| **Lesson** | **Lesson title** | **Lesson objectives** |
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| TOPIC 1 - ENERGY |
| 1.1 | Potential energy | * Consider what happens when a spring is stretched.
* Describe what is meant by gravitational potential energy.
* Calculate the energy stored by an object raised above ground level.
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| 1.2 | Investigating kinetic energy | * Describe how the kinetic energy store of an object changes as its speed changes
* Calculate kinetic energy.
* Consider how energy is transferred.
 |
| 1.3 | Work done and energy transfer | * Understand what is meant by work done.
* Explain the relationship between work done and force applied.
* Identify the transfers between energy stores when work is done against friction.
 |
| 1.4 | Understanding power | * Define power.
* Compare the rate of energy transfer by various machines and electrical appliances.
* Calculate power.
 |
| 1.5 | Specific heat capacity | * Understand how things heat up.
* Find out about heating water.
* Find out about specific heat capacity.
 |
| 1.6  | Required practical: Investigating specific heat capacity | * Use theories to develop a hypothesis.
* Evaluate a method and suggest improvements.
* Perform calculations to support conclusions.
 |
| 1.7 | Dissipation of energy | * Explain ways of reducing unwanted energy transfer.
* Describe what affects the rate of cooling of a building.
* Understand that energy is dissipated.
 |
| 1.8 | Energy efficiency | * Explain what is meant by energy efficiency.
* Calculate the efficiency of energy transfers.
* Find out about conservation of energy.
 |
| 1.9 | Using energy resources | * Describe the main energy sources available for use on Earth.
* Distinguish between renewable and non-renewable resources.
* Explain the ways in which the energy resources are used.
 |
| 1.10 | Global energy supplies | * Analyse global trends in energy use.
* Understand what the issues are when using energy resources.
 |
| 1.11  | Key Concept: Energy transfer | * Understand why energy is a key concept in science.
* Use ideas about energy stores and transfers to explain what happens when a system is changed.
* Understand why accounting for energy transfers is a useful idea.
 |
| 1.12 | Maths skills: Calculations using significant figures | * Substitute numerical values into equations and use appropriate units.
* Change the subject of an equation.
* Give an answer using an appropriate number of significant figures.
 |
| 1.13 | Maths skills: Handling data | * Recognise the difference between mean, mode and median.
* Explain the use of tables and frequency tables.
* Explain when to use scatter diagrams, bar charts and histograms.
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| TOPIC 2 - ELECTRICITY |
| 2.1 | Electric current | * Know circuit symbols.
* Recall that current is a rate of flow of electric charge.
* Recall that current (*I*) depends on resistance (*R*) and potential difference (*V*)
* Explain how an electric current passes round a circuit.
 |
| 2.2 | Series and parallel circuits | * Recognise series and parallel circuits.
* Describe the changes in the current in series and parallel circuits.
* Describe the changes in the potential difference in series and parallel circuits.
 |
| 2.3 | Investigating circuits | * Use series circuits to test components and make measurements.
* Carry out calculations on series circuits.
 |
| 2.4 | Circuit components | * Set up a circuit to investigate resistance.
* Investigate the changing resistance of a filament lamp.
* Compare the properties of a resistor and a filament lamp.
 |
| 2.5 | Required practical: Investigate, using circuit diagrams to construct circuits, the *I-V* characteristics of a filament lamp, a diode and a resistor at constant temperature | * Understand how an experiment can be designed to test an idea.
* Evaluate how an experimental procedure can yield more accurate data.
* Interpret and explain graphs using scientific ideas.
 |
| 2.6  | Required practical: Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits, including the length of a wire at a constant temperature and combinations of resistors in series and parallel | * Use a circuit to determine resistance.
* Gather valid data to use in calculations.
* Apply the circuit to determine the resistance of combinations of components.
 |
| 2.7 | Control circuits | * Use a thermistor and a light-dependent resistor (LDR).
* Investigate the properties of thermistors, LDRs and diodes.
 |
| 2.8 | Electricity in the home | * Recall that the domestic supply in the UK is 230 V ac and 50 Hz.
* Describe the main features of live, neutral and earth wires.
 |
| 2.9 | Transmitting electricity | * Describe how electricity is transmitted using the National Grid.
* Explain why electrical power is transmitted at high potential differences.
* Understand the role of transformers.
 |
| 2.10 | Power and energy transfers | * Describe the energy transfers in different domestic appliances.
* Describe power as a rate of energy transfer.
* Calculate the energy transferred.
 |
| 2.11 | Calculating power | * Calculate power.
* Use power equations to solve problems.
* Consider power ratings and changes in stored energy.
 |
| 2.12  | Key concept: What’s the difference between potential difference and current? | * Understand the concepts of current and potential difference.
* Apply the concepts of current and potential difference.
* Use these concepts to explain various situations.
 |
| 2.13 | Maths skills: Using formulae and understanding graphs | * Recognise how algebraic equations define the relationships between variables.
* Solve simple algebraic equations by substituting numerical values.
* Describe relationships expressed in graphical form.
 |
| TOPIC 3 – PARTICLE MODEL OF MATTER |
| 3.1 | Density | * Use the particle model to explain the different states of matter.
