# Scheme of work

## Physics – Space physics

This resource provides guidance for teaching the Space physics topic from our new GCSE Physics (8463). It has been updated from the draft version to reflect the changes made in the accredited specification. There are many changes throughout the document particularly to the learning outcomes and opportunities to develop skills columns.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 4.8 Space physics (Physics only)

### 4.8.1 Solar system; stability of orbital motions; satellites

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.8.1.1 | The classification of objects within our solar system. | Within our solar system there is one star, the Sun, plus the eight planets and the dwarf planets that orbit around the Sun. Natural satellites, the moons that orbit planets, are also part of the solar system. | 0.4 | Describe the different objects in our solar system and their location within our solar system.  .  Explain where in the solar system various groups of objects are likely to be found, e.g. the correct order of the planets, rocky dwarf planets and gas giants.  Explain why Pluto is no longer classified as a planet.  What is a solar system?  Research information about the solar system to find out where humans could possibly escape to in case of a large asteroid impact. | Make a scale model of the solar system. | [NASA – Solar System Exploration](https://solarsystem.nasa.gov/index.cfm)  [Cyber physics – The Solar System](http://www.cyberphysics.co.uk/topics/space/solarsystem/SolarSystem_index.html)  [BBC Bitesize – The solar system](http://www.bbc.co.uk/education/guides/zk8hvcw/revision)  [Pass My Exams – The Solar System](http://www.passmyexams.co.uk/GCSE/physics/solar-system.html)  Video clip  [YouTube: A Tour through our Solar system](http://www.youtube.com/watch?v=evWeRHMwSu0) |
| 4.8.1.1 | The name of our galaxy and our place within it. | Our solar system is a small part of the Milky Way galaxy. | 0.4 | How many stars are in the Milky Way? How many galaxies are there in the Universe?  How far have people actually travelled into the Milky Way? What is at the centre of the Milky Way?  Describe why it is not possible to explore the centre of our galaxy, the Milky Way, using manned or unmanned rockets.  Evaluate the benefits and drawbacks of sending people to colonise Mars. | Design a rocket that could take the human race to another solar system within the Milky Way. What would be needed, what waste would be produced and how would it be dealt with? Evaluate the benefits and drawbacks of using manned rockets to explore the Milky Way. | [BBC Bitesize – Stars and galaxies](http://www.bbc.co.uk/schools/gcsebitesize/science/edexcel_pre_2011/space/planetsstarsandgalaxiesrev3.shtml)  [Cyberphysics – The universe](http://www.cyberphysics.co.uk/topics/space/universe.htm) |
| 4.8.1.1 | The birth of a star from its beginnings as a nebula to how it reaches main sequence. | The Sun was formed from dust and gas (nebula) pulled together by gravitational attraction. Collisions between particles caused the temperature to increase enough for hydrogen nuclei to fuse together forming helium. The energy released by nuclear fusion processes keeps the core of the Sun hot. | 0.3 | Is the Sun a large star?  Are all stars the same size?  Why are stars so hot?  Where do stars come from?  Describe how a star forms from a cloud of dust and gas called a nebula.  State the name of the element that makes up most of the mass of a star.  Explain how the star gets bigger by accreting the particles that are attracted to it and how the star gets hotter due to the kinetic energy transferred from the impacting particles to the developing star.  Explain how the star starts to fuse hydrogen atoms together in a process called nuclear fusion when the temperature of the protostar becomes high enough. | Find out which type of star the Sun is and where it is on its lifecycle.  Research the origin of the solar system, looking at the formation of the Sun and the planets.. | Video clip on sizes of some stars and planets: [YouTube: The Real Perspective on the Solar System](http://www.youtube.com/watch?v=z6yHKE9dg0g)  [YouTube: Stephen Hawking – Formation of the Solar System](https://www.youtube.com/watch?v=Uhy1fucSRQI)  [BBC Bitesize – Formation of a star](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/stars/lifecyclestarsrev1.shtml)  [Cyberphysics – The Life Cycle of a Star](http://www.cyberphysics.co.uk/topics/space/life_of_star.htm)  [Pass My Exams – Life Cycle of Stars](http://www.passmyexams.co.uk/GCSE/physics/life-cycle-of-stars.html)  [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |
| 4.8.1.1 | The Sun’s position in its lifecycle and understanding why this stage of its lifecycle is stable. | The Sun is in the ‘main sequence’ period of its lifecycle and is stable. It is stable because the force of gravity acting inwards and trying to collapse the Sun is in equilibrium with outward force due to the fusion energy trying to expand the Sun. | 0.3 | Why doesn’t the Sun collapse in on itself under gravity?  Is the Sun a large or a small star?  Explain how the Sun’s size is kept in balance while two opposing forces are trying to make it bigger and smaller simultaneously. |  | [NASA – Stellar Evolution - The Birth, Life, and Death of a Star](http://www.nasa.gov/audience/forstudents/9-12/features/stellar_evol_feat_912.html)  [BBC Bitesize – Formation of a Star](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/stars/lifecyclestarsrev1.shtml)  [BBC Bitesize – Formation of a Star](http://www.cyberphysics.co.uk/topics/space/life_of_star.htm)  [Pass My Exams – Life Cycle of Stars](http://www.passmyexams.co.uk/GCSE/physics/life-cycle-of-stars.html) |
