Unit and Year: P1 – Radiation and Waves YEAR 9

Purpose of Unit:

1. What are the risks and benefits of using radiations?
2. What is climate change and what is the evidence for it?
3. How do waves behave?
4. What happens when light and sound meet different materials

Key Learning/Knowledge:

- To describe the model of radiation and list the order of the electromagnetic spectrum.
- To consider the uses of and risks associated with the different parts of the EM spectrum.
- To understand that all bodies emit radiation and use it to explain the greenhouse effect.
- To explore the evidence for global warming including scientific explanations for climate change.
- To explain the common properties of waves and the wave model.
- To describe reflection and refraction.
- To be able to explain how refraction of light can be used in in lenses and prisms and sound used for imaging and detection.

Key Skills:

- Be able to use the terms emit, transmit and absorb correctly.
- Be able to order the parts of the EM spectrum
- Be able to evaluate reported health studies and interpret levels of risk.
- Observe how radiation is absorbed and emitted by different materials.
- Analyse data on global warming.
- Observe and explain refraction and reflection.
- Use a ray box and powerpack correctly.
- Use a protractor to measure angles correctly.
- Use a ripple tank to investigate the properties of waves. (PAG 4)
- Recall and use the equation wave speed = frequency x wavelength.
- Know that the unit of frequency is hertz.
- Explain how colour is related to differential absorption, transmission and scattering

Key Vocabulary and meanings:

Emit – Release of energy.
Absorb – Receive or take in energy
Transmit – Energy passing through a medium.
Medium - A substance that makes possible the transfer of energy from one location to another.
Frequency - The number of waves that pass a fixed point in unit time.
Amplitude - The distance of a vibratory movement measured from the middle of the wave to its extremes.
Wavelength - The distance between two identical points (eg crests or troughs) in two adjacent waves.
Wavespeed - The distance the wave travels in a given amount of time, often measured in meters per second.
Reflection – When a wave bounces of a surface.
Refraction - The change in the direction of a wave when it passes from one medium to another.
Concave - Hollowed out or rounded inward.
Convex - The opposite of a concave shape. It curves outward, and its middle is thicker than its edges.

Links to prior knowledge/learning:

- Builds on 'Light and sound' unit from Year 8.
- Develops Maths skills using a protractor to measure angles correctly.

Unit and Year: P2 – Sustainable Energy YEAR 9

Purpose of Unit:

1. How much energy do we use?
2. How can electricity be generated?

Key Learning/Knowledge:

- To describe how energy is moved between different stores.
- To describe with examples, how the total energy of a closed system remains the same after transfers.
- To describe the difference between useful and wasted energy and how to reduce unwanted energy transfers.
- To recall and apply the equation for efficiency.
- To interpret and construct Sankey diagrams to show understanding that energy is conserved.
- To describe the main energy resources available for use on Earth, both renewable and non-renewable.
- To recall the function and structure of the National Grid, including the function of transformers.

Key Skills:

- Be able to use the terms useful and wasted energy.
- Be able to evaluate the different renewable and non-renewable energy resources.
- Be able to evaluate data on energy usage changes across time for households and nations.
- Give examples of energy transfers and stores in everyday experience.
- Convert between units of Joules and KiloWatt-Hours.
- Recall and use the equation efficiency = useful energy output ÷ total energy input
- Recall and use the equation energy = power x time.
- Know that the unit of energy is used both as Joules and as KiloWatt-Hours.
- Explain examples of how wasted energy can be reduced in a system.

Key Vocabulary and meanings:

Energy transferred – Also known as Work done, amount of energy transferred between stores in a system.
Power – Rate of energy transfer
Renewable – Can continue to be used without running out
Non-renewable – Will run out with continual use, a limited supply
Power rating – The electrical power a device operates at, how much energy it transfers each second
Dissipation – Energy, often wasted, spreading out into the environment
Efficiency – Percentage of energy transferred as useful energy
Wasted – Energy transferred into a form that isn't desired
Useful – Energy transferred into a form that is desired
Sankey diagram – A visual representation of energy transfers where the width of arrows represents how much energy is being transferred
Generator – A device to turn kinetic energy (movement) into electrical energy
National Grid – The nation-wide system of electricity transfer between power stations and homes through pylons, cables and transformers

Links to prior knowledge/learning:

- Builds on discussion of energy transfers from "Forces" from year 7.
- Develops Maths skills rearranging physics equations.

