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# Module P1 Energy for the home	**Page numbers in New Physics for You**
Item P1a: Heating Houses	
Assessable learning outcomes **Foundation Tier only: <u>low</u> demand**	
Recognise that hot objects have high temperatures and tend to cool down.	pages 41, 46
Recognise that cold objects have low temperatures and tend to warm up.	41, 46
Recognise that for warm bodies the higher the temperature the quicker they cool.	46, 47
State that temperature is measured in °C.	26-7
State that energy (heat) is measured in J.	35
Apply knowledge that the energy needed to change the temperature of a body depends on: • mass; • the material it is made from; • the temperature change.	36-7
Plan an experiment to measure the energy required to change the temperature of a body.	36-8
State that energy is needed to melt or boil things.	53, 55
Interpret data which shows that there is no temperature change when materials are: • boiling; • melting or freezing.	54
‘Standard’ demand and ‘High’ demand are shown on the next page.	

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Assessable learning outcomes both tiers: standard demand	
Recognise energy flow from a hot body to a cooler one.	pages 41-6
This will cause hotter bodies to cool and cooler bodies to warm.	41-6
Recall that temperature is a measurement of hotness.	26-7
Recall that heat is a measurement of energy.	26, 35
Recognise that the specific heat capacity of materials is: • a measure of how much energy they can hold; • the energy needed to raise the temperature of 1kg by 1oC; • different for different materials.	36-7
Describe how, even though energy is still being transferred, there is no temperature change when materials are: • boiling; • melting or freezing.	53, 54, 55
Recognise that the specific latent heat of materials is: • a measure of how much energy is needed to melt or boil them; • the energy needed to melt or boil 1kg of them; • different for different materials and states.	53, 55
State and use the equation: energy = mass x specific latent heat. (A change of subject may be required.)	54, 55
Assessable learning outcomes Higher Tier only: high demand	
Explain that temperature can be represented by a range of colours in a thermogram.	27, 50, 211
Describe temperature as a measurement of hotness on a chosen scale.	26-7
Describe heat as a measurement of energy on an absolute scale.	26, 35
State and use the equation: energy = mass x specific heat capacity x temperature change. (A change of subject may be required).	37-8
Explain that energy supplied during a change of state is used to break inter-molecular bonds and this explains why temperature does not change.	53, 55

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Item P1b: Keeping homes warm	
Assessable learning outcomes **Foundation Tier only: low demand**	
Recognise everyday examples of energy saving methods in the home.	pages 42-3, 49
Recognise good and bad conductors.	40-41
Recognise that curtains reduce energy loss through windows.	43
Recognise that many insulation materials contain air.	42
Apply the fact that air is a very good insulator to its use in keeping homes warm: • fibreglass or mineral wool is used as loft insulation; • double glazing in windows; • cavity-wall insulation foam; • reflective foil in or on walls; • draught-proofing.	42-3
Assessable learning outcomes **both tiers: standard demand**	
Interpret data and calculate cost savings of different energy saving strategies: • payback time.	12, 43
State and use the equation: efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$	102
Assessable learning outcomes **Higher Tier only: high demand**	
Explain in the context of the home the concepts of conduction, convection and radiation (absorption and emission) in terms of: • the design features of the home; • the design and use of everyday appliances in the home; • energy saving strategies.	42-3, 48-9, 50-1
State and use the equation: efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ (A change of subject is required).	102

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Item P1c: How insulation works	
Assessable learning outcomes **Foundation Tier only: low demand** State that air in a material is a very good insulator. Recognise that hot air rises and is replaced by falling colder air. Recognise that infrared energy can be reflected from a shiny surface	 pages 40-43 44-5 47, 51, 213
Assessable learning outcomes **both tiers: standard demand** Explain in domestic situations, how energy transfer can be reduced in terms of: • conduction; • convection; • radiation.	 42-51
Assessable learning outcomes **Higher Tier only: high demand** Describe how energy is transferred by: • conduction - transfer of KE between particles; • convection - change of density causes (bulk) fluid flow; • radiation - infrared radiation needs no medium. Explain that, unless air is trapped in foam, there will still be energy loss by convection in a cavity wall.	 41, 44, 46, 48 43, 44
Item P1d: Cooking with waves	
Assessable learning outcomes **Foundation Tier only: low demand** Interpret information on the electromagnetic spectrum to include microwaves and infrared radiation. Recognise that warm and hot objects emit radiation: • hotter objects emit more radiation; • black dull objects emit more radiation. Recognise that infrared radiation is absorbed by the surface of an object causing an increase in temperature: • black surfaces are good absorbers of radiation. Recognise that microwaves cause heating when absorbed by water and this is the basis of the microwave oven. State that mobile phones use microwave signals. Describe some concerns about children using mobile phones.	 209 46, 211, 213 47 213 216-7 216

