Answers: P8.5 – Life cycles of stars

Connection

1 star that fuses hydrogen in its core, in which the gravitational forces inwards are balanced by the pressure of the nuclear fusion reactions outwards
2 The force from gravity and the force from the fusion reaction
3 As the mass increases so does the surface temperature

Demonstration

1 The life cycle a star follows depends on its mass.
2 When there is no longer enough hydrogen in its core to fuse into helium.
3 After the Sun's red giant phase, its outer layers expand to form a planetary nebula and its core contracts to form a white dwarf star. The white dwarf cools down over billions of years to become a black dwarf.
4 The gravitational force is very large which means the temperature at their core becomes very high. This means that the nuclear reactions occur at a much faster rate.
5 A red supergiant will eventually explode as a supernova. The core will collapse to form a neutron star or a black hole.
6 The outer layers ejected by the star as a supernova will eventually contract to form new stars.
7 We understand how stars work and the laws of physics that they follow. Therefore, we can calculate how they will evolve in the future. There are also many stars at different stages of their lives so we can compare similar stars that are at different ages. Therefore, we can see what the younger stars will be like when they are older.

Lesson 6: P8.6 – How the elements are formed

Connection

Q1. What is a nebula?

Q2. What will our star end up turning into?

Q3. Describe how uranium would be formed?

Activation

LI: understand how new elements are produced by nuclear fusion inside a star

1. https://www.youtube.com/watch?v=YIKXvDlf8_0
2. Make a note of the title and the LI
3. Read pages 286-287
4. Define “nuclear fusion” using the glossary
5. Draw and label fig 8.23
6. Draw and label fig 8.24
7. Use section three to describe how a supernova creates elements heavier than Iron.

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P8 DIP file

Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: P8.6 – How the elements are formed

Connection

1 a huge cloud of dust and gas from which stars are formed
2 Our star will turn into a red giant then a white dwarf then a black dwarf
3 Large nebula → Protostar → Star → Red super giant → supernova → either a neutron star or black hole

Demonstration

1 The early Universe was like the core of a star, so fusion reactions happened in the Universe itself, fusing hydrogen into helium.
2 It formed stars from the early clouds of gas.
3a At the centre of the star.
3b The temperature is not hot enough for fusion to take place in the other parts of the Sun.
4 It expands to become a red giant or a red supergiant. The helium at the core of the star starts fusing into heavier elements.
5 Lighter nuclei fuse together to form heavier nuclei and so a new element. As a heavier element is formed eventually it fuses to form an even heavier element and so a series of elements are created.
6 Fusing nuclei together to form heavier elements gives out energy until you get to iron. Energy is needed when elements are formed that are heavier than iron. This makes the star cool down and the fusion reactions quickly stop.
7 You need a lot of energy to form the heavier elements, which is only present during a supernova.
8 Elements heavier than iron were formed when a previous star (or stars) exploded as a supernova. These elements were dispersed into space and became part of the cloud of dust and gas that eventually formed the protostar that became the Sun.

Lesson 7 P8.7 – Red-shift

Connection

Q1. What was in the early universe?

Q2. How would uranium be formed?

Q3. Why does fusion stop in massive stars when it gets to Iron?

Activation

LI: Explain the process of cell differentiation and give some examples

1. https://www.youtube.com/watch?v=ikgRZt1BSyk
2. Make a note of the title and the LI
3. Read pages 288-289
4. Define “Red-shift” using the glossary
5. Draw and label figure 8.25
6. Stick in and label figure 8.26 from the next slide
7. https://www.youtube.com/watch?v=t9276Lk_Ipg
8. How does red shift show that the universe is expanding?