Unit and Year: Electric Circuits Year 10 Combined

Purpose of Unit:

- What determines the current in an electric circuit?
- How do series and parallel circuits work?
- What determines the rate of energy transfer in a circuit?
- What are magnetic fields?
- How do electric motors work? (Higher)

Key Learning/Knowledge:

- Be able to recall and use the relationship between quantity of charge, current and time
- Be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties
- Be able to describe experiments to investigate the I-V characteristics of circuit elements.
- Describe the difference between series and parallel circuits in terms of potential difference, current and resistance
- Solve problems for circuits which include resistors in series, using the concept of equivalent resistance
- Calculate the energy transferred in an electric circuit when a current flows through a component
- Recall and apply the relationships between power transferred in any circuit device, the potential difference across it, the current through it, and its resistance
- Explain how the magnetic effect of a solenoid can be increased
- Describe the interaction forces between a magnet and a current-carrying conductor to include ideas about magnetic fields (Higher only)

Key Skills:

- Demonstrate knowledge and understanding of scientific techniques and procedures
- Be able to describe a method for an investigation, collect measurements and produce appropriate graphs
- Be able to identify equation needed and apply
- Apply knowledge and understanding of scientific ideas, enquiry, techniques and procedures
- Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions.
- Improve experimental procedures

Key Vocabulary and meanings:

Alternating current - Also called ac. An electric current that regularly changes its direction and size.

Charge – Electrical charge can be positive or negative

Current – Moving electric charges (eg electrons moving through a metal wire)

Direct current - Direct current is the movement of charge through a conductor in one direction only.

Directly proportional – Relationship between two variables where one variable is equal to a constant multiplying the other variable. Variables are plotted as a straight line through the origin.

Electric field – Area surrounding an electric charge that may influence other charged particles

Potential difference - The potential difference (or voltage) of a supply is a measure of the energy given to the charge carriers in a circuit. Units = volts (V). This is the voltage between two points that makes an electric current flow between them.

Resistance – The opposition in an electrical component to the movement of electrical charge through it. Resistance is measured in ohms.

Work done – Energy transferred by a force.

Work done = force × distance moving in the direction of the force.

Links to prior knowledge/learning:

KS3 provides pupils with the fundamental concepts about ***electricity***

Unit and Year: Electric Circuits Year 10 Triple

Purpose of Unit:

- What is electric charge?
- How to affect electric current?
- Series and parallel circuits
- Electrical power and energy
- What are magnetic fields?
- Electric motors (Higher)
- What is the process inside an electric generator? (Higher)

Key Learning/Knowledge:

- Be able to describe the production of static electricity
- explain how transfer of electrons between objects can explain the phenomena of static electricity
- Be able to recall and use the relationship between quantity of charge, current and time
- Be able to use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties
- Be able to describe experiments to investigate the I-V characteristics of circuit elements.
- Describe the difference between series and parallel circuits
- Solve problems for circuits which include resistors in series, using the concept of equivalent resistance
- Describe and calculate the energy transferred in an electric circuit
- Recall and apply the relationships between power transferred in any circuit device, the potential difference across it, the current through it, and its resistance
- Explain how the magnetic effect of a solenoid can be increased and explain how this can be used to generate sound in loudspeakers and headphones
- Describe and explain how a simple motor, an alternator and generator work in terms of force, magnetic fields and current. (higher only)
- Describe and explain the process inside an electric generator including electromagnetic induction (higher only)

Key Skills:

- Demonstrate knowledge and understanding of scientific techniques and procedures
- Be able to describe a method for an investigation, collect measurements and produce appropriate graphs
- Be able to identify equation needed and apply
- Apply knowledge and understanding of scientific ideas, enquiry, techniques and procedures
- Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions.
- Improve experimental procedures

Key Vocabulary and meanings:

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Resistance – The opposition in an electrical component to the movement of electrical charge through it. Resistance is measured in ohms.

Work done – Energy transferred by a force. Work done = force × distance moving in the direction of the force.

Links to prior knowledge/learning:

KS3 provides pupils with the fundamental concepts about ***electricity***

Unit and Year: Explaining Motion Year 10 Combined

Purpose of Unit:

- What are forces
- How can we describe motion?
- What is the connection between forces and motion?
- How can we describe motion in terms of energy transfers?

Key Learning/Knowledge:

- Be able to recall and apply Newton's Third Law
- Represent interaction forces as vectors
- Be able to recall and apply the between the weight of an object, its mass and the gravitational field strength
- Recall and apply the relationship between speed, distance and time, using typical everyday speeds
- Describe how to use appropriate apparatus and techniques to investigate the speed of a trolley down a ramp
- Be able to recall and apply the relationship between acceleration, change in speed and time
- Explain how to use apparatus and techniques to investigate acceleration
- Describe, using free body diagrams, examples where several forces lead to a resultant force on an object
- Explain methods of measuring human reaction times and recall typical results
- Explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety
- Describe the energy transfers involved when a system is changed by work done
- Make calculations of the energy transfers associated with changes in a system
- Calculate relevant values of stored energy and energy transfers

Key Skills:

- Demonstrate knowledge and understanding of scientific techniques and procedures
- Be able to describe a method for an investigation, collect measurements and produce appropriate graphs
- Be able to identify equation needed and apply
- Apply knowledge and understanding of scientific ideas, enquiry, techniques and procedures
- Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions.
- Improve experimental procedures

Key Vocabulary and meanings:

Equilibrium – An object is in equilibrium when there is zero resultant force on it – all the forces are balanced

Force – A push or a pull experienced by one object when it interacts with another. A force is needed to change the motion of an object. Force is measured in Newtons (N).

