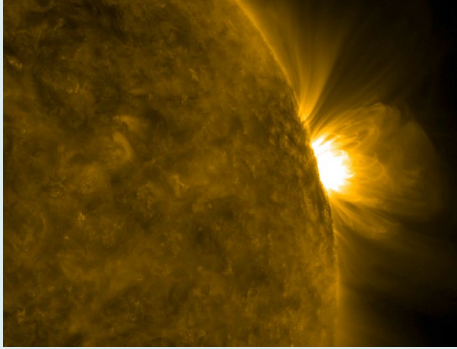


# Earth & Space Content Framework

The Earth & Space Content Framework presents six key science content ideas for informal educators engaging the public with research, discoveries, and missions from NASA's Science Mission Directorate. These six ideas represent a basic understanding of Earth and space science. To further illustrate each main idea, the following pages show

suggested content connections using NISE Network examples from the Explore Science: Earth & Space toolkits and the *Sun, Earth, Universe* exhibition. The Content Framework is a companion to the Earth & Space Learning Framework, which describes the kinds of learning experiences valued by the network when using Earth and space science content.



## The Sun powers Earth and our solar system.

Our nearest star emits a massive amount of energy across the electromagnetic spectrum and through a stream of charged particles.



## Earth is a dynamic planet.

Interactions between air, water, rock, and life, including human activities, change our planet and its climate.



## Planets and moons beyond our home world may contain water and life.

Exploring the variety of planets, moons, and smaller objects in and outside our solar system helps us to better understand life on Earth.



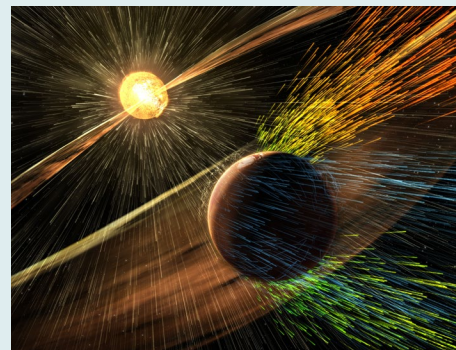
## The universe is very large, old, and mysterious.

Billions of galaxies, including countless stars, planets, and nebulae, fill a vast and expanding universe.



## Our society chooses to explore Earth and space.

Our values influence how we ask questions, develop specialized tools and technology, and work together when exploring Earth and space.



## Forces and energy connect everything in the universe.

Gravity, magnetism, and the energy transmitted by light shape all parts of the universe and help us learn more about Earth and space.



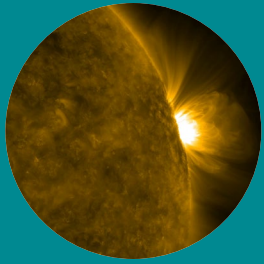
# Earth & Space Product Matrix

The Earth & Space Product Matrix shows the alignment of NISE Network resources to the three principles of the Earth & Space Learning Framework as well as the six key science content ideas of the Earth & Space Content Framework, and includes the year each was added to

the Explore Science: Earth & Space Toolkits. The hands-on activities are listed in order of toolkit subcategories: Exploring Earth, Exploring Science Practices, Exploring the Solar System, and Exploring the Universe, with the *Sun, Earth, Universe* exhibition listed at the bottom.

