Exploring our Solar System (Level 2)

Description	Learners will create their own model of our solar system to showcase the planets and some interesting facts about them. Learners will then present the model to his or her family and state one fun fact about each planet.
Leading question	How are planets positioned in our solar system?
Subjects covered	Science, Math
Total time required	3 hours over 3 days
Resources required	Pen/pencil, ruler, color pens, paper, paper/plastic plate, small round object, torch/flashlight
Learning outcomes:	By the end of this project, learners will be able to: 1. Understand how each planet's position in relation to the sun affects their temperature. 2. Demonstrate an understanding of the unique characteristics of each planet in the solar system, including size, atmosphere, and any distinguishing features. 3. Recognize the solar system planets movement in space in terms of rotation and revolution due to gravity. 4. Use quantitative approaches to collecting data and conducting multiple trials of qualitative observations. 5. Develop spatial awareness by creating 2D and 3D models of the solar system, accurately representing the positions and relative sizes of the planets. 6. Engage in critical thinking by making predictions, analyzing evidence from experiments, and drawing conclusions about planetary characteristics and their implications for life.
Previous Learning	Basic operations with numbers up to 1000
Supervision required	Medium

Day 1

Today you will learn about planets in our solar system.

Suggested Duration	Activity and Description
5-10 minutes	• Write down a description of a planet. • A planet is a large object that travels around a star like the sun. The Earth is one of eight planets that travel around the sun. Can you list any other planets you might know from movies? (Hint: have you ever

<table>
<tr><td></td><td>seen a movie or cartoon about aliens? What planet do they usually come from?)
● The solar system includes the sun, eight planets, and other objects that move around the sun due to gravity.</td></tr>
<tr><td>10 minutes</td><td>● The planets in our solar system, in the order of how close they are to the sun, are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. One easy way to remember this order is using the acronym formed by the first letter of each planet name - M-V-E-M-J-S-U-N and remembering the phrase My Very Educated Mother Just Served Us Nachos!
● Come up with your own acronym using this worksheet:
<table><tr><th colspan="2">PLANETS’ MNEMONIC</th></tr><tr><td>M</td><td>Mercury</td></tr><tr><td>V</td><td>Venus</td></tr><tr><td>E</td><td>Earth</td></tr><tr><td>M</td><td>Mars</td></tr><tr><td>J</td><td>Jupiter</td></tr><tr><td>S</td><td>Saturn</td></tr><tr><td>U</td><td>Uranus</td></tr><tr><td>N</td><td>Neptune</td></tr></table>● Recall the acronym and list planets in this order from memory.
● Share your phrase (mnemonic) for remembering the order of the planets with family members</td></tr>
<tr><td>20-30 minutes</td><td>● Draw the solar system using the fact sheet in appendix 1. Begin by arranging the planets in the right order of distance to the sun, then keep in mind the sizes and shapes of planets mentioned in appendix 1.</td></tr>
</table>

- <u>Numeracy activities:</u>
- The distance of each planet from the sun is as follows:
    - Mercury: 35 million miles
    - Venus: 67 million miles
    - Earth: 93 million miles
    - Mars: 142 million miles
    - Jupiter: 484 million miles
    - Saturn: 889 million miles
    - Uranus: 1.79 billion miles
    - Neptune: 2.8 billion miles

One million has 6 zeros and is expressed in digits as 1,000,000. Represent each figure from the list above in the place value chart below. **Do this only for the figures in millions (i.e. Mercury to Saturn).** Fifty million two hundred thousand and five hundred (50,200,500) has been done as an example in the first row. Do this for all planet distances that are in the millions of miles.

Hundred Millions	Ten Millions	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones
	5	0	2	0	0	5	0	0

- Imagine that the Earth is only 93 miles away from the sun instead of 93 million miles. If we were to represent Uranus in an equivalent way, its distance from the sun will be 1790 million miles away since 1 billion = 1000 million. Uranus will therefore be 1.79 x 1000 = 1790 million miles away from the sun. What will Neptune's distance from the sun be in millions?
- Using the figures from the previous activity, calculate the **range** of the planets' distance from the sun. The range is the difference between the largest value and the lowest value. How do you calculate this difference?
- Subtract the distance of the closest planet from the distance of the farthest planet to find the range in millions.

