

THEME

4

Earth and Space Exploration



- How do humans explore the Earth and the outer space?
- What are the technologies used by humans to explore the Earth and the outer space?
- Are there any other planets in the solar system capable of supporting life?
- What would happen to the Earth if it is hit by a meteoroid, asteroid or comet?

Stars and Galaxies in the Universe

What do galaxies mean?

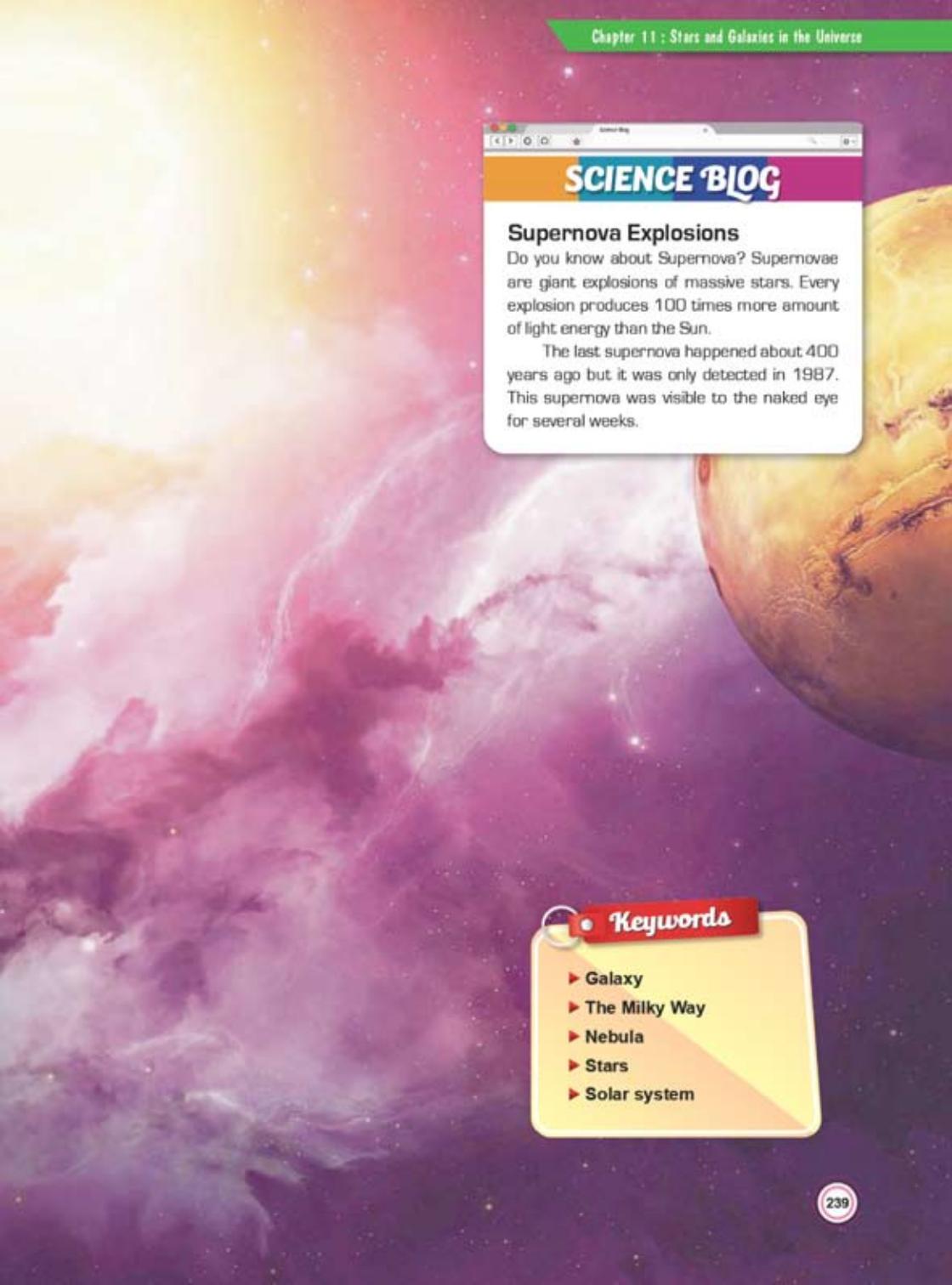
Where is our solar system located?

How do the formation and death of stars happen?

How do the stars in space differ from each other?

Let's understand:

- Stars and galaxies in the universe



SCIENCE BLOG

Supernova Explosions

Do you know about Supernova? Supernovae are giant explosions of massive stars. Every explosion produces 100 times more amount of light energy than the Sun.