| 4.8.1.2 | The lifecycle of small and large stars. | A star goes through a life cycle. The life cycle is determined by the size of the star. | 0.2 | How long does a star shine for?  What determines the length of a star’s lifecycle?  Describe the similarities and differences between the lifecycles of small and large stars.  Explain how the length of a star’s life cycle is affected by the size of the star. | Produce a flow chart to show the lifecycle of large and small stars.  Model the lifecycle of small and large stars out of plasticine. Show how the star starts its life and how the size of it changes during its life.  Research the lifecycle of a star similar to the Sun.  Find out how astronomers determine the life cycle of a star even though it may last billions of years. | [BBC Bitesize – Formation of a Star](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/stars/lifecyclestarsrev1.shtml)  [Cyberphysics – Life cycle of a star](http://www.cyberphysics.co.uk/topics/space/life_of_star.htm)  [Pass My Exams – Life Cycle of Stars](http://www.passmyexams.co.uk/GCSE/physics/life-cycle-of-stars.html) |
| 4.8.1.2 | How elements other than hydrogen are formed. | Fusion processes in stars produce all of the naturally occurring elements. Elements heavier than iron are produced in a supernova. | 0.4 | Why are stars so hot? If space is so cold why don’t stars cool down faster?  If all the elements are not made in a star then where did they come from?  Describe the conditions required for nuclear fusion.  Explain what is happening when hydrogen atoms fuse together and complete an equation to show hydrogen nuclei fusing together to make helium nuclei and other light elements.  Describe how the conditions in a supernova allow heavy elements to be formed. | Research how elements up to and including iron in the periodic table were made in stars and find out how the elements heavier than iron were formed. | [BBC Bitesize – How are elements made?](http://www.bbc.co.uk/education/clips/zwqgkqt)  [Cyberphysics – The Life Cycle of a Star](http://www.cyberphysics.co.uk/topics/space/life_of_star.htm)  [Pass My Exams – Life Cycle of Stars](http://www.passmyexams.co.uk/GCSE/physics/life-cycle-of-stars.html) |
| 4.8.1.2 | How heavy elements get distributed across the universe. | The explosion of a massive star (supernova) distributes the elements throughout the universe. | 0.3 | Where did the Sun and the planets in our solar system come from?  If heavy elements are made in a supernova how did they become part of the Earth?  Am I made of star dust if I have heavy elements in me?  Describe how heavy elements are scattered across the universe.  Explain how the cloud of gas ejected by the supernova can form a nebula in which other stars and planets can form which this time will contain heavier elements. | Draw a cartoon strip to show how a supernova could have distributed the heavy elements that made up part of the Earth. | Video clips  [YouTube: Supernovas: When Stars Die](http://www.youtube.com/watch?v=Z4l6jqKL5Qo)  [BBC Bitesize – How are elements made?](http://www.bbc.co.uk/education/clips/zwqgkqt)  [Cyberphysics – Life Cycle of a Star](http://www.cyberphysics.co.uk/topics/space/life_of_star.htm)  [Pass My Exams – Life Cycle of Stars](http://www.passmyexams.co.uk/GCSE/physics/life-cycle-of-stars.html) |
| 4.8.1.3 | How satellites stay in orbit. | Planets orbit the Sun and a moon orbits a planet. Artificial satellites orbit the Earth. Gravity provides the force that allows planets and satellites (both natural and artificial) to maintain their circular orbits. | 0.4 | Describe satellites as objects that orbit around larger objects in space.  How do satellites get into space?  Why don’t satellites in orbit fly off into space?  Explain why satellites stay in orbit in terms of the force of gravity.  Explain how the speed of an artificial satellite is linked to the height of the satellite above the Earth.  What are artificial satellites used for?  Give uses of artificial satellites including communications and monitoring the weather.  Find out how a GPS system locates your position. | Model the gravitational force acting on a satellite by swinging a bung on a string around your head. What happens if the speed is too great? | [BBC Bitesize – Satellites, gravity and circular motion](http://www.bbc.co.uk/schools/gcsebitesize/science/triple_ocr_gateway/space_for_reflection/satellites_gravity_circular_motion/revision/2/)  GCSE Boardworks – Gravity and Space Section – What is an orbit is a good animation  [BBC Bitesize – The solar system](http://www.bbc.co.uk/education/guides/zk8hvcw/revision/4)  Video clip  [YouTube: How Do Satellites Get and Stay in Orbit?](http://www.youtube.com/watch?v=IC1JQu9xGHQ) |
| 4.8.1.3 | The circular motion of satellites. HT only | The force of gravity acts towards the centre of the circular orbit and causes acceleration in that direction. The acceleration results in a changing velocity but unchanged speed. | 0.3 | How can a satellite be accelerating but staying at the same speed?  Describe and explain how satellites can orbit the Earth in a (near) circular orbit at a steady speed even though they have a force at right angles accelerating them towards the Earth.  Draw a diagram to show the forces acting on a satellite in orbit around the Earth. | Use bung demonstration from above if it wasn’t shown already. You can extend this to show what happens to the force if a heavier mass bung is used. | [The Physics Classroom – Circular Motion Principles for Satellites](http://www.physicsclassroom.com/class/circles/Lesson-4/Circular-Motion-Principles-for-Satellites)  [BBC Bitesize – The Solar System](http://www.bbc.co.uk/education/guides/zk8hvcw/revision/4) |
| 4.8.1.3 | How the speed of a satellite affects its radius. HT only. | To stay in a stable orbit at a particular distance the smaller body, the planet or satellite, must move at a particular speed around the larger body it orbits. If the speed changes then the radius of the orbit must also change. | 0.3 | Explain how changing the speed of a satellite affects the orbital radius of the satellite.  Evaluate data on the orbital speeds of planets and use this to predict the orbital radius, assuming a circular orbit. | Investigate circular motion of an object using the set up below. | [Cyberphysics – Circular Motion](http://www.cyberphysics.co.uk/topics/forces/circular_motion.htm) (be selective, this page isn’t restricted to satellites) |

