ARTEMIS: ROCKET BUILD

EDUCATOR GUIDE

This Educator Guide includes:

- Theme Overview
- Ways to Use this Learning Content
- Lesson Activities
- Extension Activities
- Minecraft Visual Glossary
- Getting Started: Minecraft Education
- Educational Standards

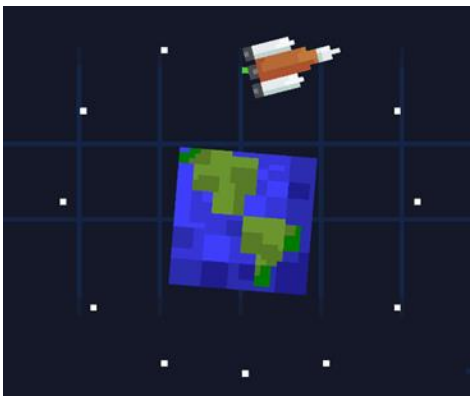
THEME OVERVIEW

Welcome to Launch Control! There is an incredibly exciting project called the Artemis program and we want you to be a part of it!

Artemis: Rocket Build is part of a series designed as a fun and creative introduction to the Artemis Program, the robotic and human exploration program led by the United States' National Aeronautics and Space Administration (NASA) and other partner agencies to return astronauts to the lunar surface. This one-hour experience will provide students, ages 8-18, with special in-game instruction to learn information about the Artemis program, the different components of rockets, and what is exactly needed in order to build and launch a rocket successfully! Players will also have the opportunity to practice their new knowledge and skills with a special mission.

This Educator Guide is designed to provide you with information to help you support game play for all students. This guide will provide you background information and helpful information to help you feel comfortable and confident to utilize this learning content in your educational environment. Within this guide, you will find the necessary materials to lead an intentional experience to engage in dialog around the Artemis program, facilitate a successful in-game experience, and support student learning throughout game play.

If you are ready, accept your first mission and get started!



WAYS TO USE THIS LEARNING CONTENT

How can this lesson be used?

Integrated into science classrooms	Artemis I: Rocket Build is connected to numerous science standards. You could easily look at your academic standards and use this learning content when you are teaching scientific process skills, Earth and space science standard, or physics. This learning content is a great way to model and simulate abstract science concepts such as gravity, force, and motion.
STEAM Labs or Digital Makerspaces	Who wouldn't love to use Minecraft in a fully integrated learning environment where everything from the furniture and technology to curriculum and assessment work together to support hands-on, minds-on learning?! The Artemis learning content could be used for student exploration through this applied technology.
Afterschool learning opportunities	After a full instructional day, students need something fun and engaging to provide motivation for learning. What could possibly be more fun and engaging than Minecraft Education?! Not only will students love playing Minecraft, but they will also learn educational concepts and develop their skills in creativity, communication, collaboration, and critical thinking.
Summer camps	Are you planning or hosting a summer camp? Who doesn't love a space-themed camp?! This learning content could be included in a space exploration week of fun and learning! Students will also have the opportunity to learn about great careers at NASA!
Homeschool groups	You don't have to be exclusively at a school or part of a school district to utilize Minecraft Education. Homeschools, families, and other organizations can purchase and manage Minecraft Education through our commercial offer. You can find more information here.

ARTEMIS I: ROCKET BUILD — LESSON ACTIVITIES

Overview of the Activities

Part 1: Arrival in Launch Control

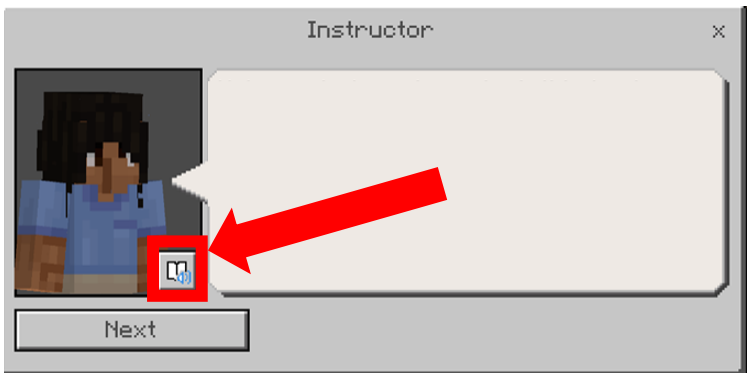
Upon arrival in Launch Control, players will be greeted by the Instructor, an NPC (non-player character). Players will need to “talk” to the instructor.

