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# Teacher Training Module:

# Science

## Learning Cycle Nine

## Earth and Space

Sindh Technical Assistance – Development through Enhanced Education Programme (STA-DEEP)

STEDA

PITE Sindh, Pakistan

Sukkur IBA University

THE AGA KHAN UNIVERSITY

## Introduction and Rationale of the Training

**Dear Teachers!**

Welcome to the new phase of the Continuous Professional Development (CPD) Program. In the previous phase, we had focused on pedagogical skills that helped you to develop your skills to make classroom more interactive, participative, and joyful for our students. In the new phase, we will continue practicing those pedagogical skills and also learn about the introduced content knowledge and skills in Mathematics, Science, English, Urdu, and Sindhi. As a result, you will be better prepared to deal classroom situation using modern teaching strategies integrated with subject knowledge.

**Our vision**

Our common goal is to improve the quality of teaching in schools all over Sindh. We want students to become active and collaborative learners, problem solvers, and critical thinkers who approach tasks with creativity and confidence. They are conceptually clear about the subject content and have the skills to link this content with the world around them. To make this possible, we, as teachers, must be better prepared for the classroom demands in pedagogy and the subject content. Moreover, we aim to professionalize these trainings so that the CPD teacher training courses make an impact and substantially change student performance.

**Our Teaching Philosophy**

The CPD training sessions, including this training, follow a participatory teaching philosophy that engages participants to apply and practice active and collaborative learning, as well as engage in self and peer reflection to become community of practice. The objective is not only to improve the teaching practices but to help you understand the theory of the subject content and the strategies that help students apply the content in daily life with confidence and mastery.

**Supporting You**

The training module is designed to support you in your classroom teaching. It will introduce you to the subject content and some approaches for use in the classroom. This will make your teaching more manageable and help you grow as a skillful teacher.

**Acknowledgement**

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We would like to express sincere gratitude to the following contributors:

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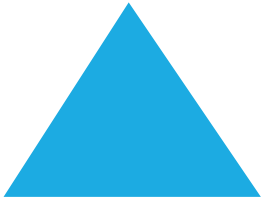
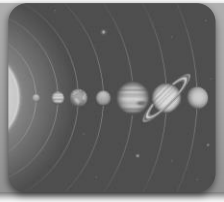


## Earth and Space

**Learning Objectives**: By the end of the session, the teachers will be able to:


Describe Earth, Solar System, Stars and Constellations relative to Sun



Explore Solar System and its plentary arrangement showing position of earth

## Session Plan

**Instructional strategies/activities**

| Time | Objective/purpose of the activity | Activities/learning experiences | Materials/resources |
|---|---|---|---|
|  10 mins | **Welcome**<br>1. Remind the rules of the workshop.<br>2. The task will allow the teachers to connect with the learning from previous cycles | 1. Quick recall of the rules of the workshop.<br>2. Each teacher will share one key takeaway from classroom implementation of the previous learning cycle. | Sticky notes/paper chits |
|  10 mins | **Warm-up**<br>**1.** The facilitator will help connect teachers to the concept of Earth and Space | 1. The facilitator will brainstorm the concept through questioning.<br>a) what is the place of Earth in the solar system?<br>b) what is the shape of Earth?<br>c) why does the Earth look flat?<br>d) Why the Sun holds a central position.<br>2. Afterward, the facilitator will ask teachers to use the given table to highlight key characteristics of the Sun, Earth, and Moon. | Board, Marker, chart paper |

