Combined Science - Physics

CP3 Knowledge organiser

P3: Energy

Lesson sequence

1. Storing and transferring energy
2. Energy efficiency
3. Insulation
4. Stored energy
5. Non-renewable energy resources
6. Renewable energy resources

1. Storing and transferring energy	
***Energy**	The capacity to do work.
***Joules**	The units of energy, symbol = J.
***Kilojoules**	1000 J, symbol = kJ.
***Thermal energy**	Energy stored on hot objects.
***Kinetic energy**	Energy stored in moving objects.
***Chemical energy**	Energy stored in chemicals such as fuels.
***Nuclear energy**	Aka atomic energy. Energy stored in the nucleus of atoms.
****Gravitational potential energy**	Energy stored in objects based on how high they are.
****Elastic potential energy**	Aka strain energy. Energy stored in bent or stretched objects.
****Other forms of energy**	Light, sound, electrical.
****First law of thermodynamics**	Energy cannot be created or destroyed, just transferred from one form to another.
****Energy transfers**	Say what form the energy starts as *and* what it becomes.
****Sankey diagram**	Shows energy transfers. The thickness of the arrow relates to the amount of energy.

2. Energy efficiency	
****Dissipation**	The way energy spreads out, becoming less useful as it does.
***Wasted energy**	Energy that is transferred into forms that can't be used.
***Friction**	Causes energy loss as heat when two surfaces rub together.
****Lubrication**	Allows surfaces to move smoothly, reduces energy loss from friction.
****Electrical resistance**	Causes wires to heat up, wasting electrical energy.
***Calculating efficiency**	$Efficiency = \frac{useful\ energy\ transferred}{total\ energy\ transferred}$
****Energy efficiency numbers**	Efficiency is between 0 and 1. 1 = no energy wasted, 0 = all energy wasted.

3. Insulation	
***Convection**	Heat transfer caused when hot fluids (gas or liquid) rise because they are less dense.
***Conduction**	Heat transfer through solids caused by vibrating particles bumping into each other.
***Radiation**	Heat transfer by infrared radiation which heats objects up when they absorb it.
****Insulation**	Materials that contain lots of tiny air pockets that prevent heat loss by conduction.
****Thermal conductivity**	A measure of how well a material conducts heat.
****Draught-proofing**	Sealing gaps around doors and windows to prevent heat loss by convection.

4. Stored energy	
***Calculating kinetic energy**	$KE = \frac{1}{2}mv^2$ Where 'KE' is kinetic energy in J, 'm' is mass in kg, 'v' is velocity in m/s.
****Calculating v from KE**	$v = \sqrt{\frac{2KE}{m}}$
****Gravitational field strength**	The strength of gravity. Different on different planets. On earth: 10 N/kg.
****Calculating gravitational potential energy**	$\boldsymbol{GPE = mgh}$ Where 'GPE' is gravitational potential energy in J, 'm' is mass in kg, 'g' is gravitational field strength in N/kg, 'h' is height change in m.

5. Non-renewable energy resources	
***Fossil fuels**	Coal, oil, natural gas. All are non-renewable.
***Non-renewable resource**	A resource that will one day run out because it is being used faster than it is being made.
****Harm from burning fossil fuels**	Carbon dioxide gas is released which causes global warming. Sulfur dioxide is released which causes acid rain.
***Renewable resource**	A resource will not run out.
***Nuclear power**	Electricity generated from nuclear fuels such as uranium.
****Nuclear power pros and cons**	😊 Lasts a long time, releases no carbon dioxide ☹ Produces very harmful waste, expensive to decommission, although rare, accidents are very dangerous.

6. Renewable energy resources	
***Wind power**	Large turbines spun by the wind. 😊 No CO_2 ☹ Lots needed, ugly?, no wind no power
***Solar power**	Solar cells turn sunlight to electricity. 😊 No CO_2 ☹ No sun no power, need lots of space, not suitable for all countries
****Tidal power**	Uses water movement from tides to spin turbines
****Tidal barrage**	A damn built across an estuary that fills up when tide goes in. 😊 Huge amounts of energy, no CO_2 ☹ Destroys important mudflat habitats
****Hydroelectricity**	A damn is built across a river valley, water released from the damn spins turbines. 😊 Lots of energy, no CO_2 ☹ Destroys habitat by flooding
***Biofuels**	Fuels made from recently plant or animal matter, often waste. 😊 Carbon neutral ☹ Needs a lot of land, increases food prices
****Carbon neutral**	When burning a fuel releases the same CO_2 it absorbed when it was growing, so there is no CO_2 increase.