Virtual Discovery Kit.

Be curious. GRAND RAPIDS PUBLIC MUSEUM

Space Exploration.

Pictured: Astronaut Nicholas Patrick performing maintenance on the International Space Station.

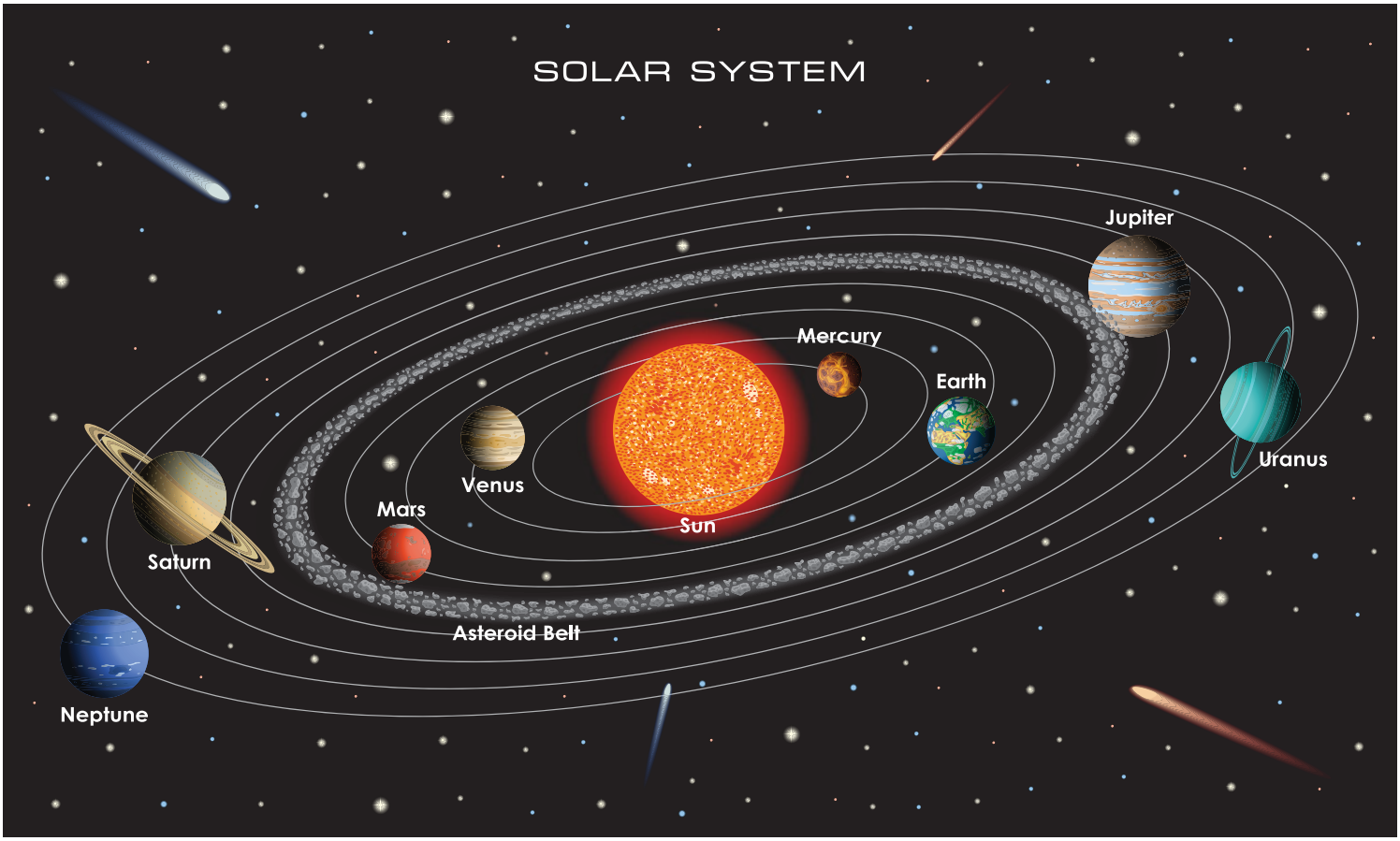
grpm.org

Space, the final frontier! Discover what we know about outer space as well as how astronauts and astronomers explore this infinite universe.