<table>
<tr>
<td></td>
<td></td>
<td>
<table>
<tr><td>Sun</td><td>Earth</td><td>Moon</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
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The facilitator will conclude the activity by taking the responses from teachers.
</td>
<td></td>
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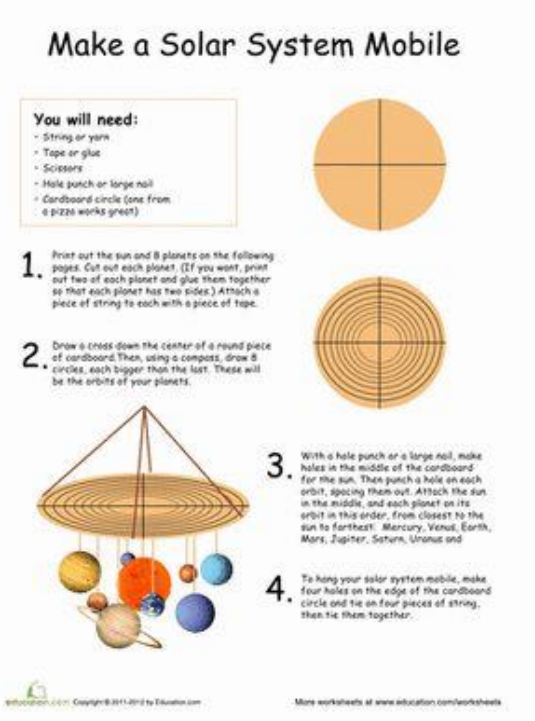
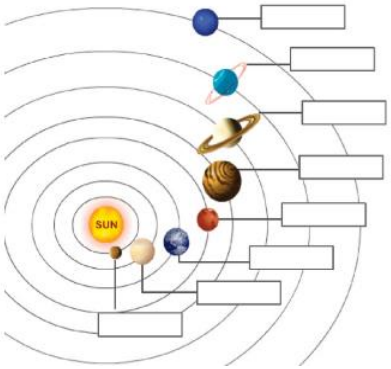
<tr>
<td>  <br>20 mins</td>
<td>Input<br>1. The facilitator will engage teachers in gathering and summarizing discussions.<br>2. The facilitator will engage the teachers in reflecting on the topic by being able to discuss about Earth and Space.</td>
<td>1 The facilitator will summarise the ideas of teachers regarding the earth, space, and solar system with the help of the Textbook and will develop the theoretical concept of participants about the mentioned topics.</td>
<td>Multimedia, Board, Marker<br>Textbook (grade 8)</td>
</tr>
<tr>
<td>  <br>45 mins</td>
<td>Practice 1<br>1 The facilitator will engage teachers to discuss, observe, and explain the</td>
<td>1 The Facilitator will distribute the teachers into four groups and assign a tiny bit of universe to each group. (Handout-1 to 4).<br>2 The group will be asked to read, discuss, and share the learning in the group based on the given questions.<br>a) What is the main concept of the reading passage assigned?</td>
<td>Reading Handout 1 to 4 chart papers, markers,</td>
</tr>
</table>

| | | | |
|---|---|---|---|
| | concepts of Earth, space.<br>2 The facilitator will guide the teachers explore and research 'Earth and Space'. | b) What are the challenges of the reading?<br>c) Now think, about how this concept will be taught in the classroom.<br><br>**Group-1:**<br>1. Will read the information on Earth (handout 01) and respond to the questions:<br>a) What are the salient features of Earth?<br>b) How these salient features differentiate Earth from the rest of the planets of solar system?<br><br>**Group-2:**<br>1. Will read about the Space (handout 02) and respond to the questions:<br>a) How is space different from the Earth's atmosphere?<br>b) How might we see through dark space?<br><br>**Group-3:**<br>1. Will read about the Solar System (handout 03) and respond to the questions:<br>a) How do we know that there are eight planets in our solar system?<br>b) How are the inner planets different from the outer planets of the solar system?<br>**Group-4:**<br>1. Will read about the Stars and Constellations (handout 04) and respond to the questions: | Questions for each group, textbooks, internet, reading material handout 07. |

| | | | |
|---|---|---|---|
| | | a) How would you distinguish between a star and a constellation?<br>b) what is the difference between astronomy and astrology?<br><br>**Guidelines for facilitator**<br>1. The facilitator will engage each group in reading and discussion on their assigned topic. After that the facilitator will guide teachers to use their learning from their assigned part to create the big picture of the universe. | |
| 10 mins | **TEAK BREAK** | | |
|  <br>30 mins | **Practice 2**<br>**Model Development**<br>1. Teachers will be able to develop the concept of the solar system and its planets through model design. | **Design a Model:**<br>1. Teachers will be asked to design a solar system model to represent the planets in it. As given below (Handout-5 ). Further, you may get an idea of model development from<br><br>https://www.jpl.nasa.gov/edu/teach/activity/kinesthetic-radial-model-of-the-solar-system/<br>For example, one idea for the model is given below: | Handout-5, chart paper, and markers. |