Helpful Hint – How to “talk” to an NPC

Keyboard/Mouse	Touch Device
If students are using a keyboard/mouse configuration, they will move towards the NPC. Once they are within range, use the crosshairs “+” on the screen to guide them to the NPC. Then, right-click on the NPC to open the dialog box.	If students are using a touch device, they will move towards the NPC. Once they are within range, a “talk” button will appear above the hotbar. They should tap the “talk” button to open the dialog box.
	

NPCs will often provide instructions and important guidance to the players. It is critical for them to read and comprehend the information. If you have younger players or emergent readers, consider demonstrating and encouraging the use of the Immersive Reader feature.

Immersive Reader is an integrated feature of Minecraft Education. It supports learners in reading or translating in-game text, including the character dialog. When a dialog box is opened, you will see an icon in the bottom right-hand corner of the NPC picture in the dialog box.



After players have read through the initial dialog boxes, they are ready to start their first mission! The first mission is to launch a satellite into space. This satellite will help communicate with the spacecraft when it flies to the Moon. In order to prepare for the first mission, players will need to visit a series of classrooms to learn some specific lessons about going to the Moon!

Before going to the classrooms, interact with the other NPCs in this Launch Control room. You will learn about some cool careers at NASA – these individuals are critical for supporting the Artemis program.

JOB TITLE	EXPLANATION OF JOB
Component Engineer	Works on the engines that power the SLS rocket
Launch Director	Oversees the countdown and lift off of NASA's SLS rocket and Orion spacecraft
Ground Support Crew	Loads the liquid propellant (fuel) into the rockets
Safety Officer	Ensures the safety requirements of the Orion crew capsule, SLS, and other systems to keep astronauts safe as they travel, live, and work in space

Cryogenic Engineering Technician	Ensures the fuel for the rocket is safe for launch—this includes fixing potentially dangerous fuel leaks!
Flight Software Design Team Lead	Writes the code that helps get the vehicle(s) into space
Lead Animator and Illustrator	Transform technical blueprints and pencil drawings into accurate, scaled 3D digital models
Marine Biologist	Helps preserve the local ecosystem by developing ways to mitigate the impact to wildlife during launch operations

This list is not comprehensive or exhaustive of all of the great careers and jobs that support the Artemis program at NASA. Interested in learning even more about the jobs and careers at NASA? This link will provide you with a curated video playlist from NASA to gather more insight and understanding from of the great minds presently working at NASA!

Activity 1: Learning about the Artemis Program

Lesson 1: Introduction to Artemis

Purpose: Learn about the Artemis program and its significance

Key Learnings from Lesson 1

In Lesson 1, students will learn the following information:

- NASA will land the first woman and person of color on the Moon as part of the Artemis missions.
- NASA will use new technologies to explore more of the Moon than ever before.
- NASA will work with other countries to set up a permanent base on the Moon.
- NASA will take the learnings from the time spent on the Moon to help send astronauts to Mars for the first time.
- Discovery, economy, and inspiration are the driving forces behind why we are going back to the Moon.

Lesson 2: How does a rocket work?

Purpose: Understand how a rocket works

Key Learnings from Lesson 2

- Engineers use Newton's laws to understand how forces work and how these laws impact rockets' ability to fly.
    - **Newton's First Law of Motion**: An object at rest stays at rest or an object in motion stays in motion, until acted upon by an outside force. Basically, objects like to stay still or keep moving until something else makes them change.