Explore the artifacts and specimens in the GRPM digital Collections at https://www.grpmcollections.org/Detail/occurrences/349 then have fun with these activities.

What is Space?

Outer space begins past the Earth's protective layer of gasses, called the atmosphere. It may seem like it is just dark and empty, but outer space is not empty at all! There are actually many objects in space, including galaxies, planets, moons and stars. The word astronomers use for these objects that occur naturally outside of Earth's atmosphere is "celestial body."



DID YOU KNOW?

- There are 8 planets in our solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.
- Jupiter has 79 moons! Four of them are so big, they can be seen from Earth with a pair of binoculars.
- The sun is a yellow dwarf star. Its temperature is more than 9000°F.

References:

- https://spaceplace.nasa.gov/story-whats-in-space/en/
- https://www.esa.int/kids/en/learn/Our_Universe/Story_of_the_Universe/What_is_space

Be curious.

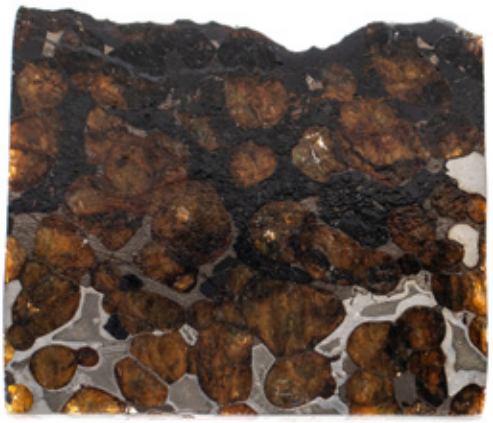
Space Vocabulary

- What is an **orbit?** The motion of an object traveling in a regular, repeating path around another object in space.
- What is our **solar system?** It includes the sun and all other objects that orbit it--including planets, moons and asteroids.
- What is a **planet?** A planet is a celestial body that is spherical, or round, in shape that orbits a star. For example, the star that planet Earth orbits is the Sun.
- What is a **moon?** A moon is a celestial body that orbits a planet. Moons come in many different materials, shapes and sizes.
- What is a **star?** Stars are balls of extremely hot gas that create enough energy to glow.
- What is an **asteroid?** Small rocky objects that orbit the Sun; they are smaller than planets.
- What is a **comet?** Comets are celestial objects that orbit the sun, and they are made of ice and dust (not rock like asteroids). On occasion, comets are visible from Earth.
- What's the difference between **meteoroids, meteors and meteorites?**
    - **Meteoroids** are small rocky objects that travel through space that are smaller than asteroids. Sometimes they are even made from pieces of asteroids that break up.
        - A **meteor** is a bright streak of light that is created when a meteoroid burns up in Earth's atmosphere.
            - **Meteorites** are what we call pieces of meteors that have landed on Earth's surface.

Take a look at some of the meteorites in the GRPM's Collection:

