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NASA STEM Facilitation Kit

Be a NASA Detective: Expanding Your Senses

NASA @ My Library

Tennessee State Library and Archives
Secretary of State Tre Hargett

STAR net
Science-Technology Activities & Resources For Libraries

NASA@ My Library is based upon work funded by NASA under cooperative agreement No. NNX16AE30A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the *NASA@ My Library* initiative and do not necessarily reflect the views of the National Aeronautics and Space Administration.

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Section 1:

Getting Started

We are excited that you have requested this NASA STEM Kit (*Be A NASA Detective: Expanding Your Senses*) through your state library. Let me tell you a bit about this project.

The *National Center for Interactive Learning* (NCIL) at the Space Science Institute (SSI), in partnership with the Chief Officers of State Library Agencies (COSLA), American Library Association (ALA) Public Programs Office, the Pacific Science Center, Cornerstones of Science, and Education Development Center, has launched the *NASA@ My Library* program. This national program is supported by NASA's Science Mission Directorate.

- Your state library is a *NASA@ My Library* partner and encourages you to provide space science programming for your patrons;
- The kit is self-contained and designed to be easy for public library staff and their volunteers to use;
- Program evaluation is very important, and we need you to complete the enclosed evaluation survey to help us improve our STEM programs that benefit all libraries (instructions are in Section 1).

Through *NASA@ My Library*, participating public libraries engage patrons in informal, lifelong learning opportunities with hands-on activities and high-profile events. These are often conducted in collaboration with national and local organizational partners, scientists, engineers, and other STEM experts. Participating state libraries are also circulating another NASA kit that we produced called *Sun-Earth-Moon Connections*. Check with your state library if you are interested in reserving it.

NASA@ My Library is part of the STAR Library Network (*STAR Net*), a hands-on learning network for libraries and their communities across the country (www.starnetlibraries.org). *STAR Net* focuses on helping library professionals build their STEM skills by providing "science-technology activities and resources" (STAR) and training to use those resources. I encourage you to take advantage of the many resources and opportunities available through *STAR Net* (www.starnetlibraries.org) including:

- A vibrant online community of 8,000 members, all invested in bringing STEM learning experiences to library patrons;
- *STAR Net's STEM Activity Clearinghouse* – an online, interactive repository that packages each of 200+ STEM hands-on activities with tips on implementation in the library setting; links to related content and online video clips and suggested books;
- Online and in-person training for library staff, which introduces them to the STEM content of the exhibits, and guides them in developing complementary programming;
- Blogs, a monthly newsletter, and social media updates with tips and timely information on special events, *STAR Net* conference and webinar presentations, and funding opportunities.

I also invite you to follow us on Facebook at https://www.facebook.com/STARLibraries/.

Sincerely,

Paul B. Dusenbery

Paul B. Dusenbery
Director, National Center for Interactive Learning/Space Science Institute
Project Director, *STAR Net* and its *NASA@ My Library*

How to Use This Resource

Developed by *STAR Net*'s *NASA@ My Library* team, Kit 2 assists library staff in facilitating programs around exciting NASA science mission topics. Kit 2 is titled "Be A NASA Detective: Expanding Your Senses," and focuses on activities and experiences that help patrons (and library staff!) be more comfortable using tools of science, and making predictions based on their observations. This kit focuses on things we cannot see with our normal vision or sense with our normal senses.

The binder is divided into 4 sections:

Section 1 contains a welcome letter, an inventory of all the items in this Kit, a Kit Packing Plan (especially useful when it's time to ship the kit to the next library), evaluation survey instructions and evaluation survey (don't forget to use the online version if you can), along with four NASA Mission Spotlights. Be sure to compare the inventory list with the contents in the Kit before returning it to your state library agency, and complete an evaluation survey after each program using Kit 2 materials and activities.

Section 2 contains Activity Guides that describe how to use the materials you received in the Kit (e.g. Planet Party) or ones that can be done with materials you already have lying around or that can be purchased at low cost (e.g. Loony Lunar Phases). Our goal for providing the necessary materials for activities is to encourage library staff to try new activities that require unique materials (e.g. telescope, IR thermometer, etc.). Some Activity Guides were developed by external partners. These guides include a cover page that creates a consistent look and feel similar to the *STAR Net*'s "Hands-on" activities in the *STEM Activity Clearinghouse*.