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P8 DIP file

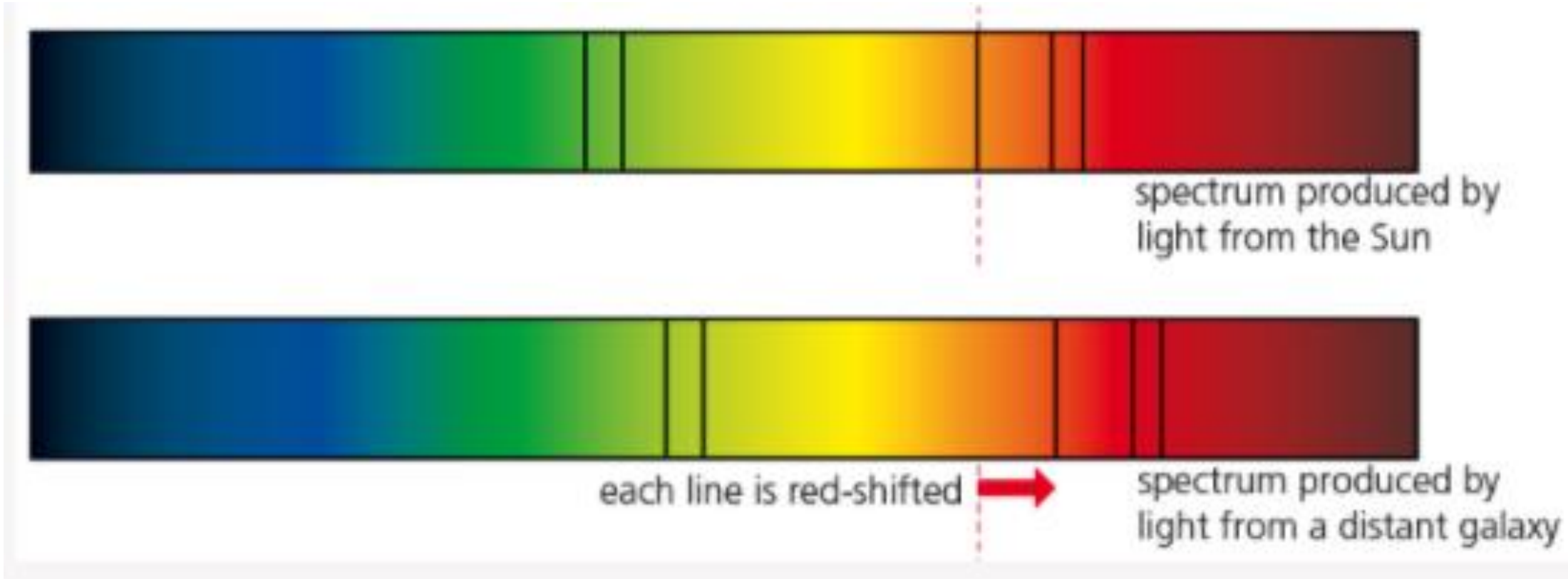
Demonstration

Attempt questions 1-8
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher


spectrum produced by
light from the Sun
each line is red-shifted
spectrum produced by
light from a distant galaxy

Answers: P8.7 – Red-shift

Connection

1 Clouds of hydrogen and helium
2 Uranium is formed from fusion resulting from the intense heat and pressure in supernova
3 Iron does not release energy when it fuses.

Demonstration

1 The light emitted from an object has its wavelengths stretched.
2 It tells us the galaxies are moving away from us.
3 Hubble discovered that the speed that a galaxy is moving away from us is directly proportional to its distance away.
4 This suggests that our Universe is expanding.
5 Observations allow us to test that the Universe behaves in a way that we would expect according to current theories. If the observations do not agree with the theory, then we need to develop the theory or produce an alternative theory that fits in with all of the observations. Therefore, theories develop over time as more observations are made.
6 The Big Bang theory describes the Universe as starting at a very small, very dense and very hot point. It then started to expand at the Big Bang and it has been expanding ever since.
7 It is impossible to tell because all the galaxies would be moving away from us wherever we are in the Universe.
8 They found that the mass of the universe was much heavier than the combined mass of all of the objects that they knew about. This suggests that there must be a lot of other matter out there (called dark matter).

Lesson 8: P8.8 – Gravity: the force that binds the Universe

Connection

Q1. What is red shift?

Q2. What percentage of the universe is visible matter? Dark matter? Dark energy?

Q3. How does red shift show that the universe is expanding?

Activation

LI: understand that gravity provides the force that keeps planets and satellites in orbits

1. https://www.youtube.com/watch?v=LvOhIRlVDb8
2. Make a note of the title and the LI
3. Read pages 290-291
4. Draw figure 8.30 and 8.31
5. https://www.youtube.com/watch?v=OTMELHUAzSM&t=6s
6. Compare the equations for force using newtons second law and the equation for weight
7. Copy the table from the next slide and calculate your weight on different planets, which is the force due to gravity.

Demonstration

Attempt questions 1-4
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P8 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

How much would you weigh on other planets?

My mass is _____ kg

Place	Gravitational pull (N/kg)	My mass (kg)	My weight (N)
Earth	10		
Mars	3.8		
Saturn	11.9		
Jupiter	26.9		
Neptune	12.2		
The Moon	1.6		
Mercury	3.6		
Venus	8.9		
Uranus	10.7		

Answers: P8.8 – Gravity: the force that binds the Universe

Connection

1 light from receding galaxies are doppler shifted to the red end of the light spectrum
2 Visible matter - 4%
Dark matter – 22%
Dark Energy – 74%
3 Distant galaxies are moving away from us in all directions, the further the galaxy, is more red shifted their light is.