1st meteorite found in Grand Rapids, MI

Iron Meteorite



Brenham Meteorite

Sikhote-Alin Meteorite

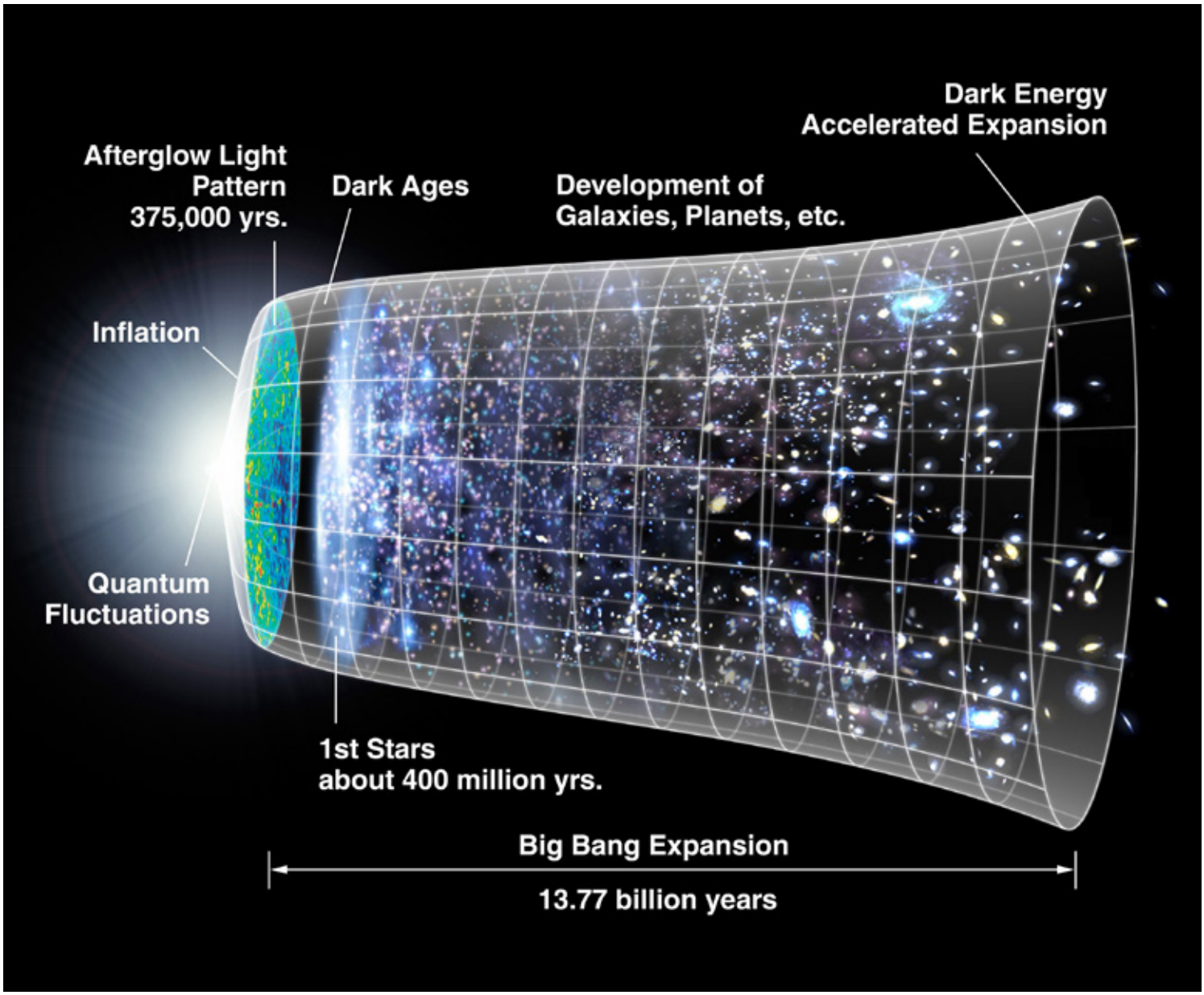
References:

- https://spaceplace.nasa.gov/asteroid/en/
- https://solarsystem.nasa.gov/planets/in-depth/
- https://solarsystem.nasa.gov/moons/overview/
- https://spaceplace.nasa.gov/how-many-moons/en/
- https://www.khanacademy.org/partner-content/amnh/the-universe/stars/a/what-is-a-star

Where Did Space Come From?

Scientists believe that the Big Bang created the universe about 14 billion years ago. What started out as something smaller than the head of a pin expanded into our universe and it continues to grow today.

The development of the universe is complicated and a bit mind-boggling. The graphic below shows a timeline of the Universe as it continues to expand. The Big Bang is at the bright point at the left, while present day is at the right nearly 14 billion years later. In between, you can see the ongoing development and expansion of galaxies, planets and other celestial bodies over time.



References:

- https://spaceplace.nasa.gov/big-bang/en/
- https://www.nationalgeographic.com/science/space/universe/origins-of-the-universe/
- https://science.nasa.gov/astrophysics/focus-areas/what-powered-the-big-bang

How Do We Learn About Space?

We learn about outer space by physically sending satellites or spacecraft there, but we can also learn about space from Earth. Special instruments, called telescopes, allow us to see objects in space. Telescopes can range from being homemade and simple all the way to very high-tech, expensive devices that orbit Earth.