DAY 2

Today you will learn about how planets move in space.

<table>
<tr><th>Suggested Duration</th><th>Activity and Description</th></tr>
<tr><td>10 minutes</td><td>

The main factor determining a planet's movement is gravity. On Earth, gravity is what keeps humans, animals, plants, buildings etc. and all living and nonliving things on Earth. It pulls everything down, that’s why we don’t fly into space! In our solar system, planets and their moons also are affected by gravity. Every object has a gravitational force, but smaller objects have very little force.
Can you think about an explanation of why this happens? Brainstorm two or three explanations for this.

</td></tr>
<tr><td>15 minutes</td><td>
Perform the following activity to understand how weight and mass affect gravity:

Select any two objects in your house that are different in weight - one object must be light like a feather or a small piece of paper, and another has to be heavier like a medium sized-toy, rubber ball etc.
Make a prediction about which object you think will fall faster and why
Drop both objects at the same time and make a note of what happens. Did the experiment validate what you had predicted?
Now try dropping a small solid object like a marble or stone and a bigger but hollow object like a basketball, football etc. What happened? Did you predict successfully what was going to happen?

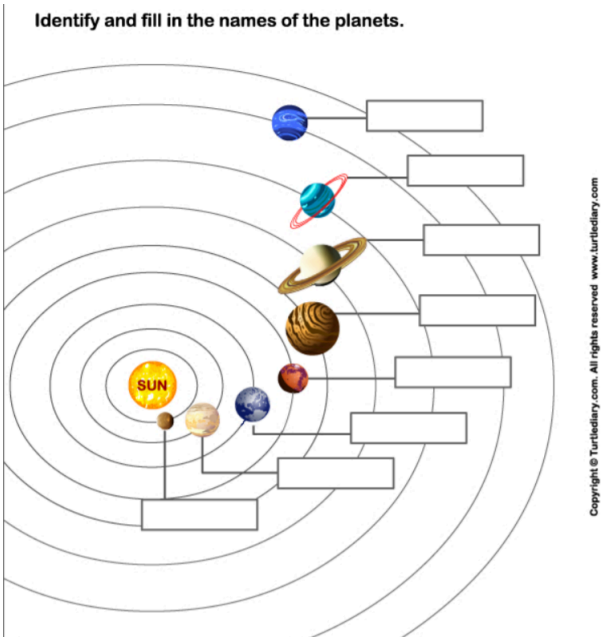
Objects fall at the same speed, but that air resistance changes the speed of the fall and makes the fall drag. The bigger the object, the stronger the drag or air resistance. Experiment with more objects and complete the following table before and after each experiment by entering your guess or hypothesis and then the result or evidence.
<table>
<tr><td>Objects</td><td>Hypothesis</td><td>Evidence</td></tr>
<tr><td>e.g. marble and football</td><td>football lands first</td><td>marble lands first</td></tr>
<tr><td><insert objects></td><td><insert hypothesis></td><td><insert evidence></td></tr>
<tr><td><insert objects></td><td><insert hypothesis></td><td><insert evidence></td></tr>
</table>
</td></tr>
<tr><td>10 minutes</td><td>

Planets are also affected by gravity, otherwise they would be all over the place in space! The gravitational pull of the sun attracts all planets