    - **Newton's Second Law of Motion**: This law is an equation (F=ma), which mathematically explains how fast an object moves or changes depends on how heavy it is and how hard it is pushed.
    - **Newton's Third Law of Motion**: Every action has an equal and opposite reaction.
- Important Vocabulary
    - **Gravity** – invisible force always pulling objects towards the ground
    - **Weight** – the force of gravity on an object
    - **Thrust** – force that makes a rocket move (force is created by rocket's engines and pushes the rocket in a certain direction)
    - **Velocity** – the speed of something in a given direction
    - **Delta-V** – the change in velocity (i.e., speed in a given direction)

Lesson 3: Propulsions and Fuels

Purpose: Learn about the parts of the Space Launch System and how propulsion and fuels are important to get the rocket off the ground and into space

Key Learnings from Lesson 3

- The rocket must carry the spaceship, astronauts, fuel to launch the rocket, and enough fuel to return to Earth – the rocket is heavy! Propulsion and fuel are critical for our rocket launch.
- Rockets have taken on many shapes over the years.

- Rocket fuel can be liquid or solid. Our rocket will be powered by liquid hydrogen and polybutadiene acrylonitrile (PBAN).
- Parts of the Artemis Space Launch System (SLS)
    - Rocket boosters
    - Core stage
    - Rocket engines
    - Orion spacecraft
    - Interim Cryogenic Propulsion Stage (ICPS)

Lesson 4: Artemis – What's next?

Purpose: To better understand the Artemis missions (past, present, and future)

Key Learnings from Lesson 4

- There are multiple missions in Artemis.
    - **Artemis I:** This mission was successfully completed in December 2022 with the return of the unmanned Orion spacecraft. This launch proved the technology capabilities and paves the way for the crewed missions.
    - **Artemis II:** Currently scheduled for 2024, Artemis II will carry a four-member crew of astronauts farther than any humans have ever been in space—beyond the far side of the Moon. The 8-10 day mission will include testing Orion's systems to ensure the crew can live in space,

demonstrating operations needed for future missions, orbiting the Moon, and collecting data before returning to Earth.
    - **Artemis III:** This will be the first crewed Moon landing since Apollo 17 in 1972. Astronauts in Orion will dock with Gateway and transfer to the Human Landing System to visit the Moon's South Pole region. The crew will remain in space for about a month before returning to Earth.
- Important Vocabulary
    - **Orion spacecraft** – NASA spacecraft that will carry astronauts from Earth to lunar orbit and back.
    - **Space Launch System Rocket** – the only rocket that can send Orion, astronauts, and cargo to the Moon on a single mission; the SLS is the most powerful rocket ever flown to space.
    - **Gateway** – the space station orbiting the Moon, where astronauts will live, conduct science experiments, and prepare for lunar surface missions. Gateway will orbit the Moon for at least 15 years, supporting long-term science investigations and discovery on and around the Moon in deep space.
    - **Human Landing System** – Starship Human Landing System, provided by SpaceX, is the final mode of transportation that will take astronauts from lunar orbit to the surface and back to orbit.
    - **Artemis Base Camp** – concept that includes all elements astronauts will need to explore and conduct science investigations on the Moon; base camp may include modern surface habitat, a rover, a mobile home, laboratory, power generation, storage, and all tools and equipment needed to live and work on the Moon

Part 2: Vehicle Assembly Building

To continue, players will need to use the elevator to go to the Vehicle Assembly Building.

Activity 2: Assemble, design, paint, and launch a satellite

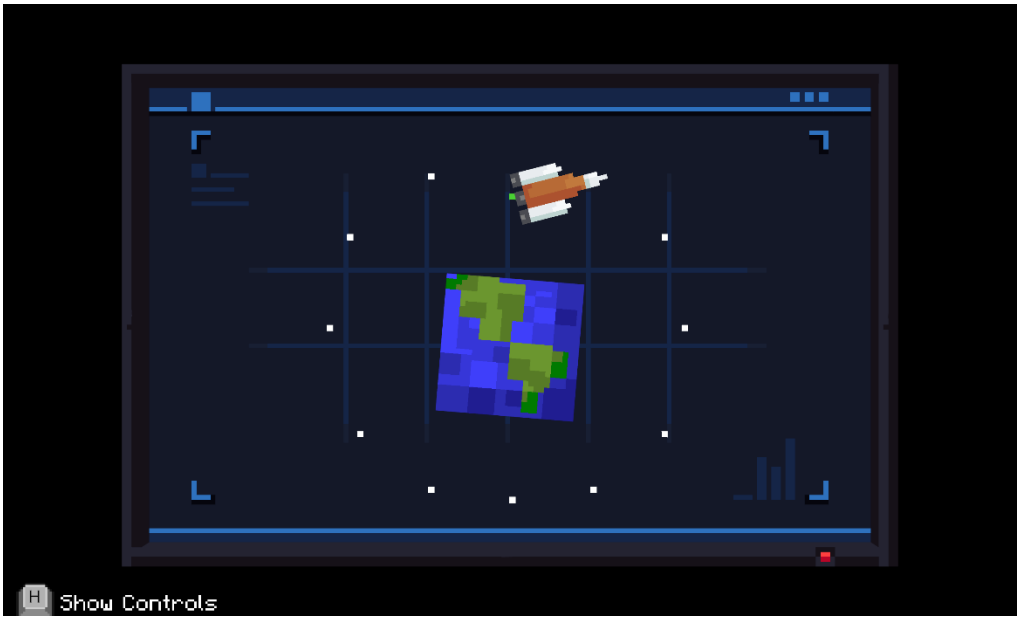
Players will now have the opportunity to build and test out some of the rocket parts. Each rocket part has a different value. Players must stay within the budget in order to test their build.

