Lesson 4.2 Earth and Orbit

Overview

During this lesson, students will gain understanding of what an orbit is and how it is achieved through space travel. Students will also look at the order of the planets and a way to remember this order through mnemonics and apply this to creating a SAM system to demonstrate the earth orbiting the sun.

Key Information

Level 4: (Ages 11-12) US Grades 5 or 6

Time: 45/90 minutes

Warm-Up	5 minutes
Mini-lesson	10 minutes
Worked Example	7 minutes
Challenge 1	7 minutes
Challenge 1 - Debug	5 minutes
Challenge 2	7 minutes
Tidy Up / Exit Ticket	4 minutes

Lesson Topics

- **Earth and Space Science**
  - Students will learn about the orbits of Earth around the Sun, and of the Moon around Earth. These include day and night; daily changes in the length and direction of shadows; and different positions of the Sun, Moon, and stars at different times of the day, month, and year
- **Math**
  - Solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate

Learning Objectives

- ***As a result of this lesson, students will be able to***
  - Identify the planets and the order they are from the sun and create a mnemonic to recall them
  - Identify what the different orbits are and understand how technology has helped us get there
  - Identify the time scale taken by Earth to orbit the sun
  - Create a system to model the earth's rotation around the sun

Materials

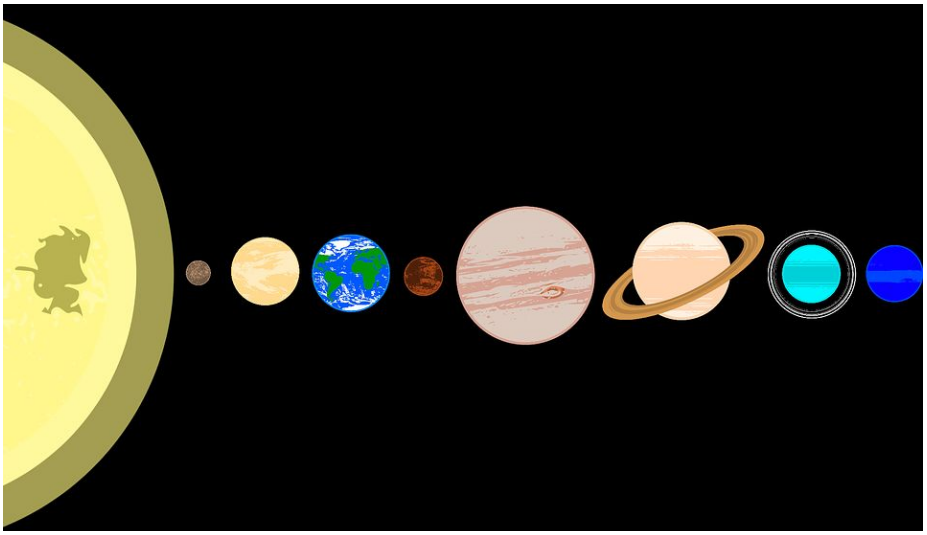
- Cardboard
- Blu-tack
- SAM Labs Kit
- SAM Labs Student Work

Warm Up – Order and Remember — 5 minutes

Can you put the planets in order from the sun?

Objective: Identify the planets and the order they are from the sun and create a mnemonic to remember them

Procedure: The objective of this task to look at the images of the planets and name them in order from the sun and look at the meaning of the word 'mnemonic' and how they can be used to remember the order.



Sample photo ideas: Solar system graphic

Link forward: Linked to mini lesson looking at the definition of an orbit is and how to get there

Mini-lesson — 10 minutes

What is an orbit and what is Earth's orbit around the Sun?

Objective: Identify what the different orbits are and understand how technology has helped us get there and identify the time scale taken by Earth to orbit the sun

Procedure: Students will look at what an orbit is and how the earth and all planets are within their own orbit of the sun. Look at how we are all a different distance away from the sun and spin the same distance from the sun in an egg shape (elliptical) at all times and this called an orbit. Students to then look at how we have got into orbit and the advancements in technology to get there.

Key Words

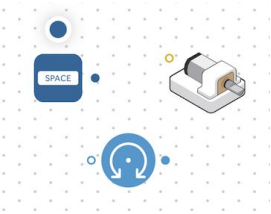
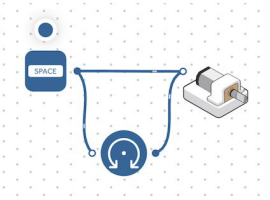
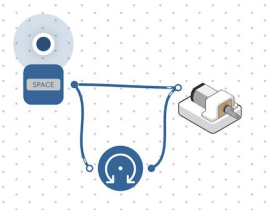
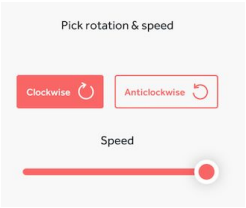
- Orbit
- Rocket
- Space race
- Low earth orbit
- Satellite

Let's Discuss: *What is an orbit? In your workbook or with a partner, record, discuss, or share complete the missing gaps using the keywords from the word bank.*

Link forward: Link to creating a SAM system to simulate the earth's orbit of the sun

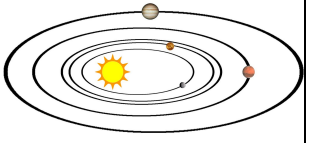
Worked Example — 7 minutes

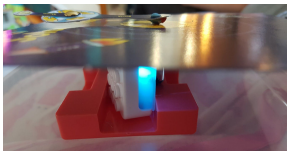
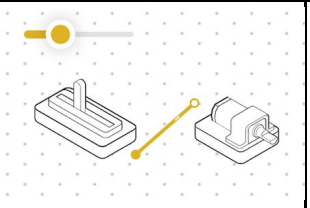
How to control the motor