	PRINCIPLES			TOOLKIT YEAR				CONTENT AREA					
	PHENOMENA	PROCESS	PARTICIPATE	2017	2018	2019	2020	SUN	EARTH	PLANETS	UNIVERSE	SOCIETY	FORCES + ENERGY
<b>EXPLORING EARTH</b>													
Exploring Earth: Bear's Shadow*	X			X			X	X	X				
Exploring Earth: Investigating Clouds	X	X	X	X			X		X			X	
Exploring Earth: Land Cover	X	X	X			X			X			X	X
Exploring Earth: Paper Mountains	X	X	X		X				X			X	X
Exploring Earth: Rising Sea		X	X	X		X			X			X	
Exploring Earth: Temperature Mapping	X	X				X		X	X			X	X
<b>EXPLORING SCIENCE PRACTICES</b>													
Exploring Science Practices: Early Explorations*	X	X					X		X				
Exploring Science Practices: Measure Up*	X	X					X		X				
<b>EXPLORING THE SOLAR SYSTEM</b>													
Exploring the Solar System: Asteroid Mining	X	X	X				X			X		X	
Exploring the Solar System: Big Sun, Small Moon	X	X		X				X	X				
Exploring the Solar System: Craters	X	X			X		X		X	X			X
Exploring the Solar System: Design, Build, Test		X	X				X					X	X
Exploring the Solar System: Hide and Seek Moon*	X	X	X		X	X			X			X	
Exploring the Solar System: Magnetic Fields	X	X			X			X	X	X			X
Exploring the Solar System: Mars Rovers		X	X		X					X		X	
Exploring the Solar System: Mission to Space		X	X				X	X	X	X	X	X	
Exploring the Solar System: Moonquakes	X	X					X		X	X			X
Exploring the Solar System: Observe the Moon	X	X	X				X	X	X				
Exploring the Solar System: Observe the Sun	X	X	X			X		X	X				X
Exploring the Solar System: Pocket Solar System		X		X		X				X		X	
Exploring the Solar System: Solar Eclipse	X	X		X				X	X				
Exploring the Solar System: Stomp Rockets		X	X		X	X						X	X
Exploring the Solar System: Story Blocks*		X	X				X					X	
<b>EXPLORING THE UNIVERSE</b>													
Exploring the Universe: Exoplanet Transits	X	X			X					X	X	X	X
Exploring the Universe: Expanding Universe	X	X				X					X		X
Exploring the Universe: Filtered Light	X	X			X	X					X		X
Exploring the Universe: Ice Orbs	X	X		X						X			
Exploring the Universe: Imagining Life		X	X	X					X	X		X	
Exploring the Universe: Nebula Spin Art	X	X					X				X		X
Exploring the Universe: Objects in Motion	X	X			X				X	X	X		X
Exploring the Universe: Orbiting Objects	X	X		X			X	X		X	X		X
Exploring the Universe: Pack a Space Telescope		X			X						X	X	X
Exploring the Universe: Space Guess Quest Game		X				X	X			X	X		
Exploring the Universe: Star Formation	X	X					X				X		X
Exploring the Universe: Static Electricity	X	X				X			X	X			X
<i>Sun, Earth, Universe</i> Exhibition	X	X	X					X	X	X	X	X	X

\* These activities were specially designed for young learners.



# The Sun powers Earth and our solar system.

Our nearest star emits a massive amount of energy across the electromagnetic spectrum and through a stream of charged particles.

## Changes in solar activity affect Earth.

In Exploring the Solar System: Observe the Sun, learners discover more about the solar activity cycle and have the opportunity to observe sunspots. During periods of intense solar activity, the Sun can emit particles that interfere with our satellite technology or cause brighter and more colorful auroras.



Exploring the Solar System: Observe the Sun

## Energy from the Sun is absorbed or reflected.

In Exploring Earth: Temperature Mapping, learners use an infrared thermometer and a lamp to investigate how different materials change temperature when they're exposed to light. Different types of land cover on Earth absorb more or less light from the Sun, causing extreme temperature differences between urban and rural areas.



Exploring Earth: Temperature Mapping

## The Sun emits different types of light.

At the Sun component of the *Sun, Earth, Universe* exhibition, learners can use the flip panels to see what the Sun looks like when observed in different wavelengths of light across the electromagnetic spectrum. The flip panels show differences in the amount of infrared, visible, and ultraviolet light emitted by the Sun at the same moment in time.



*Sun, Earth, Universe* exhibition





# Earth is a dynamic planet.

Interactions between air, water, rock, and life, including human activities, change our planet and its climate.

## Global sea level is rising due to climate change.

In Exploring Earth: Rising Sea, learners explore how to map changes in sea level using overhead views similar to those of a NASA satellite. Human activity has increased the temperature of our planet, melting more of the polar ice caps. Just like in the model, with more water in the ocean, sea level rises over time, covering coastal land.



Exploring Earth: Rising Sea

## Meteorite impacts can leave craters on Earth.

In Exploring the Solar System: Craters, learners simulate a meteorite impact and then study the resulting crater. Meteorite impacts occur throughout the solar system but are more frequent on planets and moons with thin atmospheres. Earth's thick atmosphere causes many meteors to burn up into harmless dust before they reach our planet's surface.



Exploring the Solar System: Craters

## Plants can reduce the effects of erosion on land.

In Exploring Earth: Land Cover, learners pour water over pebbles, with or without a simulated root system, to observe differences in erosion. Heavy rain on steep hillsides without a stable root system from mature trees and other plants is a common factor leading to landslides.



Exploring Earth: Land Cover



# Planets and moons beyond our home world may contain water and life.

Exploring the variety of planets, moons, and smaller objects in and outside our solar system helps us to better understand life on Earth.

## Icy moons may host underground oceans.

In Exploring the Universe: Ice Orbs, learners investigate spheres of ice mimicking icy moons found around planets such as Jupiter and Saturn. Some of these icy worlds are believed to contain oceans of liquid water, which might in turn be home to life.



Exploring the Universe: Ice Orbs

## Many stars in our galaxy are orbited by planets.

At the universe component of the *Sun, Earth, Universe* exhibition, learners can spin the beads to get a sense of how many of the stars we see in the night sky might host planets. Many of the stars in the Milky Way may have orbiting planets, but a much smaller percentage host Earth-sized planets that may contain life.