Section 3 includes Quick Facilitation Guides that help staff be better prepared to use the STEM tools included in this kit (e.g., binoculars, planisphere, telescope, Magnetic Science Kit, etc.). These guides provide a quick introduction to the tool, which should help staff facilitate the activities in Section 2 or create their own unique programs (e.g., a NASA Science Saturday event).

Section 4 includes a list of the books in Kit 2 and provides suggestions on how to tie the books and activities together. This section also provides a list of web links to kit materials that guide librarians on where to locate and purchase kit items. Two informational flyers have also been included (Night Sky Network and Solar System Ambassadors). Libraries are encouraged to work with both NASA groups to help you conduct Kit 2 programs.

We hope you enjoy Kit 2. Please contact your state library agency if you need assistance.

If you'd like to explore more hands-on activities around this and other content areas, please visit our *STEM Activity Clearinghouse* (http://clearinghouse.starnetlibraries.org).

STEM Tools and Activity Materials

- ☐ Orion 76mm Fun Scope Tabletop Reflector Telescope
  - Red-dot Finder scope
  - Instruction Manual
  - Orion MoonMap 260
  - 20mm Kellner eyepiece, 1.25"
  - 6mm Kellner eyepiece, 1.25"
  - 2x Barlow lens
- ☐ 1 Pair of Celestron Cometron 7x50mm Binoculars
  - Instruction Manual
  - 2 eyepiece caps
  - 2 optical lens caps
  - Lens cloth
  - Neck strap
  - Bag
- ☐ 1 Red light Flashlight or nighttime viewing with the planisphere and Planet Party Activity
- ☐ 1 Flashlight for use with *Secrets of Our Earth* book
- ☐ 2 Infrared thermometers
- ☐ 1 Scale
- ☐ Magnetic Science Kit
- ☐ 1 Planisphere for use with Planet Party Activity or nighttime viewing
- ☐ Rolls of adding machine paper
- ☐ 2 packs of colored pencils
- ☐ 1 Pencil box
- ☐ 12 ornament balls
- ☐ Earth ball
- ☐ 3 small magnets
- ☐ 3 large bar magnets
- ☐ Small bag of marbles
- ☐ Small bag of paper clips
- ☐ Small bag of pony beads
- ☐ 1 box to store activity items

Books

- ☐ *Secrets of Our Earth* (Carron Brown) – A Shine-A-Light Book
- ☐ *Starry Skies: Learn about the constellations above us* (Samantha Chagollan)
- ☐ *Find the Constellations* (H.A. Ray)
- ☐ *The Secret Galaxy* (Fran Hodgkins)
- ☐ *Understanding Small Worlds in the Solar System: A Tactile View* (NASA)
- ☐ *Getting a Feel for Lunar Craters* (NASA)

Kit Packing Plan

Below are some visual instructions on how best to re-pack your tote after use.

Step 1:
The telescope box, binoculars box and pencil box should go on the bottom layer.

Step 2:
Next, the IR thermometer, earth ball and two flashlights can be added over the pencil box.

Step 3:
Next, add in the Magnetic Science kit and the plastic container.

Step 4:
Last, you can put the books and rolls of paper over the Magnetic Science kit.

NASA@ My Library STARnet Science-Technology Activities & Resources For Libraries

Survey Instructions

Dear Library Staff:

As part of the *NASA@ My Library* program evaluation, we are conducting a survey to collect information about library staffs' use of and thoughts about the *NASA@ My Library* kit. Your honest feedback will help the project team improve future kits and better serve your needs and the needs of other public libraries. Below you will find information about the survey and how to complete it. Please feel free to contact Kate Greene Smith at your State Library at kate.smith@tn.gov if you have any questions.