Assessable learning outcomes **both tiers: standard demand** Describe properties of microwaves: • penetrate (about 1cm) into food; • are reflected by metal; • can cause burns when absorbed by body tissue; • go through glass and plastics.	209, 213, 214
Describe properties of infrared radiation: • heats the surface of the food; • is reflected by shiny surfaces.	214, 47
Recognise that microwaves are used to transmit information over large distances that are in 'line of sight': • some areas and places have poor signals.	211, 217, 314
Recognise that there may or may not be dangers: • to residents near to the site of a mast; • to users of mobile phones.	216-7
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how microwaves and infrared transfer energy to materials: • microwaves absorbed by water particles in outside layers increasing their KE; • infrared is absorbed by all particles on the surface increasing their KE; • energy transferred to centre of food by conduction or convection.	213
Describe how the energy associated with microwaves and infrared depends on their frequency and relate this to their potential danger.	209
Describe how diffraction and interference of microwaves can cause signal loss: • limited distance between transmitters; • high positioning of transmitters; • nuisance of obstacles affecting signals.	169, worksheet

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Item P1e: Infrared signals	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe uses of infrared radiation: • in remote controls (TV, video, DVD,) automatic doors; • short distance data links for computer or mobile phones.	page 213
State that infrared sensors detect body heat and are used for: • burglar alarms; • security lights.	213
State the two types of signal used to transmit data: • analogue; • digital.	218-9
Recognise, in the context of optical fibres, when Total Internal Reflection (TIR) happens: • glass-air, water-air or perspex-air boundary.	187, 189, 192
Recognise and describe how light and infrared radiation can both travel along an optical fibre from one end to another by reflection	192
Assessable learning outcomes **both tiers: standard demand**	
Describe the differences between analogue and digital signals: • analogue signals have a continuously variable value; • digital signals are either on (1) or off (0).	218-9
Describe, in the context of optical fibres, what happens to light incident on a glass-air, water-air or Perspex-air boundary below, at and above the critical angle.	187
Describe how light and infrared radiation can both travel along an optical fibre from one end to another by Total Internal Reflection (TIR).	192
Describe the transmission of light in optical fibres	187, 192
Assessable learning outcomes **Higher Tier only: high demand**	
Describe advantages of using digital signals: • to allow more information to be transmitted because of multiplexing (interleaving of many digital signals on the same data line); • less interference (noise not recognised and amplified).	218-9
Describe the application of total internal reflection in fibre optics: • drawing and interpreting simple ray diagrams.	187, 192
Describe advantages of using optical fibres to allow more information to be transmitted: • multiplexing; • lack of interference.	219

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Item P1f: Wireless signals	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe how radiation used for communication can be reflected.	pages 168, 211
Recognise that wireless technology uses electromagnetic radiation for communication.	209, 211
State that wireless technology can have advantages: • available 24 hours a day; • no wiring needed; • portable and convenient.	211
Recognise that some radio signals are better quality than others.	219
Interpret simple information on digital and analogue signals.	218-9
Assessable learning outcomes **both tiers: standard demand**	
Describe how radiation used for communication can be refracted.	168
Recognise common uses of wireless technology. • Radio; • mobile phones. • laptop computers.	209, 216-7
Recognise that radio stations with similar transmission frequencies often interfere.	
Assessable learning outcomes **Higher Tier only: high demand**	
Explain how long-distance communication depends on the reflection of waves from the Ionosphere or by being received and re-transmitted from satellites.	211
Explain how the refraction and diffraction of radiation can affect communications: • refraction at the interfaces of different layers of Earth's atmosphere; • diffraction by transmission dishes results in signal loss.	169, 211, 155
Explain the advantage of digital radio in terms of lack of interference. • optical fibres allow the rapid transmission of data; • optical fibres allow the transmission of data pulses using light.	218-9

