



Progression of Substantive Knowledge in Physics

Years R - 6

Science Knowledge progression document - Physics

Science Long term Plan

Year	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
R	Longitudinal Study linked to ELG Understanding the world- The Natural World - <i>explore the seasonal changes that take place around them throughout the year. They learn how these changes affect trees - create tree diaries, create observational drawings, measure and look closely at the changes to the leaves, take bark rubbings and photograph a tree, to see the changes over the seasons.</i>					
1	Longitudinal Study – link to Seasonal Changes unit - How does the weather change over the four seasons? (temperature and light)					
	Animal survival Sensing for survival	Seasons	Describing materials	Plants	Animal survival Feeding for survival Moving for survival	Habitats
2	Longitudinal Study – link to Animal Life Cycles – How a pond habitat changes over a year					
	Animal life cycles		Changing materials		Making New Plants	Pushes and pulls
3	Longitudinal Study – link to Light - How a shadow changes over a day and through the year					
	Rocks and soils	Solids, Liquids and Gases	Animals, Skeletons and Movement	Magnets	Plants and their food production	Light
4	Longitudinal Study – link to Plant Reproduction - How the seasons affect plants					
	Mixtures and separating them	Sound	Plant Reproduction	Making electrical circuits work	Living things	
5	Longitudinal Study – link to Space and gravity unit – How does our night sky change over the year?					
	Space and gravity	Fossils, geological time and classification	Making new substances	Forces that oppose motion	Digestion	
6	Longitudinal Study – Micro-organism study					
	Controlling electrical circuits	Circulation		How light behaves	Classification and Evolution	

Understanding the World	
EYFS	• <i>Explore the natural world around them.</i> • <i>Understand the effect of changing seasons on the natural world around them.</i> • <i>Explore and talk about different forces they can feel.</i> • <i>Explore how things work.</i> • <i>Recognise some environments that are different to the one in which they live.</i>

Earth and Space



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PHYSICS Earth & Space		
	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 1	<u>Year 1- Seasons</u> Knowledge Block 1- Surviving the changing seasons - There are four seasons, Spring, summer, autumn and winter - Each season is about three months long - In Spring, young animals like lambs and chicks are born, the flowers bloom and the weather starts to become warmer. - In autumn, the leaves fall off the trees and the amount of time we have in the day becomes less. - Winter has the shortest amount of time during the day and the weather is at its coldest. - In summer the trees are full of green leaves and the weather is at its warmest. - Animals and plants have adapted ways of surviving the changing seasons - These include hibernating, storing food, fattening up, migration, loss of leaves - Trees can be either evergreen or deciduous. Evergreen trees keep their green leaves all year round. Deciduous trees lose their leaves every autumn. (THIS SUBSTANTIVE KNOWLEDGE APPEARS IN THE PROGRESSION WITHIN THE BIOLOGY-VARIATION AND EVOLUTION)	<u>Year 1 Seasonal Changes</u> Pupils should be taught to: - observe changes across the four seasons - observe and describe weather associated with the seasons and how day length varies <u>Year 1 Plants</u> Pupils should be taught to: - identify and name a variety of common wild and garden plants, including deciduous and evergreen trees
Year 2		
Year 3		
Year 4		

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	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
	Space and Gravity	Year 6 Earth and space
Year 5	Knowledge Block 1: Our Solar system - A Solar system is a collection of planets, which orbit (a curved path) a star. - There are huge number of stars in space and therefore a huge number of solar systems - Our solar system consists of 8 planets, many of those planets have moons which orbit around them. - Earth's moon is not a planet but is a satellite which orbits Earth. It is around a quarter of the size of Earth. - As the Moon orbits the Earth, the Sun lights up different parts of it, making it seem as if the Moon is changing shape. We call these the phases of the moon. - The Moon doesn't emit (give off) light itself, the 'moonlight' we see is actually the Sun's light reflected off the lunar surface. - Our solar system can be represented with a model (see diagram), but it isn't possible to draw it to scale. - The planets and moons are rotating (spinning) - The time it takes one planet to rotate is called a day. On Earth this is 24 hours - The time it takes a planet to complete one orbit around its star is called a year. On Earth this is 356.25 days - The solar system is with a massive collection of stars called the galaxy (called the Milky way) - The Milky way is one of billions of galaxies in the Universe. Knowledge Block 2: What else is in the solar system? - Stars are huge balls of gas that produce vast amounts of light and heat. Asteroids are lumps of rock that orbit a star (there are millions in between Mars and Jupiter) Comets are objects that are made of Ice, which melts when they get closer to the sun leaving a tail. Knowledge Block 3: Gravity and its effects Gravity is force of attraction between two objects with mass (a quantity of matter) - The bigger the mass the bigger force it exerts - Gravity works over distance but gets weaker as distance increases - Stars, planets, moons have a very large amount of mass. They exert a gravitational attraction on each other - Differences in gravity result in smaller mass objects orbiting around larger mass objects, e.g., planets around stars and moons around planets	Year 6 Earth and space <i>Pupils should be taught to:</i> - 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.
Year 6		