Part 1: Prototype a satellite based on the budget

Players can change the configuration of their satellite by pressing the arrow buttons shown on the screen. As you change something, you will see your budget increase or decrease.

In this activity, we can only use 50 emeralds for our design. If you try to test your build and its over budget, you will see simulation feedback and it will not allow you to test your build.

You will then see the simulation occur – you will see if your satellite is successful in its initial launch.



Part 2: Design the satellite

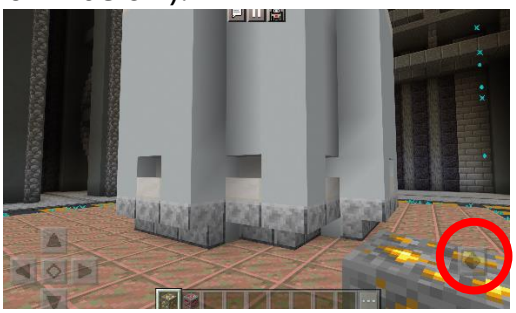
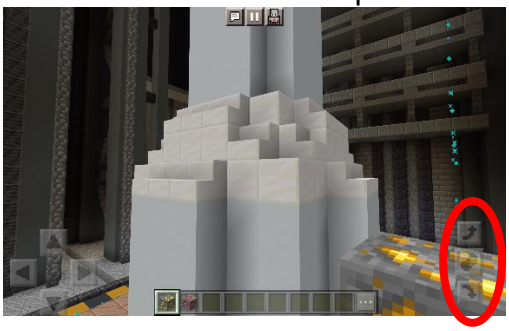
Welcome to the Upper Stage Building Hangar! In this space, players can redesign the Upper Stage however they would like. When they enter the build area, which is designated by the blue dots, the game will automatically change to Creative mode.

Players will also be able to tell that they are in Creative mode when the hearts located above their hotbar disappear.

Adventure Mode	Creative Mode
 (hearts above the hotbar)	 (no hearts above the hotbar)

In Creative mode, players will be able to fly and have access to unlimited inventory.

Helpful Hint – How to fly

Keyboard/Mouse	Touch Device
• Double tap on the [SPACE] bar to fly • Hold down the [SPACE] bar to fly up • Hold the [SHIFT] key to fly down • Double tap the [SPACE] bar to drop back down to the ground	Press the diamond-shaped button (shown below).  Use the arrows to move up and down. 

Helpful Hint – How to access and use the inventory

To open inventory, press the “E” key. 	You can use the keyword search to find specific materials (or even search by color or item type). 
Once you find a material, you can select the material and then drag and drop it into your hotbar. 	You have nine available active slots in the hotbar. You can use the numbers (1-9) to select something in your hotbar. 

Once players are finished with their design, they should return to the Instructor NPC. The Instructor will ask them if they are happy with the Upper Stage – they should select the “It’s done!” button to move on.

Players will get to see their customized build appear in the cinematic outtake.

Then, players will be instructed to paint their rocket. The players will automatically be given a spray can in their hand. They can change the color and the scale (i.e., size) of the spray based on the inventory items.