One of the most well-known telescopes is called the Hubble Space Telescope. It was launched in 1990 and is still traveling through space*. Hubble has made over 1,000,000 observations! It helped astronomers discover a black hole, find oxygen on one of Jupiter's moons, capture the birth of a star and discover planets beyond our solar system.

*Hubble is still in space at the time of this resource's publication, May 2020

Photo caption: Telescope on the observation deck of the Eiffel Tower, Paris, France

Photo caption: Hubble telescope in space

Photo caption: Red supergiant, Monocerotis. Image taken from the Hubble Space Telescope

Photo caption: Grand-design spiral galaxy Messier 74. Image taken from the Hubble Space Telescope

References and Photos:

- https://www.nasa.gov/content/goddard/hubble-timeline-full-text

Space Exploration Timeline.

Space has been captivating humans for centuries. Here are some of the most notable events in space exploration.

84 BCE - 322 BCE: — Aristotle hypothesizes that Earth is the center of the universe with everything else rotating around it.

1543: — Nicolaus Copernicus suggests that the Sun is the center of the universe.

1609: — Galileo Galilei creates his first telescope; he discovers the terrain of the Moon and four of Jupiter's moons. He also confirms that the planets rotate around the Sun, not Earth.

1642 - 1726: — Issac Newton develops mathematical laws explaining the movement of objects, including gravity.

1920s: — Using telescopes, Edwin Hubble discovers that there are more galaxies in the universe.

1927: — Georges Lemaitre suggests the Big Bang Theory, to explain how the universe developed.

October 4, 1957: — The first satellite, named Sputnik, is launched into space by the Soviet Union.

October 1, 1958: — The National Aeronautics and Space Administration (NASA) is founded.

1961: — The Soviet Union sends the first human to space, Yuri Gagarin. Alan Shephard is the first American in space one month later.

July 20, 1969: — Neil Armstrong and Buzz Aldrin are the first humans to walk on the moon.

April 11, 1970: — Apollo 13 launches and heads toward the moon. An oxygen tank ruptured and disaster was narrowly avoided. The famous line "Houston we've had a problem" came from this mission.

1983: — Sally Ride is the first American woman and Gulon Bluford is the first African American in space.

January 28, 1986: — Space shuttle Challenger disaster. The spacecraft exploded 73 seconds into its mission when the main fuel tank ignited. All seven astronauts on board perished.

August 24, 1990: — Hubble Telescope is deployed. Hubble observes stars, galaxies, and planets throughout the solar system.

September 12, 1992: — Mae Jemison is the first African American woman in space.

July 4, 1997: — Mars Pathfinder, Sojourner, arrives on Mars. Sojourner gathers pictures, samples, and other data from Mars.

November 20, 1998: — The International Space Station (ISS) is launched.

December 8, 2010: — SpaceX, a private company, launches a spacecraft and successfully brings it back to earth.

November 26, 2011: — Mars rover Curiosity is launched with the mission to see if Mars can support microbial life.

July 14, 2015: — The space probe, New Horizons, visits Pluto for the first time.

2020: — SpaceX plans to launch their first flight crewed by humans, aboard the Crew Dragon spacecraft. This will be the first crewed spacecraft to go to the International Space Station since NASA's space shuttle program ended in 2011.

Take a closer look:

1. Which space event happened closest to the year you were born?

2. Which space event happened closest to the year your parent(s) were born? How about a grandparent?

3. What do you think will be the next major space-related discovery or event?

References:

- https://www.archives.gov/research/alic/reference/space-timeline.html
- https://www.nasa.gov/missions
- https://starchild.gsfc.nasa.gov/docs/StarChild/universe_level2/cosmology.html
- https://newatlas.com/space/first-manned-crew-dragon-flight-date/
- https://history.nasa.gov/
- http://solar-center.stanford.edu/galileo/
- https://spaceplace.nasa.gov/big-bang/en/

What Is It Like to Visit Space?

Our bodies are adapted for life on Earth where there is plenty of air to breath, significant gravity and livable temperatures. Scientists and engineers have to find new ways to help astronauts adapt to the environment in outer space that our bodies are not used to.