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Item P1g: Light	
Assessable learning outcomes **Foundation Tier only: low demand**	
Identify the main features of a transverse wave: • trough and crest; • amplitude; • wavelength.	pages 166-7
Recognise that all electromagnetic waves travel at the same high speed in space.	209
Describe how, historically, the use of light greatly increased the speed of communication but that it requires the use of a code.	374
Recall that a laser produces a narrow intense beam of light.	193
Assessable learning outcomes **both tiers: standard demand**	
Describe the main features of a transverse wave: • trough and crest; • amplitude; • wavelength; • frequency as the number of waves in each second.	166-7
State and use the equation: wave speed = frequency x wavelength.	167
Describe how light was used as a means of communication: Morse code.	374
Assessable learning outcomes **Higher Tier only: high demand**	
State and use the equation: wave speed = frequency x wavelength. (A change of subject may be required).	167
Explain the advantages and disadvantages of using light, radio and electrical signals for communication.	211, 374
Explain that a laser produces an intense beam of light in which all of the waves are: • the same frequency; • in phase with each other.	193
Explain how a laser beam is used in a CD player by reflection from the shiny surface: • surface contains digital information; • information in the form of a pattern of pits.	306

Item P1h: Stable Earth	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe earthquakes as producing shock waves which can: • cause damage; • be detected by seismometers.	pages 146-7
State that exposure to ultraviolet radiation can cause: • suntan; • sunburn; • skin cancer.	210, 214
Recognise that sun block can reduce damage caused by ultraviolet light: • high factors reduce risks more; • high factors allow longer exposure without burning.	214
Describe reasons for global warming: • increased energy use; • increased CO_2 • deforestation.	107
Assessable learning outcomes **both tiers: standard demand**	
Describe that earthquakes produce shock waves, which can also travel inside the Earth.	146-7
State that there are two types of seismic waves: • longitudinal P-waves travel through both solids and liquids and travel faster than S-waves; • transverse S-waves which travel through solids but not through liquids.	146-7
Explain how darker skins reduce cancer risk: • absorb more ultraviolet radiation; • let less ultraviolet radiation reach underlying body tissues.	210, 214
Interpret given information about sun protection factor (no recall is expected).	214
Calculate how long a person can spend in the sun without burning from a knowledge of the sun protection factor.	214
Explain how human activity and natural phenomena both have effects on weather patterns. Dust from: • volcanoes reflect radiation from the Sun causing cooling; • factories reflect radiation from the city causing warming.	(107)

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe how seismic waves transmitted through the Earth can be used to provide evidence for its structure: • P-waves travel through solid and liquid rock (i.e. all layers of the Earth); • S-waves cannot travel through liquid rock; (i.e. the outer core).	pages 146-7
Describe how the ozone layer protects the Earth from ultraviolet radiation and that environmental pollution from CFCs is depleting the layer.	210
Interpret given information about climate change as a result of natural or human activity (no recall is expected).	107

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Module P2 : Living for the Future	Page numbers in New Physics for You
Item P2a: Collecting Energy from the Sun	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe that the Sun: • is a stable source of energy; • transfers energy to Earth as light and heat.	page 101
Describe that photocells: • transfer light into electricity; • produce direct current (DC); • can operate in remote locations; • have a power that depends on the surface area exposed to sunlight.	14, 103, worksheet
Describe other ways that the Sun's energy can be harnessed: • light can be absorbed by a surface and transferred into heat energy; • produce convection currents (wind) to drive turbines;	101, 48, 50
Describe that the Sun is a renewable source of energy.	14-15
Assessable learning outcomes **both tiers: standard demand**	
Describe that DC electricity is current in the same direction all the time.	248
Describe some advantages and disadvantages of using photocells to provide electricity: • low maintenance; • no need for power cables; • no need for fuel; • long life; • rugged; • renewable energy resource; • no polluting waste; • no power at night or bad weather.	14, 103, 105
Describe other ways that the Sun's energy can be harnessed: • how glass can be used to provide passive solar heating for buildings; • light can be reflected to a focus by a curved mirror; • transfer KE of air to electricity in wind turbines.	101, 48, 50, 103