Thank you for your cooperation and support,

Tennessee State Library and Archives

About the Survey

- The kit survey includes questions about:
  - **The people your *NASA@ My Library* programs serve**: including number of attendees, age groups, and underrepresented groups
  - **Your *NASA@ My Library* programs**: including who led the program, resources used, and any stories you have about the patron experience
  - **Your experience with kit resources**

- A copy of the survey questions is provided in the kit for your reference

How to Complete the Survey

- We ask that library staff complete one survey for **each** program that uses *NASA@ My Library* kit resources and/or involves an earth or space science Subject Matter Expert (SME)

- Surveys can be completed at the following link: https://go.edc.org/Kit2Survey

- It should take less than 10 minutes to complete the survey

Evaluation Survey: Be a NASA Detective

Instructions: Please complete online at: https://go.edc.org/Kit2Survey

Library & Program Information

Program Date:	
Name of Library (branch name, city, state):	
Community Type (check one):	☐ City ☐ City/Suburb ☐ Suburb ☐ Suburb/Rural ☐ Rural ☐ Other (e.g., tribal reservation, please describe):
How did you learn about this kit? (check all that apply):	☐ State Library Website ☐ Regional Conferences or Meetings ☐ Promotional Materials (e.g., flyers, emails) from my State Library ☐ Word of Mouth ☐ Other (please describe):
Contact Name/Title:	
Contact Email:	

People Served

Total # of people in attendance:	
Age group(s) in attendance (check all that apply):	☐ Infant ☐ Pre-K ☐ Early Elementary ☐ Upper Elementary ☐ Tweens ☐ Teens ☐ Adults ☐ Seniors
Did families attend? (check one):	☐ Yes ☐ No
Which underserved audiences did you specifically reach out to for this program? (check all that apply):	☐ African-Americans ☐ Alaska Natives ☐ American Indians ☐ Hispanics and Latinos ☐ Native Hawaiians and Pacific Islanders ☐ People with Disabilities ☐ Economically Dsisadvantaged ☐ Women and Girls ☐ Rural Audiences ☐ None ☐ Other (please describe): Please share how you specifically reached out to these underserved groups:
Please describe any other special promotional efforts used for this program:	

Evaluation Survey: Be a NASA Detective

Program Description

Who led or co-led the program (check all that apply):	☐ Library Staff ☐ Library Volunteers ☐ Local Science Experts (e.g., individuals from local astronomy clubs, planetariums, unversities) ☐ Other (please describe):
If you brought in a local science expert:	Please describe who they were and what they did at the program: Did your State Library help connect you with the local science expert? ☐ Yes ☐ No
Which items from the kit did you use? (check all that apply):	☐ Telescope ☐ Planet Party ☐ Binoculars for night viewing ☐ Pocket Solar System ☐ Infrared Thermometer ☐ Loony Lunar Phases ☐ Orion's Stargazers Kit ☐ Art and the Cosmic Connection ☐ Scale ☐ Magnetic Science Kit ☐ Investigating the Insides ☐ Taking Earth's Temperature ☐ Flashlight ☐ Books from the kit
Which of these additional resources did you use? (check all that apply):	☐ *STAR Net STEM Activity Clearinghouse* (clearinghouse.starnetlibraries.org) ☐ Other professionally created materials/programs (please describe): ☐ Other Source (e.g., other resources provided by your State Library; please describe): ☐ None
If you visited the online *STAR Net STEM Activity Clearinghouse*:	What was helpful? What could be improved? Do you plan to use the Clearinghouse for additional STEM programs ☐ Yes ☐ No
Do you have any stories or quotes from patrons that you'd like to share?	

Evaluation Survey: Be a NASA Detective

Public Library Experiences with Kit Resources

How satisfied or not satified were you with the following:	Not Satisfied	Slightly Satisfied	Moderately Satisfied	Very Satisfied	Extremely Satisfied	Not Applicable
The kit reservation process	☐	☐	☐	☐	☐	☐
State Library support in the use of the kit	☐	☐	☐	☐	☐	☐
State Library assistance in accessing other resources such as Earth and space science experts	☐	☐	☐	☐	☐	☐

How much do you agree or disagree with the following:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The kit was easy to use	☐	☐	☐	☐	☐
I would be interested in receiving more kits like this one	☐	☐	☐	☐	☐
Our library patrons appeared to enjoy the program	☐	☐	☐	☐	☐

Is there anything else you would like us to know about your program or your experience using the kit?