Gradient – A measure of the steepness of a line on a graph

Inertia - The property of an object that causes it to resist changes to its motion (change of speed or direction)

Momentum – A property of any moving object, momentum is a vector quantity given by mass x velocity. Momentum is measured in kilogram metres per second.]

Scalar – A quantity with size but no direction, for example speed and distance.

Vector – A quantity that has a magnitude and a direction, for example velocity and displacement

Velocity – The speed of an object in a given direction. Unlike speed, which only has a size, velocity also has a direction. It is a vector.

Work (force) – Work is done whenever a force makes something move. The amount of work is force multiplied by distance moved in the direction of the force. This is equal to the amount of energy transferred.

Links to prior knowledge/learning:

KS3 provides pupils with the fundamental concepts about ***forces and energy***

Unit and Year: Explaining Motion Year 10 Triple

Purpose of Unit:

- What are forces
- How can we describe motion?
- What is the connection between forces and motion?
- How can we describe motion in terms of energy transfers?

Key Learning/Knowledge:

- Be able to recall and apply Newton's Third Law
- Represent interaction forces as vectors
- Be able to recall and apply the between the weight of an object, its mass and the gravitational field strength
- Recall and apply the relationship between speed, distance and time, using typical everyday speeds
- Describe how to use appropriate apparatus and techniques to investigate the speed of a trolley down a ramp
- Be able to recall and apply the relationship between acceleration, change in speed and time
- Explain how to use apparatus and techniques to investigate acceleration
- Describe, using free body diagrams, examples where several forces lead to a resultant force on an object
- Explain methods of measuring human reaction times and recall typical results
- Explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety
- Describe the energy transfers involved when a system is changed by work done
- Make calculations of the energy transfers associated with changes in a system
- Calculate relevant values of stored energy and energy transfers
- Explain how levers and gears transmit the rotational effects of forces.
- Define and calculate the moment of rotational force

Key Skills:

- Demonstrate knowledge and understanding of scientific techniques and procedures
- Be able to describe a method for an investigation, collect measurements and produce appropriate graphs
- Be able to identify equation needed and apply
- Apply knowledge and understanding of scientific ideas, enquiry, techniques and procedures
- Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions.
- Improve experimental procedures

Key Vocabulary and meanings:

Equilibrium – An object is in equilibrium when there is zero resultant force on it – all the forces are balanced

Force – A push or a pull experienced by one object when it interacts with another. A force is needed to change the motion of an object. Force is measured in Newtons (N).

Gradient – A measure of the steepness of a line on a graph

Inertia - The property of an object that causes it to resist changes to its motion (change of speed or direction)

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Scalar – A quantity with size but no direction, for example speed and distance.

Vector – A quantity that has a magnitude and a direction, for example velocity and displacement

Velocity – The speed of an object in a given direction. Unlike speed, which only has a size, velocity also has a direction. It is a vector.

Work (force) – Work is done whenever a force makes something move. The amount of work is force multiplied by distance moved in the direction of the force. This is equal to the amount of energy transferred.

Links to prior knowledge/learning:

KS3 provides pupils with the fundamental concepts about ***forces and energy***

Unit and Year: P5 – Radioactive materials YEAR 11

Purpose of Unit:

1. Why are some materials radioactive?
2. How can radioactive materials be used safely?
3. How can radioactive materials be used to provide energy?

Key Learning/Knowledge:

- To explain why some materials emit ionising radiation
- To describe the different types of ionising radiation
- To mathematically construct graphs involving half life
- To describe the structure of the atom and how our understanding of it has evolved through time
- To state sources of background radiation
- To explain how radioactive materials can be used in medicine

Key Skills:

- Be able to calculate the atomic and mass numbers in atomic nuclei after an emission
- Observe what materials block different types of radiation
- Be able to evaluate risks of using radioactivity in medicine
- Use prefixes to describe scales involved in atoms/nuclei
- Draw graphs involving half-life and extrapolate data
- Infer causation from correlation in graphs and data

Proton – a positively charged particle in the nucleus
Neutron – an uncharged particle in the nucleus
Electron – a negatively charged particle that orbits the nucleus
Alpha – a radioactive emission made of 2 protons and 2 neutrons
Beta – a radioactive emission that is a high speed electron
Gamma – a radioactive emission that is an electromagnetic wave
Half-life – the time taken for half the remaining nuclei in a radioactive sample to decay

Links to prior knowledge/learning:

- Builds on key terminology from P1
- Builds on ideas around ionisation from P1

Unit and Year: P5 – Radioactive materials YEAR 11

Purpose of Unit:

1. Why are some materials radioactive?
2. How can radioactive materials be used safely?
3. How can radioactive materials be used to provide energy?