</td></tr>
</table>

	in our solar system to **revolve** around it in a fixed imaginary path called an **orbit**. Each planet also **rotates** around its own axis - which is an imaginary straight line that passes through the center of planets. All planets except for Venus and Uranus rotate counterclockwise. The sun also rotates around its axis. Do this short activity to demonstrate the rotation and revolution of planets: ○ You and your siblings/friends should choose two planets to simulate their movements. One of the selected planets must be Venus or Uranus. A third family member can play in the sun. ○ The person who is simulating Venus/Uranus will rotate in one place in clockwise while the other person simulating any of the other planets will rotate in one place counterclockwise ○ The person representing the sun will be placed in fixed position in the room and rotate counterclockwise while the two "planets" will start to move around the "sun" slowly and counterclockwise, while still rotating around themselves ○ Do this slowly otherwise you might get dizzy! ○ The person representing the sun can hold a torch or flashlight representing the sun's light. Notice how the light falls on some parts of the "earth" and not others. The lit and dim parts change when the earth rotates. This is how night and day are caused. The lit parts of the "earth" are where countries experience day and the dim parts that are turned away are where it is night time. ○ To demonstrate how seasons are caused, the person representing the "earth" should rotate and revolve around the sun *while* tilted (or leaning slightly to the right). The "sun" should have its light on. You will notice that when the northern part of the "earth" (called the Northern Hemisphere) receives direct sunlight, the lower part (called the southern hemisphere) receives less light. This is why when the Northern Hemisphere experiences summer, it is actually winter in the Southern Hemisphere. The same is true when the order is flipped as the earth continues to revolve around the sun and the Northern Hemisphere is tilted away from the sun, resulting in winter for the Northern Hemisphere and summer in the Southern Hemisphere!
5 minutes	● Do this activity to learn more about how planets move in an orbit. Take a small ● Take a small ball or round object the size of a grape and a round plate with raised edges like the following

	 ● Place the object in the plate and begin rotating the plate slowly so that the object moves along the edge of the plate ● Imagine that the plate is the solar system and the center of the plate is where the sun is positioned. This is how planets move in a fixed path around the sun! ● If the round object was the Earth, how would it move? What about Venus? ● Reflection questions - How long do you think it takes the Earth to rotate around itself? (one day) - It takes different amounts of time to complete a rotation - it takes Neptune only 16 hours while Mercury completes it in 1,408 hours! The amount of time it takes to complete a rotation is the equivalent of one day on planets! - How long do you think it takes the Earth to revolve around the sun? (one year or 365 days!)
15 minutes	Draw and label the following image on a piece of paper without looking at the appendix!

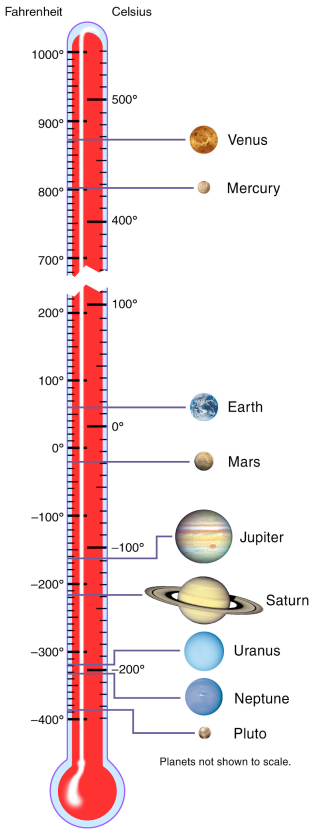
	 source: https://www.turtlediary.com/worksheet/planets-of-solar-system.html • Share your drawing with your family.
10 minutes	• **<u>Numeracy activities:</u>** - You just discovered a new planet that is very far from the sun! It takes this planet half the time it takes Earth to complete one rotation. How many hours does this planet complete one rotation around its axis? (Hint: 1 day = 24 hours) - It takes the Earth 365 days to complete one revolution around the sun (also called a year), but it takes Venus 140 days less this amount of time to complete it. How long is a year on Venus?

DAY 3

Today you will learn about temperature on different planets in our solar system and create 2D or 3D solar system models!