Credit: NASA

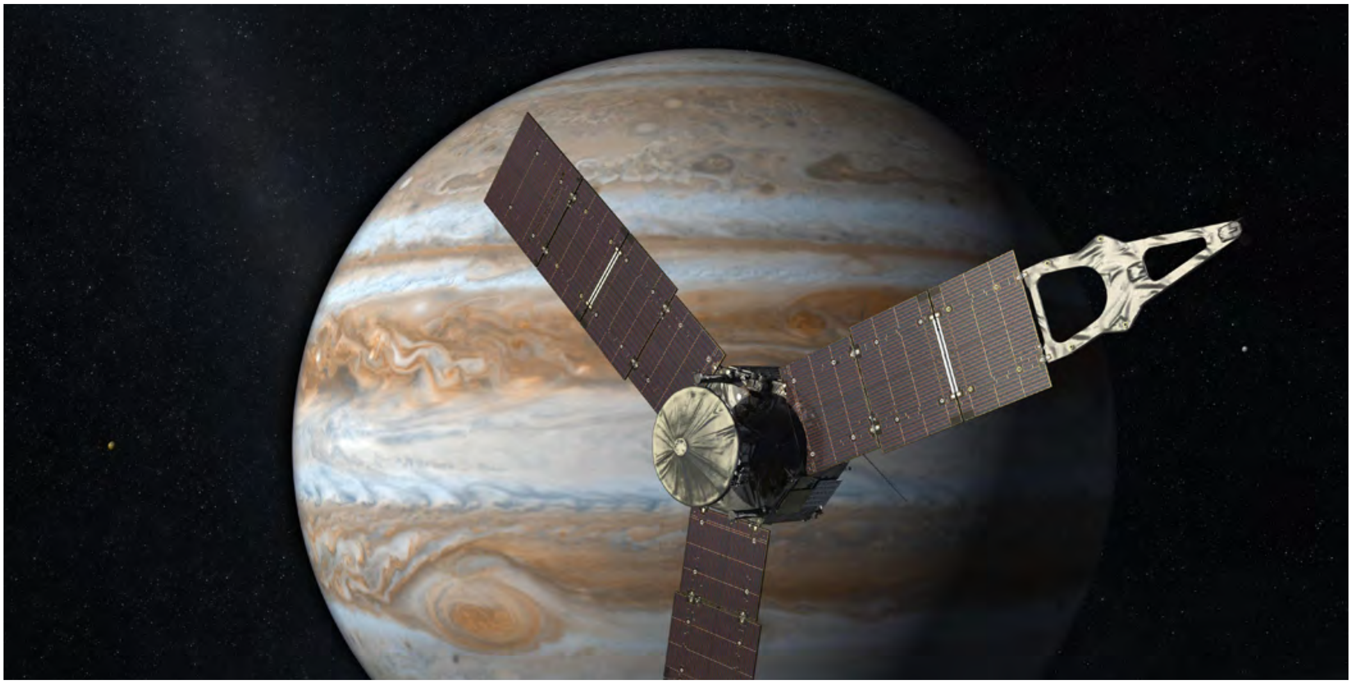
"The Eagle has landed…" The primary objective of **Apollo 11** was to complete a national goal set by President John F. Kennedy on May 25, 1961: perform a crewed lunar landing and return to Earth. Additional flight object ives included scientific exploration by the lunar module crew; deployment of a television camera to transmit signals to Earth; and deployment of a solar wind composition experiment, seismic experiment package and a Laser Ranging Retroreflector. During the exploration, the two astronauts gathered samples of lunar-surface materials for return to Earth. They also extensively photograph the lunar terrain, the deployed scientific equipment, the LM spacecraft, and each other, both with still and motion picture cameras.

Mission Website: https://goo.gl/Q6XBLp

On Jan. 9, 1969, NASA announced the prime crew of the Apollo 11 lunar landing mission. Later that year in July 1969, the crew launched to the Moon and into history. From left to right are lunar module pilot Buzz Aldrin; commander Neil Armstrong; and command module pilot Michael Collins. They were photographed in front of a lunar module mockup beside Building 1 at what is now Johnson Space Center.
Credit: NASA

Forty-nine years ago on July 20, 1969, humanity stepped foot on another celestial body. Mission Commander Neil Armstrong documented the lunar mission and snapped this image of Lunar Module Pilot Buzz Aldrin, as he carried the Passive Seismic Experiments Package (in his left hand) and the Laser Ranging Retroreflector (in his right) to the deployment area. These two experiments made up the Early Apollo Scientific Experiment Package. This photograph was taken at Tranquility Base in our Moon's Sea of Tranquility.
Credit: NASA

NASA Mission Spotlight: Juno



Credit: NASA

Juno is a NASA space probe orbiting the planet Jupiter. It was built by Lockheed Martin and is operated by NASA's Jet Propulsion Laboratory. The spacecraft was launched from Cape Canaveral Air Force Station on August 5, 2011, as part of the New Frontiers program, and entered a polar orbit of Jupiter on July 5, 2016, to begin a scientific investigation of the planet. After completing its mission, Juno will be intentionally deorbited into Jupiter's atmosphere.