**Identify and fill in the names of the planets:**



| | | | |
|---|---|---|---|
| 30 mins | **Reflection for Action**<br>**1.** This will support the teachers to apply their experience of the workshop and create a plan for their classrooms (Individual task). | 1. The facilitator will guide teachers to reflect forward and plan for their classroom implementation:<br><br>Level of Inquiry: _____<br><br>Plan<br><br>Grade level: _____<br>Topic: _____<br>SLO: _____<br>Inquiry Question/<br>pedagogy: _____<br>Procedure: _____ | |
| 15 mins | **Conclusion**<br>1. The facilitator will provide guiding prompts to teachers to reflect on their learning. | 1. Teachers will review the learning regarding the Earth, space, and solar system based on the following questions.<br>**a.** What is the learning of the session?<br>**b.** What were the challenges faced by the participants? | Sticky notes/paper chits |

**Handout-1**

## The Earth

Earth is the third planet from the Sun, and the largest of the four rocky planets in our solar system. It's also the only planet within the narrow band around the Sun known as the continuously habitable zone (CHZ), which is defined as the region in which liquid water can stay on a planetary surface for long periods of time. While other planets and moons may have frost or oceans of liquid methane, only Earth has oceans and lateacher willkes of water. Because of this, Earth is the only object in the solar system on which we know life exists.

Earth is also the only rocky planet that has total solar eclipses. Venus and Mercury don't have moons, and Mars's two moons are too small and not at the right distance to completely block out the disk of the Sun. Our solar system's four giant gas planets (Saturn, Jupiter, Uranus, and Neptune) have moons that are the right size and distance, but because they don't have a solid surface to stand on, it would be tough to see an eclipse from there!

Earth is also unique as the only known planet in the universe that has artificial light. Our ability to illuminate our homes and cities creates patterns of light visible from space. The view of our planet at night is beautiful, but it does have a dark side. Just 100 years ago people all over the world could look up and see a starry sky, but now millions of people are only able to see a few of the brightest stars, due to light pollution. As a result, there is a worldwide movement to create Dark Sky Parks—places where outdoor illumination is strictly regulated. This allows for nocturnal animals to thrive, astronomers to conduct research, Indigenous people all over the world to continue to use the sky as a source of knowledge and traditions, and the public to experience a clear view of stars, planets, and our Milky Way galaxy.

https://www.exploratorium.edu/eclipse/earth

## The Space

**The atmosphere is comprised of layers based on temperature. These layers are the troposphere, stratosphere, mesosphere and thermosphere. A further region at about 500 km above the Earth's surface is called the exosphere.**

### The different layers of the atmosphere

The atmosphere can be divided into layers based on its temperature, as shown in the figure below. These layers are the troposphere, the stratosphere, the mesosphere and the thermosphere. A further region, beginning about 500 km above the Earth's surface, is called the exosphere.

### The Troposphere

This is the lowest part of the atmosphere - the part we live in. It contains most of our weather - clouds, rain, snow. In this part of the atmosphere the temperature gets colder as the distance above the earth increases, by about 6.5°C per kilometre. The actual change of temperature with height varies from day to day, depending on the weather.

The troposphere contains about 75% of all of the air in the atmosphere, and almost all of the water vapour (which forms clouds and rain). The decrease in temperature with height is a result of the decreasing pressure. If a parcel of air moves upwards it expands (because of the lower pressure). When air expands it cools. So air higher up is cooler than air lower down.

The lowest part of the troposphere is called the boundary layer. This is where the air motion is determined by the properties of the Earth's surface. Turbulence is generated as the wind blows over the Earth's surface, and by thermals rising from the land as it is heated by the sun. This turbulence redistributes heat and moisture within the boundary layer, as well as pollutants and other constituents of the atmosphere.