Suggested Duration	Activity and Description

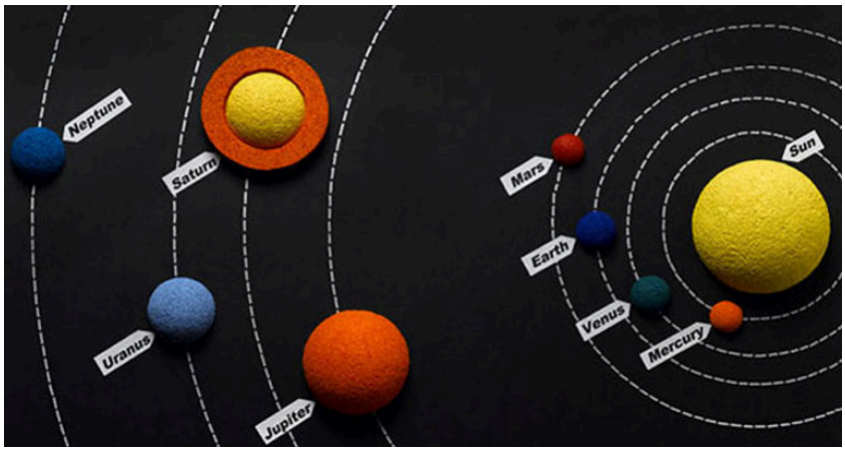
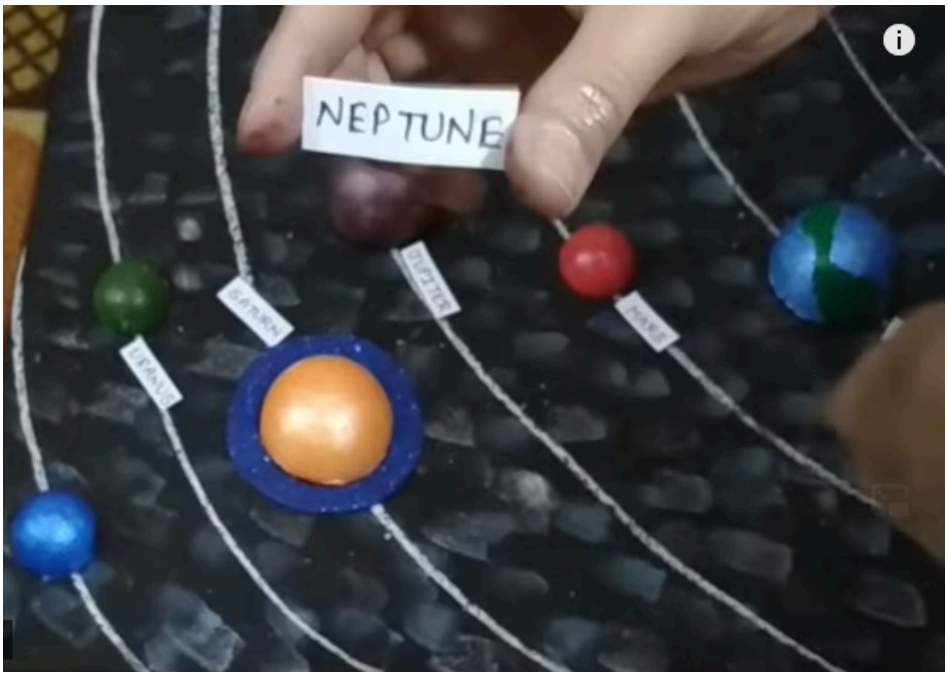
10 minutes	• Recall each planet's position with relation to the sun. How hot or cold do you think it is on each planet? Think about the weather on each planet. What planet do you think would be the hottest? Think, then look at the image below:



source: https://solarsystem.nasa.gov/resources/681/solar-system-temperatures/

- You may have answered that Mercury is the hottest since it's closest to the sun, but Venus is actually the hottest planet in our solar system with an average temperature of almost 470 degrees Celsius! This is because while Mercury has no atmosphere (like our moon), Venus' atmosphere is made up of a thick layer of carbon dioxide that traps heat. Venus is an exception since it is true that in general the farther away from the sun planets are, the lower their average temperatures are.
- Can you guess which planets are called the "ice giants"? (Answer: Neptune and Uranus).