- Slot 1 and Slot 3 will allow you to change the color of the spray.
- Slot 5 and Slot 7 will allow you to change the scale of the spray.
- Slot 9 is the active spray can for you to use once you have changed the color and scale of the spray.

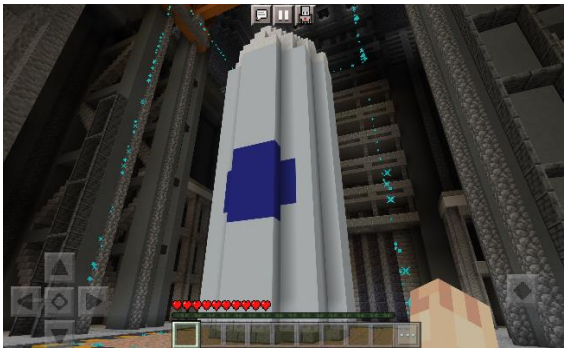
Once players are done painting, they will return to the Instructor again to let them know that they are finished. Their satellite will be launched into orbit!

Activity 3: Assemble, design, paint, and launch a cargo rocket

The cargo will hold experiments and instruments. These will help better prepare us for sending people to the Moon and give us important information about the landing spot. Launching to the Moon requires a much more powerful rocket to escape Earth's gravity.

Similar to Activity 2, players will need to select rocket parts within their budget. For this activity, players will have 160 emeralds. Once players have settled on a configuration within budget, they should select the “TEST” button to try out the simulation.

Once they have found a successful configuration, they will move back into the Upper Stage Building Hangar. They will get to redesign the cargo rocket. Players may use anything within their inventory.



Players will then have the option to paint their rocket.

Activity 4: Assemble, design, paint, and launch a rocket for a crew

In this activity, players will design a rocket outfitted for a crew! We are finally ready to send humans to the Moon. Sending people is different than just launching cargo—there must be a life support system to make sure astronauts have things like water, air, food, and ways to take care of waste! All of these additional items (plus the astronauts) are heavy! We must make sure the rocket has more power and fuel.

In addition, this rocket must be launched at a specific angle so in the case of an emergency, the astronauts can safely abort.

Similar to Activity 2 and Activity 3, players will need to select rocket parts within their budget. For this activity, players will have 190 emeralds. Once players have settled on a configuration within budget, they should select the “TEST” button to try out the simulation.

Once they have found a successful configuration, they will move back into the Upper Stage Building Hangar. They will get to redesign the upper stage for the crew. Players may use anything within their inventory.

Players will finish their design by painting this part of the rocket.

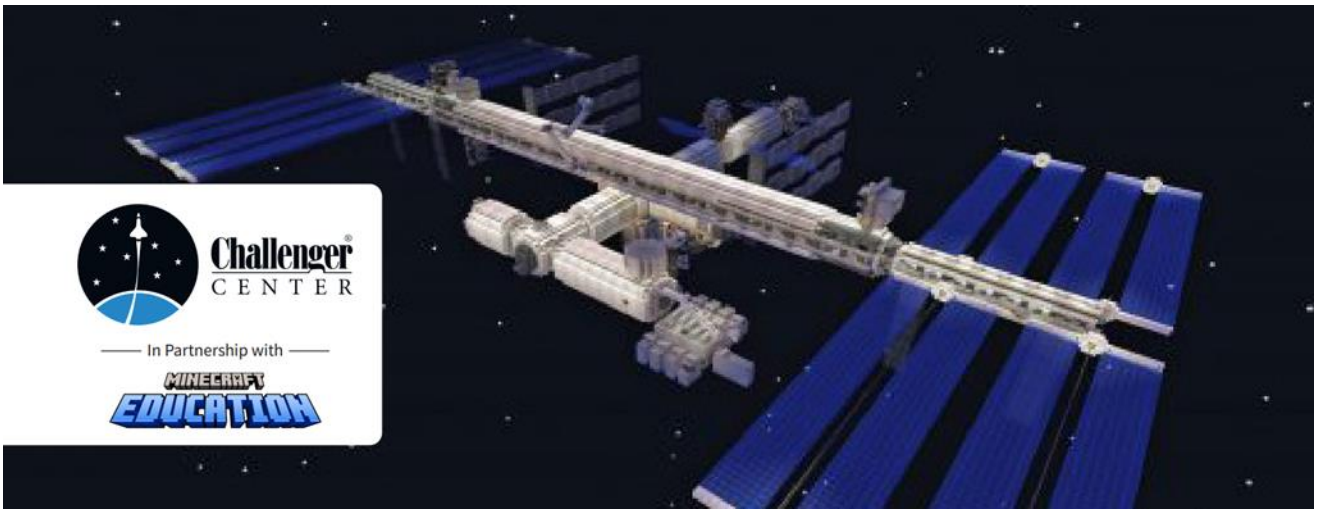
Finally...

