Student book answers

6.1 The universe was studied by early Australians

Pages 140–141

Extend your understanding 6.1

1 What is the difference between a galaxy and a constellation?

A galaxy is a group of stars held together by gravity. A constellation is a group of stars that form a picture in the night sky.

2 How could the Indigenous people use the sky as a calendar? Provide two examples to support your answer.

The Indigenous people used the appearance of certain constellations in the sky to tell them when or what to hunt. Examples include: if the emu in sky appeared to be running on the horizon, then it was time to hunt emus; if the emu appeared to be sitting down, then it was time to collect the emu’s eggs; the appearance of a Malleefowl constellation signalled that the bird was building a nest; and when the Malleefowl constellation disappeared from the sky, it was time to collect eggs.

3 What is our galaxy? What does it look like in the night sky?

Earth is in the Milky Way galaxy. It appear as a milky streak across the sky.

4 Is Orion a galaxy or a constellation? What features help you to find Orion in the night sky?

Orion is a constellation. It is a group of three stars with a ‘cloud’ of stars nearby.

5 Why might there be different stories about Orion from the Indigenous peoples across Australia?

Indigenous people live in different groups across Australia. Each group had their own stories about the constellations in the sky.

6 Why can’t we see individual stars from other galaxies at night?

A galaxy is a group of stars held together by gravity. They are too far away to see individual stars.

Student book answers

6.2 The Earth is in the Milky Way

Pages 142–143

Check your learning 6.2

Remember and understand

1 What is a:

a star A giant ball of hot glowing gases

b galaxy A group of stars held together by gravity

c light-year? The distance travelled by light in one year

2 What is a main sequence star?

A main sequence star has temperature and absolute magnitude that fall within a narrow band on the Hertzsprung–Russell diagram.

3 What is meant by the term ‘parallax’?

Parallax is when stars appear to move different amounts when they are viewed from different positions because the stars are different distances away.

Apply and analyse

4 Why does the Milky Way galaxy appear so large in the night sky compared with other galaxies?

Earth is part of the Milky Way galaxy; therefore, it appears larger than galaxies that are further away.

5 If a star that was 20 light-years away exploded right now, when would we see it exploding?

20 years after exploding

Student book answers

6.3 Stars have a life cycle

Pages 144–145

Check your learning 6.3

Remember and understand

1 What event marks the birth of a star?

The fusion of two hydrogen atoms together forms helium. The large amounts of energy are released in the form of heat and light.

2 Why are most stars ‘main sequence’ stars?

Main sequence stars are stars that fuse hydrogen atoms to form helium atoms, and produce heat and light in a narrow range. Stars spend more time doing this type of nuclear fusion; therefore, more stars are in this category.

3 What is left after a supernova?

The core remaining after a supernova is thought to be composed of dense neutrons.

Apply and analyse

4 Draw a flow chart to show the life cycle of a star the size of our Sun.

Students’ flow charts should include gas nebula, protostar, main sequence star, red giant star, variable star and white dwarf.

5 Blue stars are much larger than our Sun. However, they do not have enough energy to explode. Draw a flow chart to show the life cycle of a blue star.

Students’ flow charts should include gas nebula, protostar, main sequence star, red giant star, variable star and nebula.

Student book answers

6.4 The galaxies are moving apart

Pages 146–147

Check your learning 6.4

Remember and understand

1 How would you know you were looking at an absorption spectrum?

When you are looking at an absorption spectrum, you are seeing a full spectrum of colours with black lines present.

Apply and analyse

2 How are the emission and absorption spectra for helium similar?

The missing (black) lines on the absorption spectrum for helium would be the same as the coloured lines on the emission spectrum for helium.

3 How does red-shifted light show that a galaxy is moving away from us?

Red light has a lower frequency than blue light, so the colours of light that have been absorbed would appear to have shifted towards the red end of the spectrum when a galaxy is moving away from us.

4 Figure 6.16 shows the spectra observed from three stars. Star A is at a fixed distance from the Earth, whereas stars B and C are moving.

a What produces the dark lines on each spectrum?

The dark lines are the colours (frequencies) of light that have been absorbed by a gas, usually located around the stars.

b Which star, B or C, is moving towards the Earth? Explain your answer.

Star C is moving towards the Earth as the absorption spectrum is shifted to the blue end.

Student book answers

6.5 The Big Bang theory is supported by evidence

Pages 148–149

Check your learning 6.5

Remember and understand

1 Why is the Big Bang not a bang at all?

The Big Bang is the rapid expansion of the universe that occurred silently.