The top of the troposphere is called the tropopause. This is lowest at the poles, where it is about 7 - 10 km above the Earth's surface. It is highest (about 17 - 18 km) near the equator.

**The Stratosphere**

This extends upwards from the tropopause to about 50 km. It contains much of the ozone in the atmosphere. The increase in temperature with height occurs because of absorption of ultraviolet (UV) radiation from the sun by this ozone. Temperatures in the stratosphere are highest over the summer pole, and lowest over the winter pole.

By absorbing dangerous UV radiation, the ozone in the stratosphere protects us from skin cancer and other health damage. However, chemicals (called CFCs or freons, and halons) which were once used in refrigerators, spray cans and fire extinguishers have reduced the amount of ozone in the stratosphere, particularly at polar latitudes, leading to the so-called "Antarctic ozone hole".

Now humans have stopped making most of the harmful CFCs we expect the ozone hole will eventually recover over the 21$^{st}$ century, but this is a slow process.

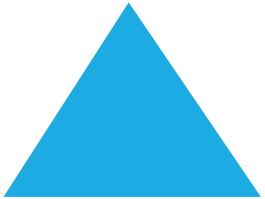
**The Mesosphere**

The region above the stratosphere is called the mesosphere. Here the temperature again decreases with height, reaching a minimum of about -90°C at the "mesopause".

**The Thermosphere and Ionosphere**

The thermosphere lies above the mesopause, and is a region in which temperatures again increase with height. This temperature increase is caused by the absorption of energetic ultraviolet and X-Ray radiation from the sun.

The region of the atmosphere above about 80 km is also caused the "ionosphere", since the energetic solar radiation knocks electrons off molecules and atoms, turning them into "ions" with a positive charge. The temperature of the thermosphere varies



between night and day and between the seasons, as do the numbers of ions and electrons which are present. The ionosphere reflects and absorbs radio waves, allowing us to receive shortwave radio broadcasts in New Zealand from other parts of the world.

**The Exosphere**

The region above about 500 km is called the exosphere. It contains mainly oxygen and hydrogen atoms, but there are so few of them that they rarely collide - they follow "ballistic" trajectories under the influence of gravity, and some of them escape right out into space.

**The Magnetosphere**

The earth behaves like a huge magnet. It traps electrons (negative charge) and protons (positive), concentrating them in two bands about 3,000 and 16,000 km above the globe - the Van Allen "radiation" belts. This outer region surrounding the earth, where charged particles spiral along the magnetic field lines, is called the magnetosphere.

**https://niwa.co.nz/education-and training/schools/students/layers#:~:text=The%20atmosphere%20is%20comprised%20of,surface%20is%20called%20the%20exosphere.**

**Space** is a vast expanse outside the Earth's atmosphere. It begins around 100 km above the Earth's surface wherein from such point onwards, air becomes non-existent. This simply means that humans along with all the other creatures on Earth cannot survive in space. And because space is a vacuum or devoid of air, it is impossible for sound waves to travel in this area or region. Simply put, no one will hear you scream no matter how loud you get.

It is also the fact that space has no air that appears to be black. Unlike in the region inside the earth's atmosphere, the air helps spread the light from the sun which makes the sky blue. Space is also filled with harmful radiation coming from the sun and from other distant stars. Astronauts or scientists that work in outer space, use a special type of suit to help them breathe in space while

protecting them from deadly radiations such as gamma rays and cosmic rays.

[Source:**https://www.acpsd.net/cms/lib011/SC02209457/Centricity/Domain/3613/PlanetsWorksheets.pdf ]**

When you look up at the night sky, you see stars and sometimes the moon and the brighter planets. Away from city lights, on a clear night, you might see the beautiful band of the Milky Way, stretching across the sky. Is there anything else up there in space?

Yes, there is much more! There are many beautiful, strange, and mysterious objects in space. We are lucky that we now have large telescopes to help us see far into space. Let's take a look through these telescopes. What do you think we might see?