The last supernova happened about 400 years ago but it was only detected in 1987. This supernova was visible to the naked eye for several weeks.

Keywords

- ▶ Galaxy
- ▶ The Milky Way
- ▶ Nebula
- ▶ Stars
- ▶ Solar system

The universe consists of every existing thing around us. Do you know that there are many objects in space which you may have never seen or known of their existence? The study of astronomy has raised our awareness of the beauty and vastness of God's creation of the universe.



My Malaysia!

Dato' Dr. Sheikh Muszaphar Shukor was the first Malaysian to venture into outer space on the 10th of October 2007.



Photograph 11.1 The Earth

Technology plays an important role in the study of outer space.



That's right! The invention of technological devices helps us to get a clearer picture about the universe.

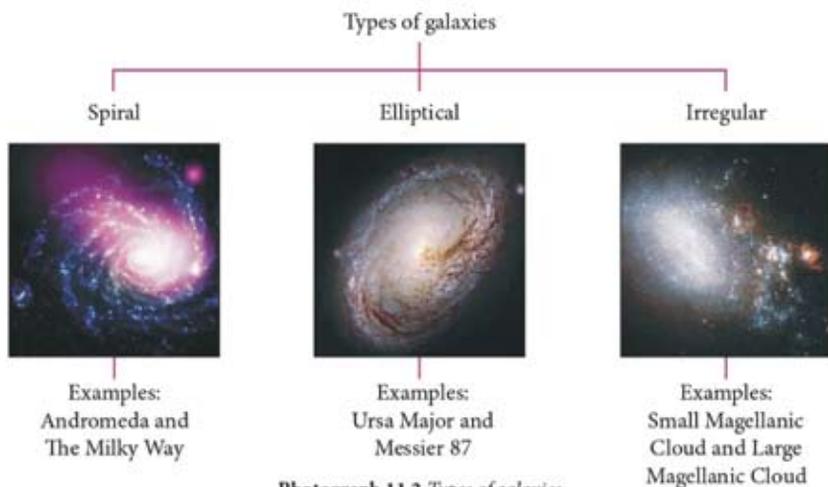
Science Info

- The Hubble space telescope was launched on the 24th of April 1990.
- This telescope is so powerful that it could see a coin from 725 km away!

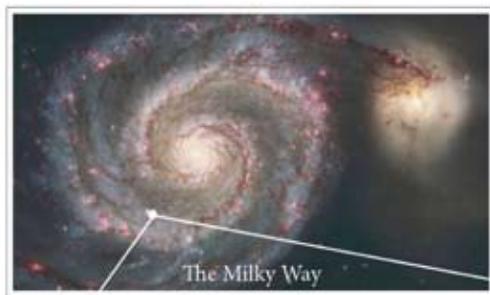


Galaxies

There are millions of galaxies in the universe. What do galaxies mean? A **galaxy** is a set of bodies consisting of millions of stars with gas and dust particles. Galaxies come in many forms, such as **spiral galaxies**, **elliptical galaxies** and **irregular galaxies** (Photograph 11.2). Our solar system is situated in the **Milky Way galaxy** (Photograph 11.3).

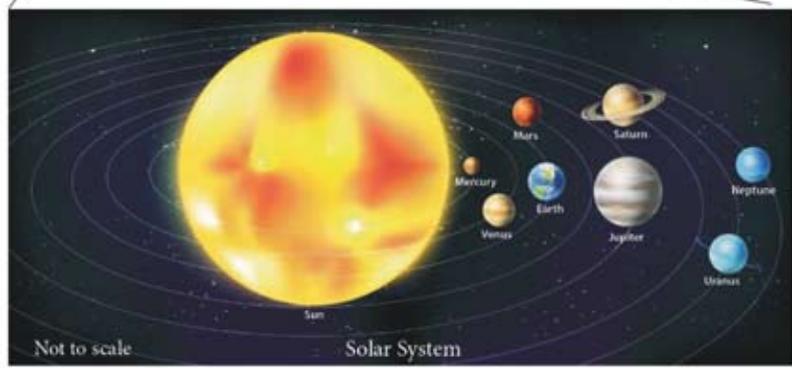


Photograph 11.2 *Types of galaxies*



THE MILKY WAY

- The Milky Way is a medium large spiral galaxy.
- Our solar system is located at the edge of one of the spiral arms of the Milky Way.
- The Milky Way consists of approximately 200 billion stars and the Sun is one of it.