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe how light produces electricity in a photocell: • energy absorbed by photocell; • electrons are knocked loose from the silicon crystal; • electrons flow freely.	pages 14, 103
Describe how the power of a photocell depends on: • light intensity; • surface area exposed.	worksheet
Explain why passive solar heating works: • glass is transparent to light; • heated surfaces emit infrared; • glass reflects infrared.	48, 50
An efficient solar collector must track the position of the Sun in the sky.	
Describe the advantages and disadvantages of wind turbines: • renewable; • rugged; • no polluting waste; • visual pollution; • dependency on wind speed; • space needed.	101, 14, 105-6
Item P2b: Generating Electricity	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise the dynamo effect: • electricity can be generated by moving a coil near a magnet; • moving a magnet near a coil.	296-7
Describe that a generator produces alternating current (AC).	298
Describe that a battery produces direct current (DC).	248
Describe the main stages in the production and distribution of electricity: • source of energy; • power station produces electricity; • national grid of power lines connecting station to consumers; • consumers are homes, factories, offices and farms.	101, 303
Describe that some of the energy of the fuel in a power station is wasted as heat energy in the environment.	104
Recognise that transformers can be used to increase or decrease voltage.	302

Assessable learning outcomes both tiers: standard demand	
Describe and recognise the dynamo effect can be increased (more current): • stronger magnets; • more turns; • faster movement.	page 300
Describe and interpret AC using a voltage-time graph.	299
Describe how simple AC generators work. • coil of wire; • magnetic field; • coil and field close; • relative motion between coil and field.	296-8
Describe how electricity is generated at a conventional power station: • burning fuel; • producing steam; • spinning a turbine; • turbine turns generator.	104
Describe and recognise that there is significant waste of energy in a conventional power station.	104
Explain how transformers are used in the National grid: • electricity is transmitted at high voltage to reduce energy waste and costs.	302-3
Assessable learning outcomes Higher Tier only: high demand	
Describe that the frequency of AC electricity is the number of cycles per second.	299
Use these equations in the context of a power station to calculate energy input, energy output, waste energy output and efficiency. • fuel energy input = waste energy output + electrical energy output; • efficiency = $\frac{\text{electrical energy output}}{\text{fuel energy input}}$ To include change of subject.	104, 102
Explain how for a given power transmission, increased voltage reduces current, so decreasing energy waste by reducing heating of cables.	302-3

Item P2c: Fuels for Power	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe that the common fuels (energy sources) used in power stations: • fossil fuels - crude oil, coal, natural gas; • renewable biomass - wood, straw, manure; • nuclear fuel.	pages 13-14
Describe that the unit of power is the watt or kilowatt:	266
Interpret data to show the cost of using expensive electrical appliances depends on: • power rating in watts and kilowatts; • the length of time it is switched on	267
Describe that waste from nuclear power is radioactive: • can be harmful; • does not give rise to global warming.	346, 106
Assessable learning outcomes **both tiers: standard demand**	
Describe that: • burning fuels releases energy as heat; • uranium fuel rods release energy as heat; • biomass can be fermented to generate methane.	35, 348-9, 14
Calculate the power rating of an appliance using the equation: power = voltage × current	266
State that the unit of electrical energy supplied is the kilowatt hour.	267
Calculate the number of kilowatt hours given the: • power in kilowatts; • time in hours.	267
Calculate the cost of energy supplied.	267
Recall that ionising radiations (from radioactive waste) can cause cancer.	346
Recall that uranium is a non-renewable resource.	349
Recall that plutonium: • is a waste product from nuclear reactors; • can be used to make nuclear bombs.	348