With telescopes we can get a much better view of the planets and moons in our solar system. We can even send satellites to the planets and get close up pictures. By studying the planets and their moons we can learn what they are made of and learn more about our own Earth.

Looking farther away, we can see other stars. Some are like our Sun, while others are much larger or smaller. Stars come in many different colors. We do not see the colors of the stars when we look up into the night sky because they are too dim. But, telescopes can collect more light and show us the colors of the stars.

Telescopes show us the giant clouds of gas and dust where stars are born. Stars form when parts of these clouds collapse and get hot enough to make their own light. Our solar system started in one of these clouds. There are many of these clouds in space.

When a star runs out of fuel, part or all of the star expands into space. Some stars shed their outer layers while the largest stars explode. The material from these stars helps form new clouds where new stars will form. So, the material from stars is recycled.

Stars, planets, and clouds of gas and dust are all collected into galaxies where they are held together by a force called gravity. Galaxies are huge, and can have billions of stars in them. They come in many different shapes. Some look like giant spirals, some look like stretched circles (elliptical), and some have an irregular shape. We live in a large spiral galaxy called the Milky Way.

As we look out even farther into space, we see more and more galaxies. There are billions of galaxies in space, each holding billions of stars. Almost everything in this picture is a galaxy (Figure 1). Telescopes are used on the Earth and in space to see farther and farther out into the Universe. The Universe is a very big place to explore and many of its secrets are yet to be discovered.