Photograph 11.3 *The location of our solar system within the Milky Way galaxy*

Birth of Stars

Stars are formed from **nebulae**. Nebulae are large clouds consisting of dust particles and gases such as hydrogen and helium.

- The gases and dust particles in a nebula are pulled by a **strong gravitational force** which causes it to form a globe.
- The strong gravitational force causes the globe of gas to shrink and compress until it becomes very dense and forms a **core**.
- The core **shrinks** and becomes **dense** due to the increasing strength of the gravitational force.
- When the temperature and pressure in the core become too high, a nuclear reaction will take place. **Hydrogen gas** turns into helium. A huge amount of heat energy and light is released.
- The core will shine and a **star** is formed.
- The star that is formed is known as a protostar.
- This new star continues to expand and becomes either an **average star** like the Sun or a **massive star**.

Death of Stars

In a star, a lot of heat is generated which will heat up the outermost layer of the star. As a result, hydrogen within this layer starts to burn. This causes the star to expand. During this stage, the star appears red in colour and is called a **red giant**.

If the red giant is not massive, a white dwarf is formed. However, if the red giant is big enough, it contracts so quickly that a big explosion called a **supernova** occurs. A supernova is extremely bright. It can be seen in daylight. As a result of the explosion, a **neutron star** is formed if the original star is a large star. If the original star is a super-large star, a **black hole** is formed. It is called a black hole because light in it cannot escape. Any matter that enters it cannot escape too.



My Malaysia!

In early 2017, Nur Adlyka Ainul Annuar made Malaysia proud by being one of the world's astronomers who successfully proved the existence of a supermassive black hole that is hidden within the cosmic universe circle.



Brain

Teaser

Predict the effects if the Sun runs out of hydrogen in its core.

Relative Size Comparison between the Earth and the Universe

The universe is beautiful and unique. There are millions of galaxies in the universe. The Milky Way is one of the many galaxies in the universe. In the Milky Way, there is a solar system which consists of eight planets that orbit the Sun, and this includes the Earth where we live in.

The Earth is smaller than a speck of dust in the universe. Can you imagine how vast this universe created by God is? We can never see the end of it. We should be thankful for the beauty of this universe which is a symbol of God's supremacy.