3-2-1... BLAST OFF!

Mission Complete.

EXTENSION ACTIVITIES

The learning doesn't have to stop here!



The Challenger Center has designed and created additional learning materials that fully support the Artemis missions. Use the link below to find out more information and the additional lesson plans.

Challenger Center Activities

- Lesson 1: Apollo to Artemis History
- Lesson 2: NASA Coding and Diversity
- Lesson 3: Rockets
- Lesson 4: Moon Base Build
- Lesson 5: Teamwork
- Lesson 6: Luner Landing

MINECRAFT VISUAL GLOSSARY

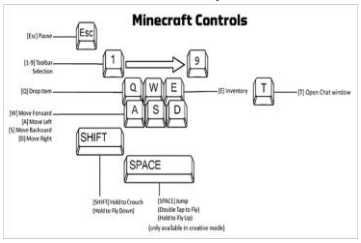
CREATIVE MODE

game mode allows players to fly and have access to unlimited inventory; in this game, you will be in creative when you are inside the blue dots

CONTROLS

(keyboard)

keyboard buttons that help you move around and complete tasks



CONTROLS

(touch)

the touch pad that helps you move around and complete tasks

PERSPECTIVE

you can change your in-game view (i.e., perspective) by pressing function + F5

DIALOG

a written conversational exchange between the player and NPC

HOTBAR

selection bar that appears on the bottom of the screen

IMMERSIVE READER

a tool to help players in reading or translating in-game text

INVENTORY

pop-up menu that shows all of the blocks and items available for use

MINECRAFT EDUCATION

a game-based learning platform

NPC

non-player character

SPAWN POINT

the location where a player begins game play

SPRAY CAN

the special inventory item (unique to this game) that will allow you to paint in different colors

HOW TO GET STARTED – MINECRAFT EDUCATION

Minecraft Education offers a unique learning platform where students can engage in creative builds and various game elements.

If you are licensed to use Minecraft Education through your O365 EDU account, download directly at aka.ms/download or reach out to your IT department for assistance. More information on deployment and license assignment can be found at aka.ms/meedeployguide.

Here's how to get setup:
1. First, check here to see if your school account is eligible.
2. If you do not have a valid O365 EDU account, you can still download and try a free demo on Windows, Mac or iPad.
3. Download Minecraft Education for Windows, Mac or iPad.

Once you are set-up with Minecraft Education, you should:

- Learn about Artemis: Rocket Build with this video.
- Use this Educator Guide!
- Play through Artemis: Rocket Build to get a better understanding of the lesson and how to navigate through the Minecraft world.

EDUCATIONAL STANDARDS – SCIENCE

NEXT GENERATION SCIENCE STANDARDS (NGSS) – UNITED STATES

Elementary (Grades 3-5)

3. Forces and Interactions 5-PS2-1 Motion and Stability: Forces and Interactions		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Planning and Carrying Out Investigations Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. **Connections to Nature of Science** **Scientific Investigations Use a Variety of Methods** • Science investigations use a variety of methods, tools, and techniques. **Science Knowledge is Based on Empirical Evidence** • Science findings are based on recognizing patterns.	**PS2.A: Forces and Motion** • Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. • The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) **PS2.B: Types of Interactions** • Objects in contact exert forces on each other. • The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.	**Cause and Effect** • Cause and effect relationships are routinely identified. • Cause and effect relationships are routinely identified and used to explain change. **Patterns** • Patterns of change can be used to make predictions.