Instructions	Workspace	Notes for Teachers
Step 1. Turn on and pair a DC Motor block.		*Press and hold the power button on the DC Motor block and pair it with the workspace*
Step 2. Drag on the following blocks to the Workspace: • DC Motor block • Switch Direction block • Key Press block		*The Switch Direction block allows the direction to be changed every time we press the key press block*
Step 3. Connect the blocks together in a sequence.		*The switch direction block cannot just go inline between the key press and the motor as the command will not make it to the motor.* *The key press block must be connected to both the motor and the switch direction block to enable the command to work.*
Step 4. Use the Key Press to test your system!		*When you press and hold the key press block the motor will go in one direction; always clockwise first as this is the default setting, and then when your press and hold the key press block again the motor will run in the opposite direction*
Step 5. Open the DC Motor block settings to change the speed.		*If you access the settings of the motor block you will see the speed is adjustable here and you will be able to see how the motor changes as you change the speed setting.*

Challenge 1 — 7 minutes

Create a system to simulate an orbit around the sun

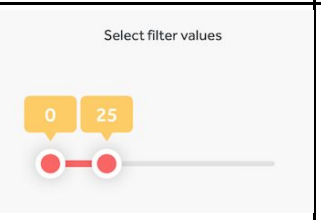
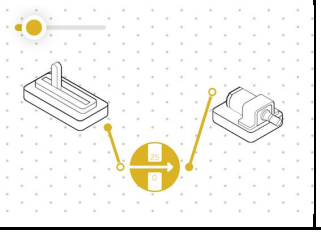
Instructions	Workspace	Notes for Teachers
Step 1. *Using card paper create a solar system. Add the orbits of each planet except the Earth.*		The image here only shows Mercury, Venus, Mars and Jupiter It is important that this is as realistic as possible with the shapes of the orbit as egg shape and must have the planets in correct order

Step 2. *Create the Earth separately and attach to a tennis racket-like shape.*		*The reason for a tennis racket shape is to allow the planet to be secure and for the end of the bat to be attached to the DC Motor block*
Step 3. *Put a small hole in the end of the paddle and through the Sun. Put the DC Motor block through both using blu-tack or plasticine to hold in place.*		*The small hole in the cardboard in the centre of the Earth will allow the end of the motor block to pierce through and a small amount of blu tac on the end will hold the planet Earth on top*
Step 4. *Add the Slider block and the DC Motor block to the Workspace.*		*Drag the Slider block and the DC Motor block to the Sam Workspace and connect them to create our system*
Step 5. *Pair up the physical blocks and watch the Earth spin when the slider is moved.*		*Pair the two blocks and test the system to make the Earth spin in orbit around the Sun. You will see the system here is more a circle as the motor spins equally*

Checks for understanding: *What is the purpose of the slider? How long is one orbit of the sun?*

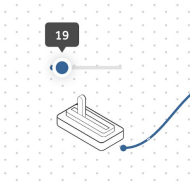
Challenge 1 - Debug it — 5 minutes

The speed of the motor is too fast, how can we slow it down?

Instructions	Workspace	Notes for Teachers
Step 1. Drag a Filter block to the Workspace.		*A filter block allows a certain range to travel through to the output*
Step 2. Edit the range of the block to 0-25.		*By editing the range to 0-25 (or similar) we are able to stop the excessive speeds from being achieved as it will cut off after the speed reaches 25.*
Step 3. Connect the Filter block to the rest of the system and test it!		*Test the system by slowly increasing the speed to check it stops when it reaches 25. You will also find it easier to reduce the speed to a slower one than increase it slowly*

Challenge 2 — 7 minutes

Calculate the relative speed of the planets

Instructions	Workspace	Notes for Teachers
Step 1: Look at the days it takes each planet to orbit the Sun.	**Mercury: 88 days** **Venus: 225 days** **Mars: 687 days** **Jupiter: 4,332 days** **Saturn: 10,759 days** **Uranus: 30,688 days** **Neptune: 60,182 days**	These are the times (in Earth days) that each planet takes to orbit around the Sun
Step 3. Calculate the relative time it takes for each planet to orbit the Sun, comparing them to Earth.		In order to do this students will have to calculate the relative time of other planets' orbit to Earth's. **Example:** Earth's Orbit = 365 days and Mercury's Orbit = 88 days. Earth's Orbit divided by Mercury's Orbit = 365/88 = 4.147x faster. We can round this down and say that Mercury orbits the Sun 4 times faster than the Earth. So Mercury will need to rotate at 4 times the speed of the Earth in our system
Step 4. Set the speed of the Slider block to '20' to represent Earth's speed around the Sun. Now calculate what setting you would have to pick to represent Mercury's Speed around the Sun.		Mercury orbits roughly 4 times as quickly therefore the slider setting for Mercury should be 4 x 20 (Earth's speed), which equals 80 This may be too fast within the model and you may need to come up with a fraction of the speeds to help model the difference

Extension Ideas:
• **Science**:
  ○ How does a rocket get into space?
  ○ How are rockets and satellites built? What materials are suitable?
  ○ What is the atmosphere and the effects it has on materials as it passess through
• **Geography:**
  ○ Where in the world are the launch sites and what environmental factors make it a good launch site
• **History**:
  ○ What is the timeline of key space launches and technological advancements
• **ICT/Computing:**
  ○ How does a satellite work? Choose a type and research the uses and how we rely on them daily		

Checks for understanding: Which planet is quickest to orbit the sun? Which planet takes the longest to orbit the sun?

Tidy Up / Exit Ticket — 4 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an exit ticket.