2 Write a description of the Big Bang theory.

The Big Bang theory is the idea (supported by evidence) that the universe started from a single location and rapidly exploded, causing all energy and matter to be thrown outwards.

Apply and analyse

3 A theory is never final. Evidence is always needed to reinforce a theory. The Planck satellite was designed to examine cosmic microwave background radiation. How do you think evidence obtained from the Planck satellite will help support the Big Bang theory?

The increased detail of cosmic microwave background radiation and its distribution that the Plank satellite is discovering support the Big Bang theory by mapping the fluctuations in the cosmic background radiation. These fluctuations have been found to correlate with the formation of nearby matter.

4 What is cosmic microwave background radiation? Why is its existence important?

Cosmic microwave background radiation is the electromagnetic radiation energy left from the Big Bang. This energy was converted into elementary matter, causing correlating fluctuations in the background radiation. This provides evidence that supports that the Big Bang started with explosive energy.

5 Cosmic microwave background radiation has been called ‘ancient whispers’. Why is this name appropriate?

The cosmic microwave background radiation detected was produced about 14 billion years ago, and is certainly ancient. It can be thought of as whispers as the intensity of this radiation has reduced over the years to a very low level.

6 What other evidence supports the Big Bang?

The proportion of lighter mass elements such as hydrogen correlate with the fluctuations in the cosmic microwave background radiation. The observations of distant galaxies provide a glimpse into how stars originally formed.

Student book answers

6.6 Technology aids cosmological research

Pages 150–151

Extend your understanding 6.6

1 Why was ASKAP built in Murchison, Western Australia?

Murchison is a four-hour drive from the port city of Geraldton. This is away from the light pollution of built-up populations.

2 What benefits are there in having so many countries involved with the ASKAP?

International collaboration allows a range of scientists with different training and abilities to work together, increasing the depth of analysis that is possible.

3 Other than astronomers, what other researchers work on the ASKAP program?

Students’ answers may include engineers, mathematicians and chemists.

4 Why are supercomputers needed to interpret the data from the ASKAP?

There is a large amount of raw data collected (10 gigabytes per second) by the ASKAP. A supercomputer is needed to interpret and analyse this data.

5 What are the researchers using the ASKAP hoping to find?

Researchers are hoping to determine more detail about where galaxies come from, how planets formed and how the universe evolved.

Student book answers

Review 6

Pages 152–153

Remember and understand

1 Match each word in the left column with its correct meaning in the right column.

Sun groups of stars that are close together in the sky

galaxy theory of the creation of the universe in a huge explosion-like event

star chart everything that exists in space

constellation huge collection of stars held together by gravity

universe used to locate and identify objects in the night sky

Big Bang our closest star

Sun – our closest star

Galaxy – huge collection of stars held together by gravity

Star chart – used to locate and identify objects in the sky

Constellation – a group of stars that are close together in the sky

Universe – everything that exists in space

Big Bang – theory of the creation of the universe in a huge explosion-like event

2 What is the main difference between astronomy and astrology?

Astrology is the belief that the movement of celestial bodies and their relative positions can affect human behavior on Earth. Astronomy is the scientific study and documentation of the universe, including the movements and features of celestial bodies.

3 What are scientists Penzias and Wilson famous for discovering?

Penzias and Wilson are famous for discovering cosmic microwave background radiation.

4 Decide whether the following statements are true or false.

a All stars are yellow and very hot.

False – stars can appear as a range of colours and temperatures.

b All galaxies are the same shape and size.

False – stars are all spherical but can be a range of sizes.

c The brightness of a star when viewed from the Earth is its absolute magnitude.

False – the brightness of a star when viewed from Earth is the apparent magnitude.

d Bigger stars are usually hotter, brighter and burn for longer than smaller stars.

False – smaller stars are usually hotter, dimmer and burn for longer.

5 Why are light-years used instead of kilometres as a unit of distance?

Light-years are used instead of kilometres because of the vast distances in space.

6 Explain why it is difficult to judge the distance of a star by measuring only its brightness.

Different stars emit different amounts of light, so it is difficult to measure the distance of a star due to its brightness alone.

7 How does the night sky enable us to look back in time?

The night sky enables us to look back in time as light from the universe, which takes time to arrive on Earth, shows images of events that have happened in the past.

8 List the following in order of size from the largest to the smallest: neutron star, the Sun, white dwarf, red giant.

Red giant, the Sun, white dwarf, neutron star

9 State two differences between a white dwarf and a red giant.

A white dwarf is smaller and has a hotter surface than a red giant.