EDUCATIONAL STANDARDS – SCIENCE

NEXT GENERATION SCIENCE STANDARDS (NGSS) – UNITED STATES

Middle School (Grades 6-8)

MS-PS2 Motion and Stability: Forces and Interactions		
Science and Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Constructing the Explanations and Designing Solutions • Apply scientific ideas or principles to design an object, tool, process or system. **Engaging in Argument from Evidence** • Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.	**PS2.A: Forces and Motion** • For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) • The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5) **Systems and System Models** • Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4) **Stability and Change** • Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2) **Influence of Science, Engineering, and Technology on Society and the Natural World** • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

EDUCATIONAL STANDARDS – SCIENCE

SCIENCE PROGRAMMES OF STUDY – NATIONAL CURRICULUM IN ENGLAND

Key Stage 2

Working Scientifically – Years 3 and 4

- asking relevant questions and using different types of scientific enquiries to answer them
- setting up simple practical enquiries, comparative and fair tests
- gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
- recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables
- using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
- identifying differences, similarities or changes related to simple scientific ideas and processes

Working Scientifically – Year 5 and 6

- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

Earth and Space – Year 5

- describe the movement of the Earth, and other planets, relative to the Sun in the solar system
- describe the movement of the Moon relative to the Earth
- describe the Sun, Earth and Moon as approximately spherical bodies

Forces – Year 5

- explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
- identify the effects of air resistance, water resistance and friction, that act between moving surfaces

EDUCATIONAL STANDARDS – SCIENCE

SCIENCE PROGRAMMES OF STUDY – NATIONAL CURRICULUM IN ENGLAND

Key Stage 3

Working Scientifically

Scientific attitudes

- pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- evaluate risks.

Experimental skills and investigations

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- make predictions using scientific knowledge and understanding
- select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate

Analysis and evaluation

- interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- identify further questions arising from their results.

Physics

Motion and forces

Describing motion

- speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)
- the representation of a journey on a distance-time graph
- relative motion: trains and cars passing one another.

Forces

- forces as pushes or pulls, arising from the interaction between two objects
- moment as the turning effect of a force
- forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water
- forces measured in newtons, measurements of stretch or compression as force is changed
- non-contact forces: gravity forces acting at a distance on Earth and in space, forces between magnets and forces due to static electricity.

Balanced forces

- opposing forces and equilibrium: weight held by stretched spring or supported on a compressed surface.

Forces and motion

- forces being needed to cause objects to stop or start moving, or to change their speed or direction of motion (qualitative only)
- change depending on direction of force and its size.

EDUCATIONAL STANDARDS – SCIENCE

AUSTRALIAN F-10 CURRICULUM – SCIENCE

Year 3

Science involves making predictions and describing patterns and relationships (ACSHE050)

- making predictions about change and events in our environment
- considering how posing questions helps us plan for the future

Year 4

Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076)

- observing qualitatively how speed is affected by the size of a force
- exploring how non-contact forces are similar to contact forces in terms of objects pushing and pulling another object

Science involves making predictions and describing patterns and relationships (ACSHE061)

Year 5

The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)

- identifying the planets of the solar system and comparing how long they take to orbit the sun
- modelling the relative size of and distance between Earth, other planets in the solar system and the sun

Scientific knowledge is used to solve problems and inform personal and community decisions

- describing how technologies developed to aid space exploration have changed the way people live, work and communicate

Year 7

Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object (ACSSU117)

- investigating the effects of applying different forces to familiar objects
- investigating common situations where forces are balanced, such as stationary objects, and unbalanced, such as falling objects
- exploring how gravity affects objects on the surface of Earth
- considering how gravity keeps planets in orbit around the sun

Year 8

Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems (ACSSU155)

- recognising potential energy is stored energy, such as gravitational, chemical, and elastic energy
- investigating different forms of energy in terms of the effects they cause, such as gravitational potential causing objects to fall and heat energy transferred between materials that have a different temperature

Year 10

The motion of objects can be described and predicted using the laws of physics (ACSSU229)

- gathering data to analyse everyday motions produced by forces, such as measurements of distance and time, speed, force, mass and acceleration
- recognising that a stationary object, or a moving object with constant motion, has balanced forces acting on it
- using Newton's Second Law to predict how a force affects the movement of an object
- recognising and applying Newton's Third Law to describe the effect of interactions between two objects