Electricity



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PHYSICS Electricity		
	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 1		
Year 2		
Year 3		
Year 4	<u>Electricity</u> Knowledge Block 1- Electricity as a power source - Lots of devices are powered by electricity - Electricity comes from a source There are two main sources- batteries and mains Knowledge Block 2- What batteries do - A battery pushes electricity to the device. - To be able to push electricity the battery must be connected to the device using wires - This is called a circuit Knowledge Block 3- Making devices work harder - If there are more batteries added to a circuit this provides a bigger push on the electricity - This will make the device work harder e.g., brighter bulbs, faster spinning motor, louder buzzer Knowledge Block 3- Insulators and conductors - Some materials will allow electricity to flow through them- Conductors - Metals such as silver, gold and copper are good conductors. Water is also a conductor of electricity. - Other materials will not allow electricity to flow through them- Insulators - Plastic, wood, glass and rubber are good electrical insulators. That is why they are used to cover materials that carry electricity. - A switch opens and closes a circuit	<u>Year 4 Electricity</u> Pupils should be taught to: - 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.

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Year 5		
Year 6	Controlling electrical circuits Knowledge Block 1: Pushing electrical current • Current is the flow of electricity around a circuit. • The power supply in a circuit pushes the current round the circuit. • The voltage of the power supply is a measure of this push. • Voltage is measure in volts. • Batteries have a limited store of energy and when this is gone, they can no longer push the current Knowledge Block 2: Electrical current • Current is the flow of electricity through a conductor. • When current passes through a device it makes it work • Increasing the voltage (the number of cells in the battery) increases the current. The larger the flow of current, the harder the device works. Knowledge Block 3: Electrical resistance • All parts of a circuit offer resistance to electrical current including the wires. • Resistance is the slowing down of electrical current. • The more devices added into a circuit the greater the resistance. This means less current flows around the circuit	<u>Year 6 Electricity</u> <i>Pupils should be taught to:</i> • <i>associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit.</i> • <i>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.</i> • <i>use recognised symbols when representing a simple circuit in a diagram.</i>

Energy Pathways



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PHYSICS Energy Pathways		
	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 1		
Year 2		
Year 3	<u>Light</u> Knowledge Block 1- Light and sight • There must be light for us to see. • Light comes from a source. • We need light to see things, even shiny things. • Light from the sun can be dangerous and that there are ways to protect their eyes Knowledge Block 2- What light does when it hits materials • If an object is transparent light will go through it and we will be able to see through it. • If an object is opaque, it will block the light and no light will get through. This is what forms shadows. • The closer to the light source an object is, the bigger the shadow will be. This is because the object blocks more of the light. • The further away from the light source an object is, the smaller the shadow will be. This is because the object blocks less of the light. • If an object is perfectly reflective, light will bounce back off it and we will see reflections of objects. • If the material is translucent, it will allow light through, but we won't be able to see through it.	<u>Year 3 Light</u> <i>Pupils should be taught to:</i> • 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.

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Year 4	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
	<u>Sound</u> Knowledge Block 1: Describing Sound • Sounds can be produced in a variety of ways. • Sounds have the properties of pitch and volume. • When a sound is produced it spreads out from its source in all directions Knowledge Block 2: How sound is made and travels • Sound is caused by vibration (objects move rapidly back and forth or up and down) • When objects vibrate it makes the objects in contact with it also vibrate. This includes the air. • The vibration travels through the air and makes other objects it is in contact with vibrate including your ear drum. Knowledge Block 3: Pitch and Volume changes • Pitch and volume are caused by how the material vibrates • The pitch of a sound is caused by how fast an object vibrates. This is called the frequency of vibration. Higher the frequency, higher the pitch • Smaller objects or tighter strings tend to vibrate with a higher frequency • The volume of sound is caused by how big each vibration is. This is called the amplitude of vibration. The bigger the amplitude the higher the volume. • Sounds get fainter as the distance from the sound source increases.	<u>Year 4 Sound</u> Pupils should be taught to: • <i>identify how sounds are made, associating some of them with something vibrating</i> • <i>recognise that vibrations from sounds travel through a medium to the ear</i> • <i>find patterns between the pitch of a sound and features of the object that produced it</i> • <i>find patterns between the volume of a sound and the strength of the vibrations that produced it</i> • <i>recognise that sounds get fainter as the distance from the sound source increases.</i> <u>HIAS Science team guidance</u> <i>The ideas that children have to grapple with about sound are very abstract and challenging. They need to learn that when objects vibrate, they produce sounds and sounds move through materials by making that material vibrate in turn. None of these vibrations can be seen by the naked eye and so they are abstract concepts. It gets even trickier because children also have to learn how changes in the way an object vibrates can lead to changes in pitch and volume. Dylan Williams says that some ideas are more troublesome than others; this is a very troublesome idea and so the more mature a child is when they have to understand and use it the better.</i>