10 Explain why the ASKAP is an important tool for astronomers.

The ASKAP will provide answers to questions about the universe that are still unanswered.

Apply and analyse

11 Briefly describe the Doppler effect.

In the Doppler effect, when a moving object sends out a wave (sound or light), the frequency in front of the object is increased (the higher pitch or blue shifted) and the frequency behind the object is decreased (lower pitch or red shifted).

12 What was the link between Hubble’s observations and the Doppler effect?

The link between Hubble’s observations and the Doppler effect is that the further away a galaxy is, the more red shifted the spectrum. Therefore, the further away a galaxy, the faster it is moving away from the Earth.

13 Why can’t you see stars (apart from the Sun) during the day?

Stars are present during the day, but as the Sun is the brightest object in the sky, due to its proximity, it prevents the other stars from being seen.

14 Draw a diagram to show why different stars are visible from different places on the Earth’s surface.

Students’ answers will vary.

Evaluate and create

15 Many ancient cultures had legends about the origin of constellations. Investigate Koori, Polynesian or Ancient Greek legends about constellations. Do these legends still influence how we view and understand the constellations today?

Students’ answers will vary.

16 a How does the pitch of an ambulance siren change as it races past you?

The pitch becomes lower.

b Why does the change occur?

The sound waves become more spread out as the ambulance moves away from the viewer.

c Would the driver of the ambulance hear this change?

No, the ambulance driver does not change position in relation to the siren.

17 If the Sun is 149 600 000 km from the Earth and light travels at 300 000 km/s, calculate how long it takes for light to reach us from the Sun. Express your answer in minutes.

Time taken for light to reach us from the Sun: 499 seconds = 8.3 minutes

18 How many kilometres from Earth is each of these celestial objects.

a Star Altair at 16.7 light-years 1.57 × 1014 km

b Coalsack nebula at 600 light-years 5.68 × 1015 km

c Jewelbox star cluster at 7600 light-years 7.19 × 1016 km

19 If the speed of light is 300 000 km/s, what is the distance does light travel in:

a 1 second? 300 000 km

b 1 minute? 18 000 000 km

c 1 hour? 1.08 × 109 km

d 1 day? 2.59 × 1010 km

20 Why don’t we use light-years for measuring distances within our solar system?

The distances within our solar system are relatively small and so it is appropriate to use kilometres as a measure of distance. For instance, it only takes a few hours for light to travel from the Sun to Pluto.

Critical and creative thinking

21 Create a poster showing the fate of the Sun as it expands from its current size into a red giant and then as it contracts size into a white dwarf. Label each stage and find photos from the Internet to illustrate the process. View a space movie. What is the plot? Create a poster showing what things in the movie are scientifically correct and what things are not.

Students’ answers will vary.

22 On 27 September 2007 the space probe Dawn was launched from Cape Canaveral at a cost of US$357 million, excluding the cost of the rocket (Figure 6.19). Dawn’s 4.8 billion kilometer 8-year journey included the exploration of the asteroid Vesta in 2011 and the dwarf planet Ceres, between Mars and Jupiter, in 2015. Humans hunger for knowledge. But does this knowledge enhance our civilization? And is space exploration vital to our survival.

Students’ answers will vary.

23 Watch the movie Interstellar and research how the discovery of gravitational waves would help us to understand the nature of dark energy which is causing the Universe’s expansion to accelerate. Have a class discussion about this.

Students’ answers will vary.

Research

24 Choose one of the following topics for a research project. Present your report in a format of your own choosing.

Dark matter

Scientists think that there is extra matter in the universe that is invisible. This is called dark matter. What is the difference between ordinary matter and dark matter? What evidence do scientists have for the existence of dark matter? What is the composition of dark matter? Scientists believe that the universe started from the Big Bang and that it will expand before gravitational forces pull it back in to start the entire process all over again. What effect does dark matter have on the future of our universe?

Ion propulsion

The engines on some spacecraft use a unique, hyper-efficient system called ion propulsion. What is an ion? Can such an engine lift a spaceship from the Earth’s surface? Why? What is the fuel used? How does this fuel produce thrust? Why are large solar collectors necessary? What is the thrust produced by the engines?

Australian observatories

The Parkes Radio Telescope is a well-known Australian telescope. Find out a brief history of this telescope and what it is used for. The movie The Dishmight be helpful in your research.

Australian scientist

Australian scientist Penny Sackett has lead teams of scientists in researching the exoplanets similar to earth. What is an exoplanet? How do astronomers search for them?

Students’ answers will vary.