Our bodies need to adjust to the changes:

- In the very low gravity of space, called microgravity, you don't use your muscles for everyday tasks like walking and standing. Therefore, it is very important to exercise every day so your muscles don't weaken.
- Your body actually stretches out and becomes an inch or two taller.
- When you get back to Earth, you have to relearn how to use muscles that you didn't use in space. It also takes a while for your balance to return.

Some daily routines looked very different:

- To stay in place while you sleep, you need to strap your sleeping bag to the floor, wall or ceiling. You also strap your head to a pillow with Velcro.
- Staying clean can be challenging. Showering in space is impossible! Instead of taking a shower, you would use dry shampoo and soaps that do not need to be rinsed off with water.
- There is no way to cook in the space station, and fresh food is hard to keep on a mission, so most food is freeze-dried.

Draw a picture of or describe yourself doing a task in space.

Remember, there is no gravity so your body and all objects will be weightless and floating.

References and Photos:

- https://www.nasa.gov/audience/forstudents/k-4/home/F_Living_in_Space.html
- https://www.nasa.gov/feature/an-astronaut-s-tips-for-living-in-space-or-anywhere
- https://www.wired.com/2014/11/marsha-ivins/

Becoming an astronaut

NASA has requirements to become an astronaut, including: [1]

1. U.S. citizenship
2. Master's degree in a STEM field, including engineering, biological science, physical science, computer science or mathematics, from an accredited institution.
3. At least two years of related professional experience or at least 1,000 hours pilot-in-command time on jet aircraft.
4. Pass the NASA long-duration flight astronaut physical.

Once somebody is accepted as an astronaut candidate, they go through very difficult training [2]. They take many classes, practice public speaking, learn new languages, and complete training to give medical care. Astronaut candidates also participate in a variety of simulations to get used to the conditions in space.

▲
Photo caption: Six astronauts in training at the Johnson Space Center in the aircraft KC-135. This is designed to let them experience what is like to be weightless. The aircraft uses special engineering to create brief periods of microgravity. It is nicknamed the Vomit Comet because it makes people feel sick to their stomach.

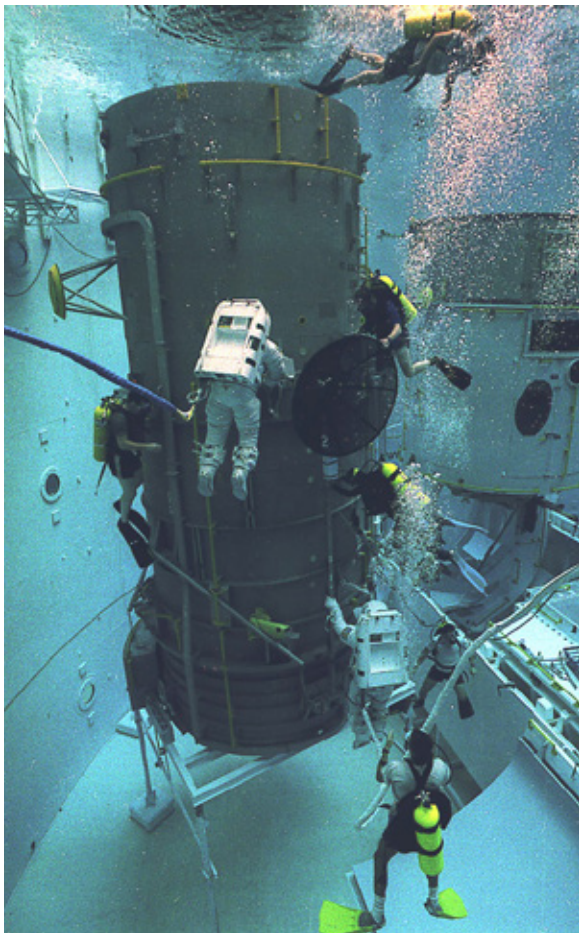


Photo caption: Underwater view of astronauts training in the Neutral Buoyancy Simulator--a large swimming pool filled with more than 6,000,000 gallons of water. They are able to practice carrying out tasks, like repairing the Hubble Space Telescope, while being in low gravity conditions and wearing bulky spacesuits. ▶

What do you think?

If you were an astronaut, where would you want to go in outer space? What planet, moon or galaxy would you want to explore?