### 4.8.2 Red-shift (Physics only)

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment Opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.8.2 | The light from distant stars and galaxies shows red- shift. | There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies, the faster they are moving and the bigger the observed increase in wavelength. This effect is called red-shift. | 0.3 | Describe the absorption or emission spectrum of light from the Sun.  Explain how the absorption or emission spectrum of light from a similar star to the Sun differs from that of the Sun.  What is red-shift and what does it show?  Why does the pitch of a fire engine siren change as the fire engine comes towards you then moves away from you?  Explain how light is shifted towards the red end of the spectrum as the light source is moving away from us as the movement makes the wavelength longer.  Are all galaxies moving away from us at the same speed?  Explain why more distant stars would have a greater red-shift than nearby stars in terms of their speed. | Model red-shift by eg   * a small loudspeaker on the end of a string and swung in a circle.. * a sound file of an emergency services siren going away from a stationary observer   .  Demonstrate distant galaxies getting further away from you by using a balloon with some crosses on to represent galaxies and then inflate the balloon. | [BBC Bitesize – Red-shift](http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/origins/redshiftrev3.shtml)  Video clips  [Pass My Exams – Red Shift and the Expanding Universe](http://www.passmyexams.co.uk/GCSE/physics/the-expanding-universe-red-shift.html) |
| 4.8.2 | The red shift of light provides evidence for the Big Bang model (theory) for the creation of the universe. | The observed red-shift provides evidence that space itself (the universe) is expanding and supports the Big Bang theory. | 0.3 | How does red-shift provide evidence of the Big Bang?  Explain how the red-shift of distant stars and galaxies shows that they are moving away from us. This is evidence of the universe starting off from a small point in space and expanding outwards.  Describe the red-shift of light from distant stars and galaxies as evidence of the stars and galaxies moving away from us as the space between the stars and galaxies is expanding – not as the galaxies themselves getting bigger. The further away the light source is from us, the greater the amount of space between, that is expanding, and the faster the light source is moving away from us. | Research theories on the creation of the universe and outline the evidence that supports and disproves these theories.  . | [The Big Bang – NASA Science](http://science.nasa.gov/astrophysics/focus-areas/what-powered-the-big-bang/)  [BBC Universe | The Big Bang](http://www.bbc.co.uk/science/space/universe/questions_and_ideas/big_bang)  [Cyberphysics - Doppler Effect and Red Shift](http://www.cyberphysics.co.uk/topics/space/redshift.htm)  [Pass My Exams – Red Shift and the Expanding Universe](http://www.passmyexams.co.uk/GCSE/physics/the-expanding-universe-red-shift.html) |
| 4.8.2 | How the universe began according to the Big Bang theory. | The Big Bang theory suggests that the universe began from a very small region that was extremely hot and dense.  Since 1998 onwards, observations of supernovae suggest that distant galaxies are receding ever faster. | 0.6 | How did the universe begin?  Describe how efforts to measure red-shift have advanced through the use of space telescopes and telescopes that are ground-based.  Why do radio-based telescopes have to be larger than the other types?  Why are X-ray telescopes not used on Earth?  That there is still much about the universe that is not understood, for example dark mass and dark energy. | How have observations of space improved over the last one hundred years? | [BBC Universe | Hubble Space Telescope](http://www.bbc.co.uk/science/space/universe/exploration/hubble_space_telescope)  [Pass My Exams – Hubble Space Telescope (HST), X-ray Telescopes, Gamma Ray Telescopes](http://www.passmyexams.co.uk/GCSE/physics/space-based-telescopes-hubble-x-ray-telescope-gamma-ray-telescope.html)  [Pass My Exams – Earth Based Telescopes – Radio Telescopes](http://www.passmyexams.co.uk/GCSE/physics/earth-based-telescopes-radio-telescopes.html) |