*Sun, Earth, Universe* exhibition

## There is a lot of space between planets in our solar system.

In Exploring the Solar System: Pocket Solar System, learners create a scale model solar system using a simple folding technique. Given the great distances between planets, it may only take months for a NASA mission to reach Mars compared with the years it would take to reach the outer planets of the solar system.



Exploring the Solar System: Pocket Solar System





# The universe is very large, old, and mysterious.

Billions of galaxies, including countless stars, planets, and nebulas, fill a vast and expanding universe.

## Stars form when gas and dust clump together.

In Exploring the Universe: Star Formation, learners use a model to explore how different types of stars form. The more gas and dust that clump together, the larger the new star's mass. Most known stars range from less massive and cooler red dwarf stars to more massive and very hot blue stars.



Exploring the Universe: Star Formation

## Nebulas are large clouds created by dying stars.

In Exploring the Universe: Nebula Spin Art, learners create a model of a dying star by mixing up paint into colorful creations. The messy process of creating a nebula stirs up elements in nearby space, which become the building blocks for new stars and planets.



Exploring the Universe: Nebula Spin Art

## The universe has been expanding for a long time.

In Exploring the Universe: Expanding Universe, learners demonstrate that the universe is expanding, even though objects within it aren't. Many objects are held tightly together by gravity, such as Earth, our solar system, and even galaxies like the Milky Way.



Exploring the Universe: Expanding Universe



## Our society chooses to explore Earth and space.

Our values influence how we ask questions, develop specialized tools and technology, and work together when exploring Earth and space.

### Planning a mission to space is a complex process with many steps.

At the board game within the *Sun, Earth, Universe* exhibition, learners use teamwork to plan and execute a space mission. Mission teams include scientists, engineers, technicians, artists, and members from many more professions. They work together to develop questions, plan experiments, and build spacecraft that will explore our planet, the solar system, and beyond.



*Sun, Earth, Universe* exhibition

### We ask questions about the future to help us consider new space technology.

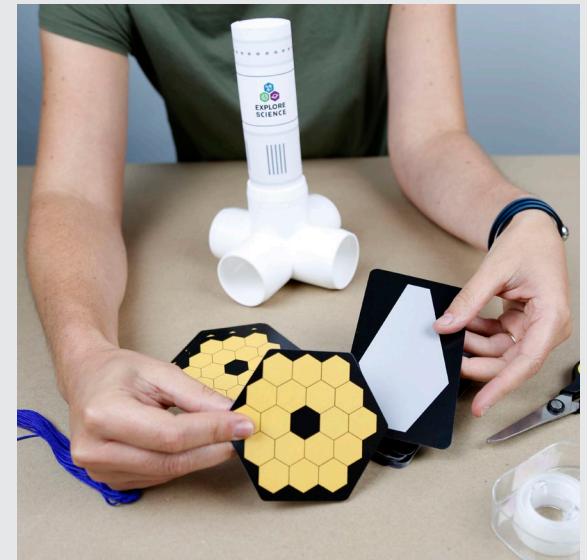
In Exploring the Solar System: Asteroid Mining, learners imagine how future societies might mine materials from asteroids. Before scientists and engineers can start mining, however, they need to come up with ideas for how their mining machines might work. Our society will also need to consider how mining asteroids might change our lives, now and into the future.



Exploring the Solar System: Asteroid Mining

### NASA teams work together to launch, guide into orbit, and operate a space telescope.

In Exploring the Universe: Pack a Space Telescope, learners practice folding and unfolding a model space telescope with a launch vehicle. Each NASA space telescope requires diverse groups of scientists, engineers, managers, and other professionals to ensure all of its many components will have a successful launch and become an operational observatory.



Exploring the Universe: Pack a Space Telescope





# Forces and energy connect everything in the universe.

Gravity, magnetism, and the energy transmitted by light shape all parts of the universe and help us learn more about Earth and space.

## Gravity keeps objects in orbit.

In Exploring the Solar System: Orbiting Objects, learners use a model to explore how gravity influences objects. Every object in space exerts a gravitational pull on every other object. Gravity keeps planets and other objects in orbit around stars and also makes stars move within a galaxy.



Exploring the Solar System: Orbiting Objects

## The Sun's magnetic fields extend out into space, impacting planets in the solar system.

In Exploring the Solar System: Magnetic Fields, learners use paper clips to map out the magnetic fields on the surface of a model Sun. Charged particles leaving the Sun, known as the solar wind, can cause extra electrical currents to flow around the planets of the solar system. These currents can be observed as auroras.



Exploring the Solar System: Magnetic Fields

## NASA scientists use telescopes and other instruments to capture and filter different energies of light.

In Exploring the Universe: Filtered Light, learners use color filters to examine features captured in space images. Scientists use telescopes and other tools to make observations of multiple energies of light, including infrared, ultraviolet, and visible light. Studying the same space object with different filters reveals more information than what we can see with our eyes only.



Exploring the Universe: Filtered Light