[1] https://www.nasa.gov/audience/forstudents/postsecondary/features/F_Astronaut_Requirements.html
[2] https://www.nasa.gov/audience/forstudents/5-8/features/F_Astronauts_in_Training.html

Museum Object Study

Specimens are all around us; they are the plants, animals and minerals that make up the world we live in. They form our understanding of Earth and inform humanity's role in the environment. These natural collections represent our planet's diversity at a particular place and time.

Artifacts are all around us, too. They are the objects humans make and use. They frame our understanding of our world and the people in it. Everyday objects hold many stories and pieces of information that we can uncover! Take a shoe for instance. It can become the spark for a study of fashion or advertising; it can generate comparisons of human and animal feet; it could even spark questions about gender, sports and culture.

Reading an Object

Learning to 'read' objects is a skill to be acquired through practice, just like reading a book. Observations help teach us how to really look at an object and make inferences.

Some questions you may ask of any natural specimen are included here:

Describe

- What color(s) is it?
- Describe its texture, shape, size, structure (e.g., rough, furry, circular, large, four-legged, etc.)

Role

- What is it? Animal, plant, rock/mineral?
- What is its role in nature?

Setting

- What habitat (rainforest, desert, tidepool, etc.) would the specimen be found in?
- What is its range (across Michigan, the United States, North America, etc.)?
- Is the object found in the past, present, or both?

Big Idea

- What can we learn from it?
- Why was this object chosen from the GRPM Collections?
- How could this specimen be used to tell a bigger scientific story?

Some questions you may ask of any artifacts are included here:

What is it?

- Describe or draw the object.
- What does it look like, feel like, sound like?
- How big is it?
- What materials is it made from?

What was it used for?

- What can you infer based on your observations?

Who made the object?

- Who used it? Owned it?

How has it changed over time?

- Do we use the same or similar object today? If yes, explain.
- If we no longer use the object, what has taken its place?

What is the object's social significance?

- Why was it chosen for this collection?
- What story does it tell us? What can we learn from it?

Where was the object created?

- Where was it used?
- What can we learn about this object based on where it came from?

When was this object created/used?

- What does this tell us about the time period in which the object was created?
- What can we learn about the world through this piece? How has the world changed

Practice your observations with the Artifact and Specimen Observations guide. You can make a detailed observation of each specimen in the Space Exploration Discovery Kit Collection.

Identifier: 2011.3.4 Identifier: E2007.1.109 Identifier: 2019.9.93 Identifier: E2007.1.101 Identifier: 2018.55.1

Artifact and Specimen Observations

Object Name:_____ Accession Number: _____

Describe and/or sketch your detailed observations of the object.

Consider its texture, appearance, shape, and size. Record labels, patterns, markings, and anything else you think is interesting.

Record Measurements:

Don't forget the units!

Length: _____

Width:_____

Height: _____

Record Materials.

What is the object made from?

1._____

2._____

3._____

4._____

5._____

Other thoughts and wonderings.

What did you learn about this object?
What are you curious about?

_____

_____

_____

_____

_____

_____

_____

_____

Roger B. Chaffee, a hometown hero.

Roger B. Chaffee, born in Grand Rapids, MI, was an American naval officer and aviator, aeronautical engineer, and NASA astronaut in the Apollo program. The GRPM's planetarium is named in his honor, the Roger B. Chaffee Planetarium. On January 27, 1967, tragedy struck NASA's Apollo program when a flash fire occurred in command module 012 during a launch pad test of the Apollo/Saturn space vehicle being prepared for the first piloted flight, the AS-204 mission. Chaffee, who was preparing for his first spaceflight, was one of three astronauts who died in this tragic accident.

Reflect on an essay written by 14-year-old Roger Chaffee:

We can learn a lot about a person and about the time they grew up by studying primary sources such as writings. In his essay, "Why I Chose My Career" Roger B. Chaffee tells about his home life and hobbies as well as discussing his interest in pursuing a career in electronic engineering after high school. He was 14 years old when he wrote this.

Analyze his essay:

1. Visit the GRPM online Collections and ready Roger's essay: "Why I Chose My Career"
2. Describe at least two things you can learn about Roger by reading this childhood essay.