* Describe differences in density for different states of matter.
* Calculate density for the different states of matter.
 |
| 3.2  | Required practical: To investigate the densities of regular and irregular solid objects and liquids | * Interpret observations and data.
* Use spatial models to solve problems.
* Plan experiments and devise procedures.
* Use an appropriate number of significant figures in measurements and calculations.
 |
| 3.3 | Changes of state | * Describe how, when substances change state, mass is conserved.
* Describe energy transfer in changes of state.
* Explain changes of state in terms of particles.
 |
| 3.4 | Internal energy | * Describe the particle model of matter.
* Understand what is meant by the internal energy of a system.
* Describe the effect of heating on the energy stored within a system.
 |
| 3.5 | Specific heat capacity  | * Describe the effect of increasing the temperature of a system in terms of particles.
* State the factors that are affected by an increase in temperature of a substance.
* Explain specific heat capacity.
 |
| 3.6 | Latent heat | * Explain what is meant by latent heat.
* Describe that when a change of state occurs it changes the energy stored but not the temperature.
* Perform calculations involving specific latent heat.
 |
| 3.7 | Particle motion in gases | * Relate the temperature of a gas to the average kinetic energy of the particles.
* Explain how a gas has a pressure.
* Explain that changing the temperature of a gas held at constant volume changes its pressure.
 |
| 3.8  | Key concept: Particle model and changes of state | * Use the particle model to explain states of matter.
* Use ideas about energy and bonds to explain changes of state.
* Explain the relationship between temperature and energy.
 |
| 3.9 | Maths skills: Drawing and interpreting graphs | * Plot a graph of temperature against time, choosing a suitable scale.
* Draw a line or curve of best fit.
* Interpret a graph of temperature against time.
 |
| TOPIC 4 – ATOMIC STRUCTURE |
| 4.1 | Atomic Structure | * Describe the structure of the atom.
* Use symbols to represent particles.
* Describe ionisation.
 |
| 4.2 | Radioactive decay | * Describe radioactive decay.
* Describe the types of nuclear radiation.
* Understand the processes of alpha decay and beta decay.
 |
| 4.3 | Properties of radiation and its hazards | * Describe radioactive contamination.
* Give examples of how radioactive tracers can be used.
* Explain how contaminated waste is disposed of.
 |
| 4.4 | Nuclear equations | * Understand nuclear equations.
* Write balanced nuclear equations for alpha decay.
* Write balanced nuclear equations for beta decay.
 |
| 4.5 | Radioactive half-life | * Explain what is meant by radioactive half-life.
* Calculate half-life.
* Choose the best radioisotope for a task.
 |
| 4.6 | Irradiation | * Explain what is meant by irradiation.
* Understand the distinction between contamination and irradiation.
* Appreciate the importance of communication between scientists.
 |
| 4.7 | Key concept: Developing ideas for the structure of the atom | * Understand how ideas about the structure of the atom have changed.
* Understand how evidence is used to test and improve models.
 |
| 4.8 | Maths skills: Using ratios and proportional reasoning | * Calculate radioactive half-life from a curve of best fit.
* Calculate the net decline in radioactivity.
 |
| TOPIC 5 - FORCES |
| 5.1 | Forces | * Describe a force.
* Recognise the difference between contact and non-contact forces.
* State examples of scalar and vector quantities.
 |
| 5.2 | Speed | * Calculate speed using distance travelled divided by time taken.
* Calculate speed from a distance–time graph.
* Measure the gradient of a distance–time graph at any point.
 |
| 5.3 | Acceleration | * Describe acceleration.
* Calculate acceleration.
* [Higher tier] Explain motion in a circle.
 |
| 5.4 | Velocity–time graphs | * Draw velocity–time graphs.
* Calculate acceleration using a velocity–time graph.
* [Higher tier] Calculate displacement using a velocity–time graph.
 |
| 5.5 | Calculations of motion | * Describe uniform motion.
* Use an equation for uniform motion.
* Apply this equation to vertical motion.
 |
| 5.6 | Heavy or massive? | * Identify the correct units for mass and weight.
* Explain the difference between mass and weight.
* Understand how weight is an effect of gravitational fields.
 |
| 5.7 | Forces and motion | * Understand what a force does.
* Explain what happens to an object if all the forces acting on it cancel each other out.
* Analyse how this applies to everyday situations.
 |
| 5.8 | Resultant forces | * Calculate the resultant from opposing forces.
* Draw free-body diagrams to find resultant forces.
* [Higher tier] Understand that a force can be resolved into two components acting at right angles to each other.
 |
| 5.9 | Forces and acceleration | * Explain what happens to the motion of an object when the resultant force is not zero.
* Analyse situations in which a non-zero resultant force is acting.
* Explain what inertia is.
 |
| 5.10  | Required practical: Investigating the acceleration of an object | * Plan an investigation to explore an idea.
* Analysing results to identify patterns and draw conclusions.
* Compare results with scientific theory.
 |
| 5.11 | Newton’s third law | * Identify force pairs.