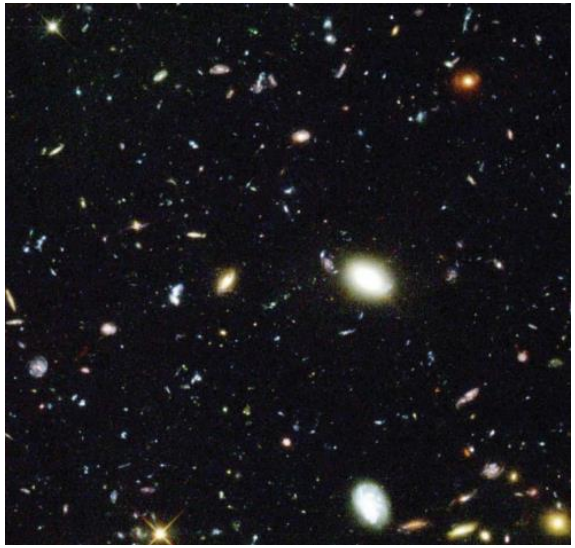


**Figure 1**: Deep field image from the Hubble Space Telescope. Every speck is a whole galaxy

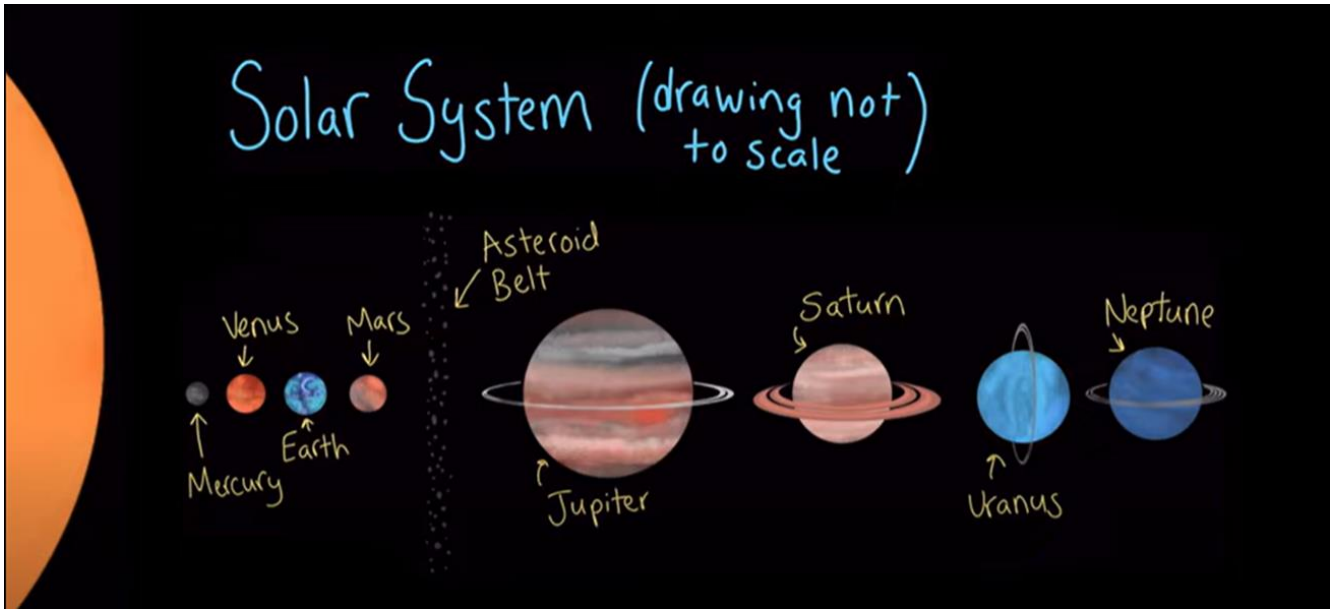
## Handout-3

### The Solar System

**The solar system** is a group of heavenly bodies gravitationally bound by a single star - and in this case, the sun. Our solar system formed from a nebula about 4.6 billion years ago. It consists of the sun, four inner planets (Mercury, Venus, Earth, and Mars), the asteroid belt, four outer planets (Jupiter, Saturn, Uranus, and Neptune), and the Oort cloud. Of the eight planets, Mercury, Venus, Earth, and Mars are classified as terrestrial planets. These planets are all compact and have rocky surfaces. On the other hand, the other four which are the outermost members of the solar system are the gas giants. More technically known as the Jovian Planets, Jupiter, Saturn, Uranus, and Neptune are much larger in size and mass than the rocky planets and they do not have solid surfaces.

https://youtu.be/wTyqO-tfs7Q

https://www.khanacademy.org/science/middle-school-earth-and-space-science/x87d03b443efbea0a:earth-in-space/x87d03b443efbea0a:the-solar-system/v/the-solar-system-ms



## Stars and Constellations

The **stars** are massive celestial gases that can be seen twinkling graciously in the clear night sky. The stars are made up of hydrogen gas and can emit light and heat energy through the process of nuclear fission which produces helium. The sun in our solar system is classified as a star. Stars are giant, luminous spheres of plasma. There are billions of them — including our own sun — in the Milky Way galaxy. And there are billions of galaxies in the universe. So far, we have learned that hundreds of stars also have planets orbiting them.

A group of stars is called a globular cluster. This globular cluster NGC 6380 is located approximately 35,000 light-years from Earth. (Image credit: ESA/Hubble & NASA, E. Noyola)

https://www.space.com/57-stars-formation-classification-and-constellations.html

On the other hand, **constellations** are a group of stars that form invisible patterns when the sparkling dots (stars) in the night sky relate to each other.

https://spaceplace.nasa.gov/constellations/en/

## What Are Constellations?

**The Short Answer:**

There are a few different definitions of constellations, but many people think of constellations as a group of stars. The constellations you can see at night depend on your location on Earth and the time of year. Constellations were named after objects, animals, and people long ago. Astronomers today still use constellations to name stars and meteor showers.

There are a few different definitions of **constellations**, but many people think of constellations as a group of stars. Often, it's a group of stars that looks like a particular shape in the sky and has been given a name. These stars are far away from Earth. They are not connected to each other at all. Some stars in a constellation might be close while others are very far away. But, if you were to draw lines in the sky between the stars like a dot-to-dot puzzle – and use lots of imagination – the picture would look like an object, animal, or person.

Over time, cultures around the world have had different names and numbers of constellations depending on what people thought they saw. Today, there are 88 officially recognized constellations.

