (KS2)

How does one measured variable affect another?
Show your results in a graph.



Examples of scientific enquiry at St Bartholomew's

Working Scientifically (Disciplinary Knowledge)



How disciplinary knowledge is built up over time.



Key Concept: Investigating Cause and Effect		Key Concept: Analysing			
<p>Science is about finding the cause or causes of phenomena in the natural world</p> <ul style="list-style-type: none"> Science is a search to explain and understand phenomena in the natural world. There is no single scientific method for doing this; the diversity of natural phenomena requires a diversity of methods and instruments to generate and test scientific explanations. Often an explanation derives from the factors that must be present for an event to take place, as shown by evidence from observations and experiments. In other cases, supporting evidence is based on correlations revealed by patterns in systematic observation. 		<p>Scientific explanations, theories and models are those that best fit the evidence available at a particular time</p> <ul style="list-style-type: none"> A scientific theory or model representing relationships between variables of a natural phenomenon must fit the observations available at the time, and lead to predictions that can be tested. Any theory or model is provisional and subject to revision in the light of new data, even though it may have led to predictions that accord with data in the past. 			
National Curriculum	Observing and measuring	Recording Data	Asking and exploring questions	Performing Tests	Concluding, prediction, evaluating
EY					
<p>KS1 NC</p> <ul style="list-style-type: none"> asking simple questions and recognising that they can be answered in different ways observing closely, using simple equipment performing simple tests identifying and classifying using their observations and ideas to suggest answers to questions gathering and recording data to help in answering questions. 	<ul style="list-style-type: none"> I know that to observe means to look closely and notice similarities and differences related to my enquiry question I know that measuring tells the size of something. I know how to use a hand lens I know that a hand lens makes small objects appear bigger I know how to use same sized objects to make measure comparison I know observation can be instant or take place over time. 	<ul style="list-style-type: none"> I know where to place my data on a given simple table I know where to place my data on a given bar chart / pictogram/ Venn diagram I can group things based on given criteria 	<ul style="list-style-type: none"> I can sort and classify using given criteria I know that groups and sorting helps us observe similarities and differences. I know that variables change over time. 	<ul style="list-style-type: none"> I can follow a modelled investigation in small parts 	<ul style="list-style-type: none"> I know that my observations and recordings enable me to answer my question
<p>LKS2 NC</p> <ul style="list-style-type: none"> asking relevant questions and using different types of scientific enquiries to answer them setting up simple practical enquiries, comparative and fair tests making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment, including thermometers and data loggers gathering, recording, classifying and presenting data in a variety of ways to help in answering questions recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions identifying differences, similarities or changes related to simple scientific ideas and processes using straightforward scientific evidence to answer questions or to support their findings. 	<ul style="list-style-type: none"> I know that I observe / measure the dependent variable. I know that a dependent variable is the variable that is changing I know that systematic observation is one that is controlled. I know that temperature is measured in OC using alcohol and digital thermometers. I know that force is measured in N using a Newton meter I know that sound is measured in decibels using dataloggers. <p><i>(KS1 Maths Curriculum)</i></p> <ul style="list-style-type: none"> I know that length is measured in m and cm using a ruler, tape measure I know that capacity is measured in ml and L using measuring cylinders I know that time is measured in mins and sec using a stopwatch I know that mass is measured in g and Kg using balanced and digital scales I can read scales in divisions of 1,2,5 and 10. 	<ul style="list-style-type: none"> I know that the control variable builds the table I know that the dependent variable data is organised in a table. I know that the control variable builds the x axis I know that the dependent variable data is organised on the y axis I can label and identify features I have observed I know that a diagram is simplified and contains key features. I know how to use my careful observations in a given simple key to identify 	<ul style="list-style-type: none"> I know there are different types of scientific enquiries. I know that comparative and fair testing involves exploring cause and effect. I know that classifying involves sorting and grouping according to similarities and differences. I know that researching involves using secondary sources to find answers to questions I know that 'observations over time' focus on similarities and differences, patterns and change at regular intervals. I know and give reasons for my choice of enquiry I know that my question is based on my variables I can identify the control and dependent variables I can recognise a fair test 	<ul style="list-style-type: none"> I can make suggestions as to how to investigate 	<ul style="list-style-type: none"> I know how to describe the similarities and differences or changes in my data I know how to use tables and bar charts to look for patterns and relationships (cause and effect) and describe these in words. I know how to use the relationship (cause and effect) or pattern to predict a future change I can use my scientific knowledge to explain my findings.

Working Scientifically (Disciplinary Knowledge)



How disciplinary knowledge is built up over time.

Key Concept: Investigating Cause and Effect		Key Concept: Analysing			
<p>Science is about finding the cause or causes of phenomena in the natural world</p> <ul style="list-style-type: none"> Science is a search to explain and understand phenomena in the natural world. There is no single scientific method for doing this; the diversity of natural phenomena requires a diversity of methods and instruments to generate and test scientific explanations. Often an explanation derives from the factors that must be present for an event to take place, as shown by evidence from observations and experiments. In other cases, supporting evidence is based on correlations revealed by patterns in systematic observation. 		<p>Scientific explanations, theories and models are those that best fit the evidence available at a particular time</p> <ul style="list-style-type: none"> A scientific theory or model representing relationships between variables of a natural phenomenon must fit the observations available at the time, and lead to predictions that can be tested. Any theory or model is provisional and subject to revision in the light of new data, even though it may have led to predictions that accord with data in the past. 			
National Curriculum	Observing and measuring	Recording Data	Asking and exploring questions	Performing Tests	Concluding, prediction, evaluating
<p>UKS2 NC</p> <ul style="list-style-type: none"> planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs using test results to make predictions to set up further comparative and fair tests identifying scientific evidence that has been used to support or refute ideas or arguments. 	<ul style="list-style-type: none"> I use my knowledge of variables and measures to make decisions about which to observe and measures and equipment to use. I know that systematic observation is based on the control variable <i>(LKS2 Maths Curriculum)</i> I can read scales that involve decimal numbers and negative numbers. 	<ul style="list-style-type: none"> I know how to organise data using my knowledge of control and dependent variables in tables, charts and diagrams. I know that a line graph represents changes over time. I know that the x axis is the control variable I know that the y axis is the dependent variable (line graphs are taught in maths in year 6) 	<ul style="list-style-type: none"> I can identify how to control variables in different enquiry types I know how to use variable to generate an enquiry question for different enquiry types. I can explain my choice of enquiry choice I can design a fair test 	<ul style="list-style-type: none"> I can plan and perform part of an investigation independently 	<ul style="list-style-type: none"> I can use my scientific knowledge to question my findings and decide when further testing is required. I know that all results allow me to question and predict, however, not all results are reliable