	• Fun fact: Pluto shown in the image above used to be considered a planet, until scientists discovered that it did not meet all the criteria for being considered a planet and is instead called a “dwarf planet”.
30 minutes	• Numeracy activities: - Let’s see if it’s true that in general planets that are farther from the sun are colder. Recreate the figure above in a number line from -300 to 500 (representing degrees celsius) and write down the name of each planet under their average temperature. Mark each point indicating the temperature of a planet in a different color and write the name of each planet in that same color as the point on the number line. Now, underneath each planet's name, write a number indicating the order of planets in relation to the sun. 1 should go under Mercury, 2 under Venus etc. What can you conclude? Is it true that planets farther away from the sun are colder? - Let’s find out the range of temperatures of the solar system and the average temperature of a planet in the solar system! Make sure you pay attention to planets with negative average temperatures!
30-40 minutes	• Now it’s time to create your solar system model to showcase what you have learned. Make sure that your model represents all planets along with 2-3 fun facts about each one such as size, shape, average temperature etc. • You can create a 2D model on a piece of paper. Draw, color, and cut out: - the sun - the eight planets in the solar system as accurately as possible. Make sure that you draw these big enough to cut out for your solar system display • You can also use scrunched up paper or aluminum foil to make paper or aluminum foil balls for a 3D model. An adult should scrunch up pieces of paper, soak it in water and keep scrunching it until it reaches the desired consistency, and finally tape around it to create a sphere out of paper. Aluminum foil can be used instead to create a sphere for the planets. Simply scrunch up pieces of aluminum foil to create a spherical shape and rub it against a rough surface to smoothen it. You can create balls of different sizes for the planets and finally label each ball to represent each of the eight planets. You can also use any round objects available in your house for the 3D model. • You may choose to include the orbital paths for each planet in your final model. Below are some examples of solar system models: 3D model examples:

	 source: https://www.toppr.com/guides/science/science-projects/how-to-make-a-solar-system-project-at-home/  Source: https://www.youtube.com/watch?v=qpUq-d4DuoI
10 minutes	• Present the model to his or her family and state one fun fact about each planet. • Then ask your family for feedback. The feedback should include: • What do they love about the solar system model?

	• Any questions they have? • Any suggestions for improvement? You can also quiz family members to see how much they know about planets! You can come up with three questions that they would like to ask your family. Use the feedback from the family members to revise the solar system model.

ASSESSMENT CRITERIA

A majority of my learners were able to:

- ☐ Have the correct understanding of planets in the solar system and each planet's position in relation to the sun
- ☐ Understand the solar system and planet's movement in space.
- ☐ Complete a 2D or 3D solar system model with facts about each planet
- ☐ Understand the unique characteristics of each planet, including size, atmosphere, and notable features. Check if they can provide accurate facts about each planet during their model presentation.
- ☐ Evaluate mathematical skills by reviewing their calculations related to planetary distances, temperature comparisons, and other quantitative data. Ensure that they can accurately represent these figures.

Additional enrichment activities:	• Learners can perform more complex operations using temperature figures by dividing figures for example to find out how many times more hot/cold a planet is compared to another • Learners can write a short story imagining life on a planet of their choice and describing what a day would look like there.
Modifications for simplification	Learners can draw the solar system and show planets' distance from the sun and write a few interesting facts about each planet using the information in appendix 1. Learners can do the experiments on day 2 to demonstrate gravity, rotation and revolution, night and day and seasons.

APPENDIX

APPENDIX 1 - INTERESTING FACTS ABOUT PLANETS

Earth

- The planet we live on
- Has only one moon
- 3rd planet from the sun
- Average temperature = 20 °C
- Has continents and oceans
- 1 day = 24 hrs

Mercury

- The closest to the sun
- Appears gray
- Has no atmosphere
- The smallest planet. 18 Mercuries would fit into Earth
- 1 year = 88 Earth days
- 1 day = 58 Earth days

Sun

- Is a star
- Planets orbit around it
- Provides the Earth with warmth

Jupiter

- 5th planet from the sun
- Largest planet
  1 year = 12 Earth years
- 1 day = 10 hrs

Uranus

- Appears light blue
- 7th planet from the sun
- 1 year = 84 Earth years
- 1 day = 17 hours

Neptune

- Appears blue
- 8th planet from the sun
- 1 year =165 Earth years
- Has 6 faint rings

 Saturn • A gas giant made up of mainly gases • 6th planet from the sun • Has large rings • 2nd largest planet •	 Mars • Appears bright red • 4th planet from the sun • Has two moons • Likely candidate for a future human habitat	 Venus • 2nd planet from the sun • Appears yellow • Hottest planet • Similar to Earth in size and material • Hosts thousands of volcanoes and craters • Known as evening or morning star • I year = 220 Earth days • 1 day = 241 Earth days

Source: https://www.simpleeverydaymom.com/solar-system-for-kids-game/

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