---

5. At just 14 years old, Roger B. Chaffee knew what career he wanted to pursue. Draw or describe what type of things you would like to do for a career. Consider:[3]
   - What problem do you want to solve?
   - How do you like to spend your time? What things are you excited about?
   - Who do you look up to? What about them inspires or motivates you?

[3] https://www.wellesley.edu/careereducation/resources/20-questions-jumpstart-your-career-exploration-0

Create Your Own Astronomical Tools

For thousands of years, curious scientists and astronomers have used tools to help them study the mysteries of space. Create your own tools, then get outside to use them.

Planispheres:

Planisphere is another name for star finder. There is evidence of people using early star finders in ancient Rome, more than 2,000 years ago![4] Planispheres are simple to put together and can be used to find stars and study the sky without expensive equipment.

- The Grand Rapids Amateur Astronomical Association offers instructions and a video tutorial to make a planisphere:
  - How to Assemble and Use a Planisphere
  - Video Tutorial - Learn How to Assemble and Use a Planisphere

An early Islamic star finder called an Astrolabe

A star chart from 1670.

Solar system models:

Before modern tools like telescopes and spacecraft existed, people began speculating about outer space and developing models to share their ideas. People in the past used to think that the sun and other objects in outer space orbited around the Earth. Now, we understand that all of the objects in our solar system, including our planet Earth, orbit around the sun.

Scientific models are ways of representing real things. They can be physical models, drawings or even math equations. Models can help us understand things that are hard to visualize or that are very big. Solar system models can help us see about what planets are in our solar system, the sizes of these plants or the distances between them.

- Create your own solar system model using materials you have around the house.
  - Solar System modeling ideas for elementary-aged learners: Scholastic's Making Models of the Solar System; PBS Learning Media - Meet the Planets
  - Solar System modeling for middle school-aged learners: PBS Learning Media - Map a Model Solar System
  - Complex lesson for high school-aged learners: NASA - The Voyage Scale Model Solar System

[4] https://skyandtelescope.org/astronomy-resources/star-finding-with-a-planisphere/

Telescopes.

In 1609, Galileo Galilei created the very first telescope; with it, he discovered what the surface of the moon looked like and was the first person to see some of Jupiter's moons.

- Follow the directions at National Geographic Kids steps to Make a Telescope at home.

Imagine:

What do you think it would have been like to be the very first person to look into space with a telescope and discover new things like moons?

References:

- http://www.supercoloring.com/coloring-pages/earth-and-moon

What Do You Think?

- What do you think is the coolest object in this collection? Why?

- What is the most interesting thing you learned in this discovery kit?

- If you could travel to outer space, would you? Where would you want to go?

- What do you think it would be like to be an astronaut?

- What is one question you still have about space exploration?

Learn more!

Opportunities to learn more through NASA's resources are endless. Check out these cool things.

- NASA TV - Always streamed live on YouTube. They always stream spacewalks live here.
- Story Time from Space
- Make a Cardboard Rover - Instructions for this make-at-home activity that uses common household supplies
- Space Place
- Submit a Question for NASA

A Day in the Life Aboard the International Space Station.
https://www.nasa.gov/audience/foreducators/stem-on-station/dayinthelife

STEMonstrations - Watch astronauts perform STEM demonstrations on the International Space Station.
https://www.nasa.gov/audience/foreducators/stem-on-station/dayinthelife

Watch President John F. Kennedy's speech about the nation's space effort, given at Rice University in 1962. This speech includes the famous line, "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard."

- https://www.jfklibrary.org/learn/about-jfk/historic-speeches/address-at-rice-university-on-the-nations-space-effort

Explore the European Space Agency's Space for Kids website.

- https://www.esa.int/kids/en/home
- Navigate through intergalactic games and activities with Paxi, a little green explorer from another planet.

The Jet Propulsion Laboratory has great resources to fascinate curious learners of all ages.

- Gallery of high-quality space images.
- STEM Activities

Participate in Zooniverse's citizen science project Galaxy Zoo. You will look at telescope images of distant galaxies and help classify these images based on shapes.

- https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/

Do you have what it takes to be an astronaut? The European Space Agency has developed a training program and set of physical and educational challenges that are important for astronauts.

- https://www.esa.int/Education/Expedition_Home/Train_like_an_astronaut_challenges