Demonstration

1 All of them. Anything that has a mass can exert a force of gravity.
2 Gravity forms galaxies, stars and planets.
3 Our weight is the force of gravity on us, so the stronger the force of gravity the more our weight.
4a Weight = mass × g = 1000 × 9.81 = 9810 N
4b a = F / m = 9810 / 1000 = 9.81 m/s^2
4c Yes – all objects will fall to the ground with an acceleration = g (assuming that there is no air resistance)

P8 - Revision

Connection

Q1. Draw an equation triangle for newtons second law

Q2. What are the units of force? Mass? Acceleration?

Q3. If a person of mass 100kg experiences a force from gravity of an unknown planet of 2500N, what is the acceleration due to gravity?

Activation

LI: Create a topic summary sheet

1. Fold an A3 sheet so it is divided into 8 sections
2. Look back over you lesson and group them into 8 main headings
3. Summarise the key points into each section, use keywords and diagrams and symbols rather than sentences

Consolidation

Look though the relevant past paper questions for this topic - From the P8 DIP file – see if you can complete any additional questions

Demonstration

Test yourself by working with the person sitting next to you by talking though each box on your summary sheet and seeing how many key facts you can remember

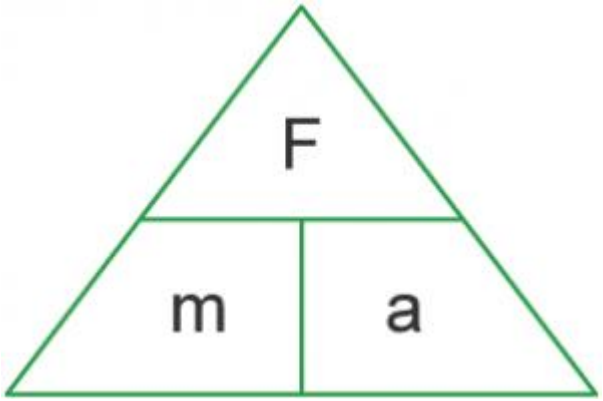
Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: Lesson 9

Connection

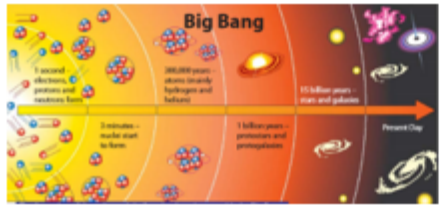
1



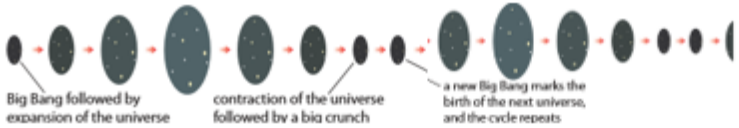
2 Force - Newtons, Mass – kilograms, acceleration – meters per second squared.

3 a=f/m=2500N/100kg=25m/s^2

DART P8 – The Universe – Past, Present and Future

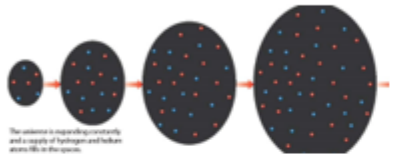


There are several theories of the universe. The Big Bang theory states that an enormous amount of concentrated energy and matter appeared suddenly. Nothing existed before this moment. The universe started off very small and has expanded ever since. Gravity caused stars to form by attracting together hydrogen and helium atoms. Gravity is also gradually slowing down the expansion. The future is uncertain. The universe may carry on expanding, stop expanding or it might contract and eventually implode – the big crunch.



Some people find it difficult to visualise that there was nothing before the Big Bang. The oscillating theory of the universe suggests that the creation of this universe followed the death of the last universe. The cycle repeats itself, with a series of universes, one after the other.

In the steady-state theory the appearance of the universe has never changed and never will. It assumes that the universe is expanding but does not accept that the matter in the universe occupies an ever-increasing volume. It states that as the universe expands a supply of hydrogen and helium atoms fills in the spaces.