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Year 5	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 6	<u>How light behaves</u> Knowledge Block 1: How light travels - When light is emitted from a light source, it travels in straight lines until it hits an object. This can be represented by an arrow. Shadows form when light hits an opaque object. The area behind the object is in darkness because light can only travel in straight lines. - Shadows have the same shape as the objects that cast them. Knowledge Block 2: How light behaves when it hits objects - When light hits a transparent object, it goes through it in a straight line so we can see a clear image through it. - When light hits a translucent material, it goes through it but is scattered, this means light can pass through, but we can't see an image through it. - When light hits a mirrored surface, it reflects off it in straight lines, so we can see an image in the reflective material. - Sometimes when light hits a material it reflects off it in many different directions (it is scattered). In this case light will be reflected but no image will be seen in the material. - Shiny surfaces are better reflectors and rough surfaces scatter light more. Opaque objects don't allow any light to pass through them Knowledge Block 3: How we see - Animals see objects when light is reflected off the object and enters the eye through the pupil. - The pupil changes its size to allow enough, but not too much light into the eye. - Too much light damages the eye and too little results in poor quality images.	<u>Year 6 Light</u> Pupils should be taught to: - 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.

Forces



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PHYSICS Forces		
Year 1	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 2	<u>Year 2- Pushes and pulls</u> Knowledge Block 1 - Objects can move (be in Motion) in various ways-roll, slide and bounce Knowledge Block 2 - The pushing or pulling of an object can affect its motion. - Pushing or pulling can do three things, slow down, speed up or change the direction of an object. Knowledge Block 3 - The larger the push/pull the bigger the effect on motion	<u>Year 3 Forces and Magnets</u> Pupils should be taught to: - compare how things move on different surfaces - notice that some forces need contact between two objects <u>HIAS Science team guidance</u> The first-time forces are mentioned in the National Curriculum is in year 3 in the topic on magnets. Magnets are a non-contact force which may appear almost magical if children have not first had a firm grounding in the idea that objects can be made to move differently through the physical acts of pushing and pulling. For this reason, we have constructed a topic that we think should be taught in key stage one that teaches the idea of contact forces changing how things move.

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Year 3

Magnets

Knowledge Block 1- What magnets do

- Magnets exert **attractive forces** on some **metals**

Knowledge Block 2- Magnets don't need to touch

- Magnetic forces work through other materials including air, so magnets don't need to be touching to **exert** their force. It is called a **non-contact force**

Knowledge Block 3- Magnets attract and repel

- Each end of a magnet is called a **pole**, opposite poles are called north and south.
- Magnets exert **attractive** forces on each other when the poles facing each other are north and south (opposites).
- Magnets exert **repulsive** forces on each other when the poles facing each other are the same.

Knowledge Block 4- what affects magnetic strength

The strength of magnetic forces is affected by:

- The strength of the magnet.
- The distance between the magnet and the object.
- The material the object is made from.

Year 3 Forces and Magnets

Pupils should be taught to:

- *compare how things move on different surfaces*
- *notice that some forces need contact between two objects, but magnetic forces can act at a distance*
- *observe how magnets attract or repel each other and attract some materials and not others*
- *compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials*
- *describe magnets as having two poles*
- *predict whether two magnets will attract or repel each other, depending on which poles are facing.*

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Year 4	Substantive Knowledge from Learning Journeys	National Curriculum Statutory Requirement
Year 5	<u>Forces that oppose motion</u> Knowledge Block 1: 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 and air 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. Knowledge Block 2: 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 surface over another, one of three things must happen: - The surfaces must rise slightly - The bumps on the surface must bend - The bumps on the surface must break - All of these actions require a force, this is what causes friction Knowledge Block 3: Managing Forces - Some objects require large forces to make them move; gears, pulley and levers can reduce the force needed to make things move. - The use of levers can reduce the force needed to move things. The object you are lifting is called the load, and the force you apply to the arm to make the object move is called the effort. - The use of pulleys can reduce the force needed to move things (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 lever)	<u>Year 5 Forces and Magnets</u> Pupils should be taught to: <i>explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object</i> <i>identify the effects of air resistance, water resistance and friction, that act between moving surfaces</i> <i>recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.</i>
	Year 6	