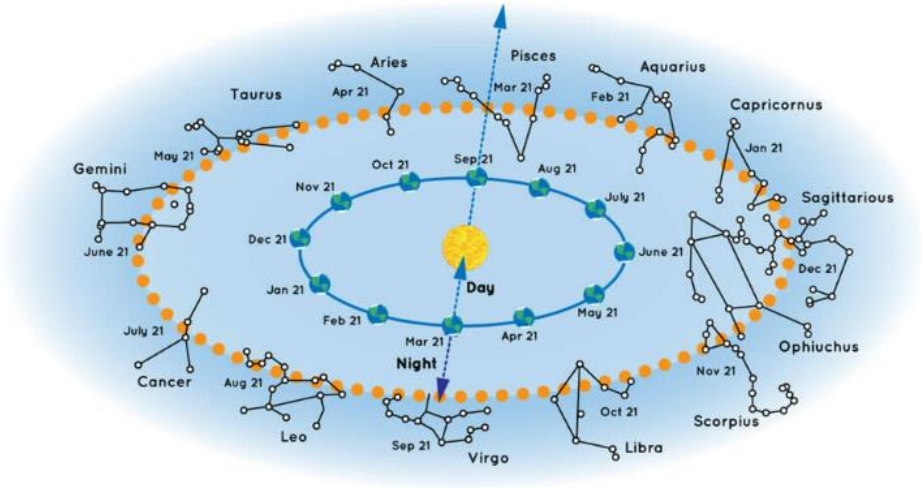
https://spaceplace.nasa.gov/constellations/en/

## What constellations can you see in the night sky?

The constellations you can see at night depend on the time of year. Earth orbits around the Sun once each year. Our view into space through the night sky changes as we orbit. So, the night sky looks slightly different each night because Earth is in a different spot in its orbit. The stars appear each night to move slightly west of where they were the night before.

Your location on Earth also determines what stars and constellations you see, and how high they appear to rise in the sky. The Northern Hemisphere is always pointing in a different direction than the Southern Hemisphere. This means that stargazers in Australia, for example, get a slightly different view of the sky and can see a few different constellations than those in the United States.

It can be a little confusing to picture how the night sky changes as we orbit the Sun. You can see how it all works in the illustration below.



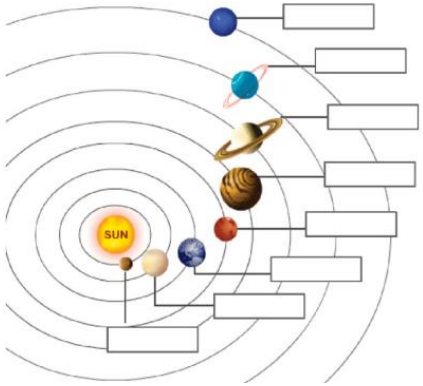

*A chart showing some of the constellations that are visible from the Northern Hemisphere in different times of year. Credit: NASA/JPL-Caltech*

For example, say you're in the Northern Hemisphere looking into the night sky on September 21. You'll probably be able to see the constellation Pisces. But you won't see Virgo because that constellation is on the other side of the Sun. During that time of year, Virgo's stars would only be

## Handout-5

**Develop a model of the solar system and identify planets and write in it.**

**Identify and fill in the names of the planets:**




Further, take the model development idea from

https://www.jpl.nasa.gov/edu/teach/activity/kinesthetic-radial-model-of-the-solar-system/

## Additional Resources

**References**

https://www.acpsd.net/cms/lib011/SC02209457/Centricity/Domain/3613/PlanetsWorksheets.pdf

https://www.jpl.nasa.gov/edu/teach/activity/kinesthetic-radial-model-of-the-solar-system/

https://www.bbc.co.uk/bitesize/topics/zkbbkqt

https://www.bbcearth.com/

https://www.stem.org.uk/resources/community/collection/12347/year-5-earth-and-space

https://www.filamentlearning.com/planet-mechanic-unit-introduction

https://www.teachingexpertise.com/classroom-ideas/middle-school-astronomy-activities/

https://artsandculture.google.com/story/solar-system/OQUR89_yw2bufQ?hl=en

http://www.thunderboltkids.co.za/Grade6/04-earth-and-beyond/chapter1.html