Key Learning/Knowledge:

- To explain why some materials emit ionising radiation
- To describe the different types of ionising radiation
- To mathematically construct graphs involving half life
- To describe the structure of the atom and how our understanding of it has evolved through time
- To state sources of background radiation
- To explain how radioactive materials can be used in medicine
- To explain what fission and fusion are and how they can be used to provide electricity

Key Skills:

- Be able to calculate the atomic and mass numbers in atomic nuclei after an emission
- Observe what materials block different types of radiation
- Be able to evaluate risks of using radioactivity in medicine
- Use prefixes to describe scales involved in atoms/nuclei
- Draw graphs involving half life and extrapolate data
- Infer causation from correlation in graphs and data

Proton – a positively charged particle in the nucleus
Neutron – an uncharged particle in the nucleus
Electron – a negatively charged particle that orbits the nucleus
Alpha – a radioactive emission made of 2 protons and 2 neutrons
Beta – a radioactive emission that is a high speed electron
Gamma – a radioactive emission that is an electromagnetic wave
Half-life – the time taken for half the remaining nuclei in a radioactive sample to decay
Fission – the splitting of a large nuclei into two smaller ones, also emits some neutrons and a large amount of energy
Fusion - the joining together of two small nuclei to make a larger one

Links to prior knowledge/learning:

- Builds on key terminology from P1
- Builds on ideas around ionisation from P1

Unit and Year: P6 – Matter – Models and explanations YEAR 11 – Triple

Purpose of Unit:

1. **How does energy transform matter?**
2. **How does the particle model explain the effects of heating?**
3. **How does the particle model relate to materials under stress?**
4. **How does the particle model relate to pressure in fluids?**
5. **How can scientific models help us understand the Big Bang?**

Key Learning/Knowledge:

- To describe how to calculate densities for solids and liquids
- To explain how changes in energy can change matter
- To mathematically describe how springs deform and how energy can be stored in springs
- To describe and explain both qualitatively and quantitively how pressure varies in a fluid
- To describe how the universe and the solar system has evolved over time
- To describe how a change in pressure of a gas effects its volume and vice versa.
- State the meaning of several different celestial objects found in the solar system
- Link ideas of centripetal force to orbits of planets and stars
- Link ideas of density to floating and sinking of objects in fluids

Key Skills:

- Calculate changes in energy when there is a temperature change
- Calculate changes in energy when there is a change of state
- Draw and describe particle models of solids, liquids and gases
- Construct graphs of extension vs force for springs
- Interpret extension vs force graphs
- Link the particle model to pressure

Density – mass/volume of a material, measured in kg/m^3

Specific heat capacity – the energy required to increase the temperature of 1 kg of a substance by 1°C

Latent heat of fusion – Energy required to change 1kg of a substance from a solid to a liquid

Latent heat of vaporisation – Energy required to change 1kg of a substance from a liquid to a gas

Elastic – a material that returns to its original shape after deformation

Plastic – a material that doesn't return to its original shape after deformation

Big bang – the universe started very small and very dense and has been expanding ever since

Pressure – Force per unit area, units of Pascal

Links to prior knowledge/learning:

- Builds on key terminology from C1
- Linked to power from P2/P3
- Linked to centripetal force from P4

Unit and Year: P6 – Matter – Models and explanations YEAR 11 – Combined

Purpose of Unit:

1. **How does energy transform matter?**
2. **How does the particle model explain the effects of heating?**
3. **How does the particle model relate to materials under stress?**

Key Learning/Knowledge:

- To describe how to calculate densities for solids and liquids
- To explain how changes in energy can change matter
- To mathematically describe how springs deform and how energy can be stored in springs

Key Skills:

- Calculate changes in energy when there is a temperature change
- Calculate changes in energy when there is a change of state
- Draw and describe particle models of solids, liquids and gases
- Construct graphs of extension vs force for springs
- Interpret extension vs force graphs

Density – mass/volume of a material, measured in kg/m^3

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Latent heat of vaporisation – Energy required to change 1kg of a substance from a liquid to a gas

Elastic – a material that returns to its original shape after deformation

Plastic – a material that doesn't return to its original shape after deformation

Links to prior knowledge/learning:

- Builds on key terminology from C1
- Linked to power from P2/P3