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Assessable learning outcomes **Higher Tier only: high demand**	
Describe and evaluate the advantages and disadvantages of different energy sources.	pages 13-15, 104-6
State, be able to use and manipulate the equation: power = voltage × current	266
Use the kilowatt hour as a measure of the energy supplied;	267
State and use the equation: energy supplied = power x time to calculate: • power in kW or W; • time in hours and / or minutes.	266-7
Describe the advantages and disadvantage of using off-peak electricity in the home.	
Describe the advantages and disadvantages of nuclear power: • decommissioning costs; • pollution from fuel processing; • risk of accidental emission of radioactive material; • high maintenance costs; • independence from fossil fuels; • high stocks of fuel; • no greenhouse gases.	105-7, 349
Item P2d: Nuclear Radiations	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe and recognise that nuclear radiation can be beneficial or harmful: • state one example of a beneficial use; • harmful effect: damages living cells.	346-7
State and recognise the three types of nuclear radiation: • alpha; • beta; • gamma.	340-1
Describe and recognise that there is background radiation in the environment which is always present.	340, 350
Describe how to handle radioactive materials safely: • protective clothing; • tongs / keep your distance; • short exposure time; • shielded and labelled storage.	350

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Assessable learning outcomes both tiers: standard demand	
Describe examples of beneficial uses of radiation: • alpha - smoke detectors; • beta - tracers and paper thickness gauges; • gamma - treating cancer, non-destructive testing and sterilising equipment.	pages 346-7
Describe that radioactive materials give out nuclear radiation.	340-1
Describe the relative penetrating power of alpha, beta and gamma.	340-1
State that nuclear radiation ionises materials.	338, 346
Describe that ionisation produces charged particles.	338, 244
Describe background radiation and state that it is caused by radioactive substances, rocks, soil, living things and cosmic rays.	340, 350
Describe some ways of disposing radioactive waste e.g. • low level waste in land-fill sites; • encased in glass and left underground; • reprocessed.	350
Assessable learning outcomes Higher Tier only: high demand	
Describe how alpha, beta and gamma can be identified by their penetrating power.	340-1
Explain ionisation in terms of: • removal of electrons from particles; • gain of electrons by particles.	338, 244
Explain the problems of dealing with radioactive waste: • remains radioactive for a long time; • terrorist risk; • must be kept out of groundwater; • acceptable radioactivity level may change over time.	350

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Item P2e: Our Magnetic Field	
Assessable learning outcomes **Foundation Tier only: low demand** Describe that: • the Earth is surrounded by a magnetic field; • magnets have a north and south pole; • the Earth's core contains a lot of molten iron; • a plotting compass shows the direction of a magnetic field; • cosmic rays are ionising radiations from space.	pages 280-2
Describe that electrical current (moving electrical charges) in a coil creates a magnetic field.	286-7
Describe that the Moon may be the remains of a planet which collided with the Earth.	
Describe that the Sun: • is a source of ionising radiation; • causes solar flares that can interfere with the operation of artificial satellites;	
State the uses of artificial satellites; • Telecommunications; • weather prediction; • spying; • (satellite) navigation systems.	154-5
Assessable learning outcomes **both tiers: standard demand** Describe: • the shape of the Earth's magnetic field; • that charged particles are deflected by magnetic fields.	282
Describe the shape of the magnetic field around a current-carrying coil (direction of field from current not required).	286-7
Describe how a collision between two planets can result in an Earth-Moon system: • the planets collide; • their iron cores merge to form the Earth; • less dense material orbits as the Moon.	
Describe the nature solar flares: • clouds of charged particles from the Sun; • ejected at high speed; • produce strong disturbed magnetic fields.	

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Assessable learning outcomes **Higher Tier only: high demand** Describe that cosmic rays: • are fast moving particles which create gamma rays when they hit the atmosphere; • spiral around the Earth's magnetic field to the poles; • cause the Aurora Borealis. Describe that magnetic fields can be generated by moving charged particles. Discuss the evidence for the Earth-Moon system as the result of a collision between two planets. Describe the consequences of a solar flare arriving at the Earth: • satellite communications; • electricity distribution.	
Item P2f: Exploring our Solar System	
Assessable learning outcomes **Foundation Tier only: low demand** State and recognise that: • Earth is one of a number of planets that orbit the Sun; • the moon orbits Earth; • Earth orbits the Sun. State and recognise that the universe consists of: • stars and planets; • comets and meteors; • black holes; • large groups of stars called galaxies. Describe that stars can be seen even though they are far away because they are: • very hot; • give off their own light. Describe that radio signals take a long time to travel through the solar system. Explain that manned spacecraft need to take food, water and oxygen. Explain that unmanned spacecraft (probes) do not need food, water or oxygen.	pages 148-151 150-2, 157-8 156-7 161 161 161