* Understand and be able to apply Newton’s third law.
 |
| 5.12 | Momentum | * Explain what is meant by momentum.
* Apply ideas about the rate of change of momentum to safety features in cars.
* Use momentum calculations to predict what happens in a collision.
 |
| 5.13 | Keeping safe on the road | * Explain the factors that affect stopping distance.
* Explain the dangers caused by large deceleration.
 |
| 5.14 | Forces and energy in springs | * Explain why you need two forces to stretch a spring.
* Describe the difference between elastic and inelastic deformation.
* Calculate extension, compression and elastic potential energy.
 |
| 5.15  | Required practical: Investigate the relationship between force and the extension of a spring | * Interpret readings to show patterns and trends.
* Interpret graphs to form conclusions.
* Apply the equation for a straight line to the graph.
 |
| 5.16 | Key concept: Forces and acceleration | * Recognise examples of balanced and unbalanced forces.
* Apply ideas about speed and acceleration to explain sensations of movement.
* Apply ideas about inertia and circular motion to explain braking and cornering.
 |
| 5.17 | Maths skills: Making estimates of calculations | * Estimate the results of simple calculations.
* Round numbers to make an estimate.
* Calculate order of magnitude.
 |
| TOPIC 6 - WAVES |
| 6.1 | Describing waves | * Describe wave motion.
* Define wavelength and frequency.
* Apply the relationship between wavelength, frequency and wave velocity.
 |
| 6.2 | Transverse and longitudinal waves | * Compare the motion of transverse and longitudinal waves.
* Explain why water waves are transverse waves.
* Explain why sound waves are longitudinal waves.
 |
| 6.3 | Key concept: Transferring energy or information by waves | * To understand that all waves have common properties
* To understand how waves can be used to carry information
* To understand various applications of energy transfer by different types of electromagnetic waves
 |
| 6.4 | Measuring wave speeds | * Explain how the speed of sound in air can be measured.
* Explain how the speed of water ripples can be measured.
 |
| 6.5 | Required practical: Measuring the wavelength, frequency and speed of waves in a ripple tank and waves in a solid | * Develop techniques for making observations of waves.
* Select suitable apparatus to measure frequency and wavelength.
* Use data to answer questions.
 |
| 6.6 | Reflection and refraction of waves  | * Describe reflection, transmission and absorption of waves.
* Construct ray diagrams to illustrate reflection.
* Construct ray diagrams to illustrate refraction.
 |
| 6.7 | The electromagnetic spectrum | * Recall the similarities and differences between transverse and longitudinal waves.
* Recognise that electromagnetic waves are transverse waves.
* Describe the main groupings and wavelength ranges of the electromagnetic spectrum.
 |
| 6.8 | Reflection, refraction and wave fronts | * Explain reflection and refraction and how these may vary with wavelength.
* Construct ray diagrams to illustrate refraction.
* Use wave front diagrams to explain refraction in terms of the difference in velocity of the waves in different substances.
 |
| 6.9 | Gamma rays and X-rays | * List the properties of gamma rays and X-rays.
* Compare gamma rays and X-rays.
 |
| 6.10 | Ultraviolet and infrared radiation | * Describe the properties of ultraviolet and infrared radiation.
* Describe some uses and hazards of ultraviolet radiation.
* Describe some uses of infrared radiation.
 |
| 6.11  | Required practical: Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface  | * Explain reasons for the equipment used to carry out an investigation.
* Explain the rationale for carrying out an investigation.
* Apply ideas from an investigation to a range of practical contexts.
 |
| 6.12 | Microwaves | * List some properties of microwaves.
* Describe how microwaves are used for communications.
 |
| 6.13 | Radio and microwave communication | * Describe how radio waves are used for television and radio communications.
* Describe how microwaves are used in satellite communications.
* Describe the reflection and refraction of radio waves.
 |
| 6.14 | Maths skills: Using and rearranging equations | * Select and apply the equations *T* = 1/*f* and *v* = *f λ*
* Substitute numerical values into equations using appropriate units.
* Change the subject of an equation.
 |
| TOPIC 7 - ELECTROMAGNETISM |
| 7.1 | Magnetism and magnetic forces | * Explain what is meant by the poles of a magnet.
* Plot the magnetic field around a bar magnet.
* Describe magnetic materials and induced magnetism.
 |
| 7.2 | Compasses and magnetic fields | * Describe the Earth’s magnetic field.
* Describe the magnetic field of a current.
 |
| 7.3 | The magnetic effect of a solenoid | * Draw the magnetic field around a conducting wire and a solenoid.
* Describe the force on a wire in a magnetic field.
 |
| 7.4 | Calculating the force on a conductor | * Explain the meaning of magnetic flux density, *B*.
* Calculate the force on a current-carrying conductor in a magnetic field.
 |
| 7.5 | Electric motors | * List equipment that uses motors.
* Describe how motors work.
* Describe how to change the speed and direction of rotation of a motor.
 |
| 7.6 | Key concept: The link between electricity and magnetism | * Explore how electricity and magnetism are connected.
* Describe simple uses of electromagnets.
 |
| 7.7  | Maths skills: Rearranging equations | * Change the subject of an equation.
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