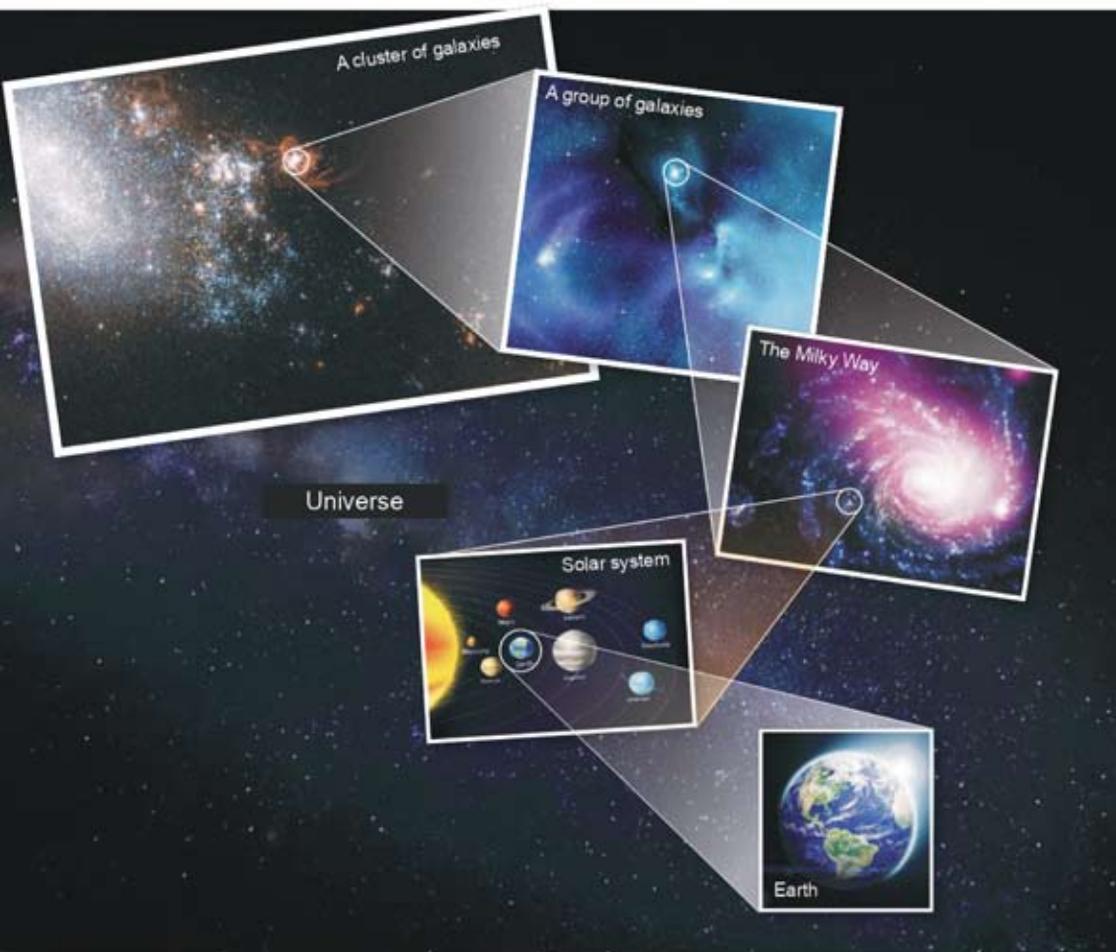


Figure 11.2 Comparison of relative sizes of the Earth, the solar system, the Milky Way, galaxies and the universe

Characteristics of Stars

Have you ever observed the stars in the sky at night? If you look closely, some stars appear bright while some appear dim. These stars can be classified based on the following characteristics.

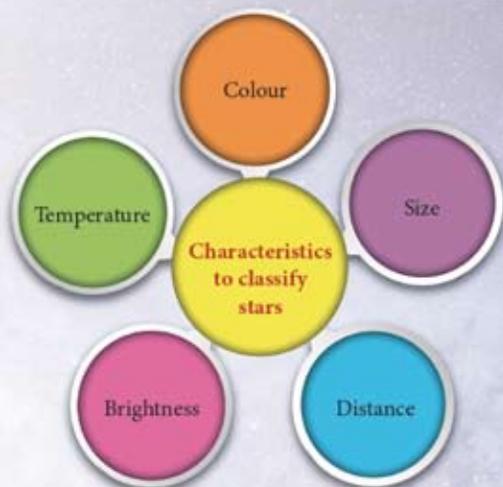


Figure 11.3 Characteristics to classify stars

Generally, stars have colours that correspond to its surface temperature which ranges from a lower to higher temperature. Table 11.1 shows the classification of stars based on **colour** and **temperature**.

Table 11.1 Classification of stars based on colour and temperature

Colour							
	Red	Orange	Yellow	Yellowish-white	White	Bluish-white	Blue
Temperature (K)	<3 500	3 500 – 5 000	5 000 – 6 000	6 000 – 7 500	7 500 – 11 000	11 000 – 25 000	>25 000



Figure 11.4 Temperatures of stars for comparison

Stars have different **sizes**; the really big ones are called supergiant stars, big stars are called giant stars while the really small ones are called dwarf stars (Figure 11.5). The **brightness** of a star depends on its size, **distance** and surface temperature. The brightest stars in the sky are **Sirius** and **Rigel**.

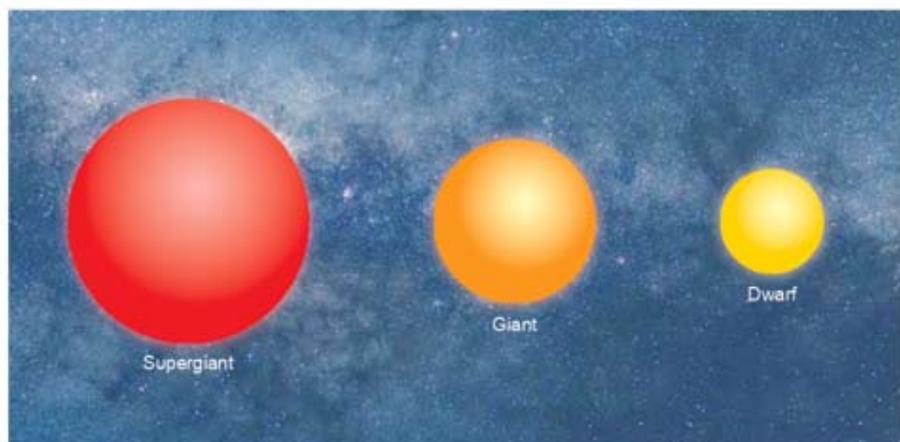


Figure 11.5 Sizes of stars

Activity 11.1

21
Century

Aim: To gather information on the characteristics of stars.