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Assessable learning outcomes both tiers: standard demand	
State and recognise the relative positions of Earth Sun and planets (includes the order of the planets).	pages 150-1
Describe that gravitational force determines the motion of planets and satellites.	148, 153
Describe some of the difficulties of manned space travel between planets: • enough fuel; • long time required; • effect of low gravity on health; • shielding from cosmic rays; • maintaining a stable atmosphere; • providing enough food and water; • keeping warm.	161
Recall that unmanned spacecraft can withstand conditions that are lethal to humans.	161
State that unmanned spacecraft can send back information on: • temperature, magnetic field and radiation; • gravity, atmosphere and surroundings.	161
Assessable learning outcomes Higher Tier only: high demand	
State the relative positions of planets, stars, comets, meteors, galaxies and black holes.	150-2
State and recognise that circular motion requires a centripetal force.	70, 148
State and recognise that gravity provides the centripetal force for orbital motion.	71, 148
Describe that a light-year is: • a measurement of very large distances; • the distance light travels in a year.	171, 157
Explain the advantages and disadvantages of using unmanned spacecraft to explore the Solar System: • costs; • safety; • reliability; • maintenance.	161

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Item P2g: Threats to Earth	
Assessable learning outcomes **Foundation Tier only: low demand**	
State that large asteroids have collided with the Earth in the past.	page 152
State that asteroids are rocks.	152
Describe some of the consequences of a collision with a large asteroid: • crater; • ejection of hot rocks; • widespread fires; • sunlight blocked by dust; • climate change; • species extinction.	
Describe that the tail of a comet is a trail of debris.	152
Describe that a near-Earth object (NEO) is an asteroid or comet on a possible collision course with Earth.	worksheet
Describe that Near Earth Objects may be seen with telescopes.	worksheet
Assessable learning outcomes **both tiers: standard demand**	
Describe that asteroids: • are left over from the formation of the Solar System; • orbit between Mars and Jupiter.	152, 151
Describe some of the evidence for past asteroid collisions: • craters; • layers of unusual elements in rocks; • sudden changes of fossil numbers between adjacent layers of rock.	worksheet
Describe that comets: • have highly elliptical orbits; • are made from ice and dust; • come from objects orbiting the Sun far beyond the planets.	152
Describe that the speed of a comet increases as it approaches a star.	152
Describe that observations of near-Earth objects (NEO) can be used to determine their trajectories.	worksheet

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain why the asteroid belt is between Mars and Jupiter: • the large gravity of Jupiter disrupts the formation of a planet.	page 151
Explain why the speed of a comet increases as it approaches a star: • the strength of gravity increases.	152-3
Suggest and discuss possible actions which could be taken to reduce the threat of near-Earth objects (NEO): • surveys by telescope; • monitoring by satellites; • deflection by explosions.	worksheet
Item P2h: The Big Bang	
Assessable learning outcomes **Foundation Tier only: low demand**	
Describe some ideas about the Big Bang theory for the origin of the Universe; • started with an explosion; • the Universe is still expanding.	158
Describe that stars: • have a finite 'life'; • start as a huge gas cloud.	152, 157
Describe that not even light can escape from a black hole.	157
Assessable learning outcomes **both tiers: standard demand**	
Describe that: • all galaxies are moving away from us; • distant galaxies are moving away more quickly; • microwave radiation is received from all parts of the universe.	158
Describe the end of a medium-weight star like our Sun: • red giant; • planetary nebula; • white dwarf;	157
Describe the end of a heavy-weight star: • red giant; • supernova; • neutron star or black hole.	157

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Assessable learning outcomes **Higher Tier only: high demand**	
Explain how the Big Bang theory accounts for: • light from galaxies is shifted to the red end of the spectrum; • the further away galaxies are, the greater the red shift; • the age and starting point of the Universe.	page 158
Describe the life history of a star: • interstellar gas cloud; • gravitational collapse producing a proto-star; • thermonuclear fusion; • long period of normal life (main sequence); • end depends on mass of star;	152, 156-7
Explain the properties of a black hole; • large mass; • large gravity; • not even light can escape.	157

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