The overall result of this is that the same amount of matter would occupy a particular volume at any time. Edwin Hubble showed that distant galaxies were moving away from us and each other. The colour of light from these galaxies was shifted towards the red end of the visible spectrum. This is called red shift. For instance, you might expect to see the colour blue but instead see yellow, which is nearer the red end of the spectrum than blue. Red shift happens if a light-emitting object is moving away from you. The further a galaxy is away from us, the faster it is moving. The light from very distant galaxies is red-shifted more. Hubble's observations are evidence for an expanding universe. Penzias and Wilson were collecting radio signals. They noticed that they were picking up microwaves which were coming equally from everywhere in space. Microwave energy is what is left as the universe cools down from once being very hot. It is like going into a room a long time after the heating has been turned off. There will still be a little warmth left.

References:

https://www.space.com/52-the-expanding-universe-from-the-big-bang-to-today.html

https://www.nasa.gov/topics/solarsystem

Universal: A Journey Through the Cosmos; Cox et al; 2017

QUESTIONS

1a According to the Big Bang theory, what was there before the Big Bang?

1b State the Big Bang Theory.

1c Describe the role of Gravity in the formation of stars.

2a Describe what may happen to the universe in the 'big crunch'.

2b Explain what is meant by an oscillating universe.

2c Density measures how much matter there is in a particular volume. Explain why the density of the universe remains roughly constant in the steady-state theory.

3a State one difference between the Big Bang and the steady state theories of the universe.

3b. Explain whether the oscillating universe is an extension of the Big Bang or the steady-state theory.

3c. Describe and explain how the work of Edwin Hubble and other scientists provided evidence for the Big Bang Theory.

ANSWERS - P8 DART - The universe

1a Nothing existed before this moment.

1b. The Big Bang theory states that an enormous amount of concentrated energy and matter appeared suddenly. The universe started off very small and has expanded ever since.

1c. Gravity caused stars to form by attracting together hydrogen and helium atoms. Gravity is also gradually slowing down the expansion.

2a The universe may carry on expanding, stop expanding or it might contract and eventually implode

2b The oscillating theory of the universe suggests that the creation of this universe followed the death of the last universe. The cycle repeats itself, with a series of universes, one after the other.

2c As the universe expands a supply of hydrogen and helium atoms fills in the spaces. The overall result of this is that the same amount of matter would occupy a particular volume at any time.

3a In the steady-state theory the appearance of the universe has never changed and never will whereas in the Big Bang theory the universe started off very small and has expanded ever since.

3b Students can come to their own conclusion giving reasons. Suggested answer: The oscillating theory of the universe states that the death of the universe is followed by the birth of a new one in a cyclic pattern. It is a closer match to the big bang theory because the death of a universe could mean nothingness and the birth suggests a future expansion which fits in with the Big Bang theory.

3c. Students should the information in the last paragraph to help them summarise the science behind the evidence.

‘Edwin Hubble showed that distant galaxies were moving away from us and each other. The colour of light from these galaxies was shifted towards the red end of the visible spectrum. This is called red shift.. Red shift happens if a light-emitting object is moving away from you. The further a galaxy is away from us, the faster it is moving. The light from very distant galaxies is red-shifted more. Hubble’s observations are evidence for an expanding universe. Penzias and Wilson were collecting radio signals. They noticed that they were picking up microwaves which were coming equally from everywhere in space. Microwave energy is what is left as the universe cools down from once being very hot.’

Attainment Band :	P8 Space (AQA) Knowledge and Understanding
Yellow Plus/ Yellow	Describe the relationship between a solar system and a galaxy. Explain the balance of forces in a stable star. Explain the role of fusion in the life cycle of a star. Explain the role of fusion in the formation of elements. Explain the relationship between speed and radius in stable orbits Explain how in a stable orbit that speed is constant but that velocity is changing. Explain what this evidence suggests about the Universe. Recognise that scientists are still developing explanations around the ideas of dark energy and dark matter.
Blue	Describe how moons are arranged in the Solar System in relation to planets. Explain the role of gravity in star formation. Describe the stages in the life cycle of a star similar in size to our Sun and of a star much larger than our Sun. Explain how heavy elements become distributed throughout the Universe. Explain the role of gravity in enabling objects to describe circular orbits. Recall that more distant galaxies are travelling away faster. Explain how red-shift provides evidence for the Big Bang.
Green	Describe how planets and dwarf planets are arranged in the Solar System. Recall what stars are formed from. Recall that stars go through a life cycle. Recall that elements heavier than iron are produced in a supernova. Compare the orbital motions of planets, moons and artificial satellites. Recall that an observed increase in wavelength of light results in red-shift. Recall that the Big Bang suggests the Universe started from a small dense region
White	Some elements of the above have been achieved