Instruction

1. Work in groups.
2. Surf the following websites by scanning the QR codes given.

(a)



Info

Skychart

<http://astronomynow.com/uk-sky-chart/>

(b)



Info

Stellarium

<http://www.stellarium.org/>

3. Gather information on the similarities and differences between stars.
4. Present the information gathered.

Activity 11.2

Aim: To observe objects in the sky at night and at daytime.

Instruction

1. You are required to participate in a trip organised by your teacher to the Observatory Station or the National Planetarium.
2. Collect information about:
 - (a) the characteristics of stars
 - (b) the birth and death of stars
 - (c) types of galaxies
3. Note everything down in your science journal.



Photograph 11.4 National Planetarium, Kuala Lumpur



Photograph 11.5 Melaka Planetarium Adventure Science Centre

My Malaysia!

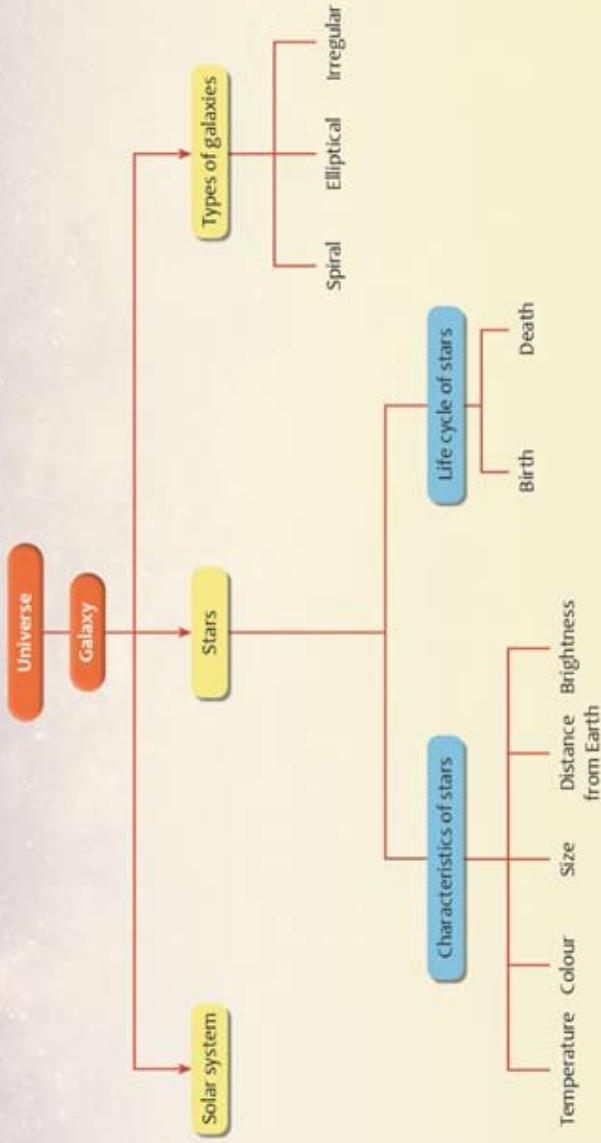
The National Planetarium was officially opened in 1994 as a space science education facility for the public. The design of this facility is very unique, as it is a combination of Islamic architecture and astronomy.



National Planetarium
<http://www.planetariumnegara.gov.my>

Formative Practice 11.1

1. What does a galaxy mean?
2. Describe the birth of a star.
3. Predict the effects that will happen to the solar system when the Sun dies.
4. What are the characteristics to classify stars?
5. Based on observation on Earth, how can the temperature of a star be determined?



Interactive Quiz 11

Quiz



SELF-REFLECTION

After learning this chapter, you are able to:

11.1 Stars and galaxies in the universe

- Communicate the characteristics of objects in space.
- Compare and contrast the characteristics of stars (including the Sun) and relate them to the observation of stars on Earth.

Summative Practice 11

1. Photograph 1 shows an object that is located in a galaxy.

- (a) Name the object.
- (b) What is the surface temperature range of this object?
- (c) This object has its own light. How does this happen?



Photograph 1

2. The Sun is a star, not a planet. 

- (a) Do you agree with this statement? Explain your answer.
- (b) Why does the Sun appear bigger and brighter as compared to other stars in the universe?

3. A group of astronauts would like to carry out a mission to the Andromeda galaxy which is near the Milky Way galaxy, using a spaceship. In your opinion, would this mission be successful? Explain your answer. 

HOTS Mastery 11

4. If an astronomer designs a vehicle that can go to the Sun, what characteristics should this vehicle have to enable it to transport astronauts? 