Juno's mission is to measure Jupiter's composition, gravity field, magnetic field, and polar magnetosphere. It will also search for clues about how the planet formed, including whether it has a rocky core, the amount of water present within the deep atmosphere, mass distribution, and its deep winds, which can reach speeds up to 618 kilometers per hour (384 mph).

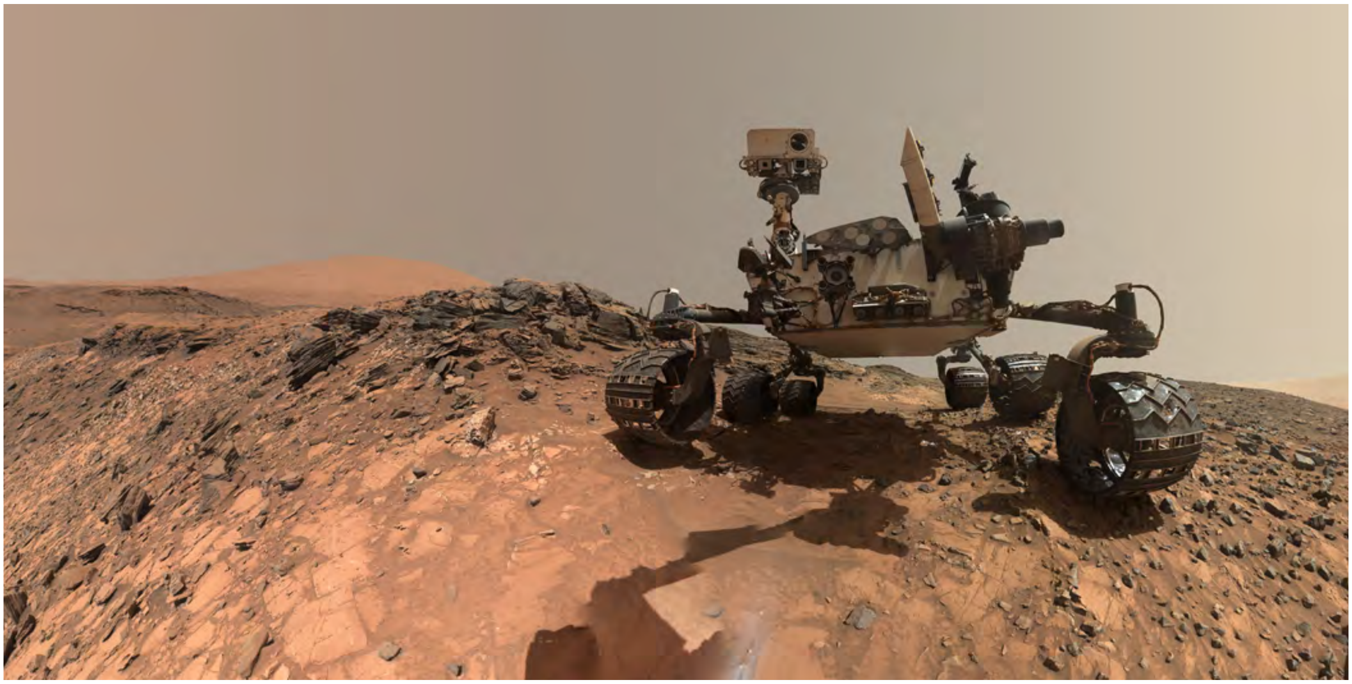
Mission Website: https://goo.gl/1vnLLp

Stormy Jupiter. This image captures the intensity of the jets and vortices in Jupiter's North North Temperate Belt.

NASA's Juno spacecraft took this color-enhanced image on May 23, 2018, as Juno performed its 13th close flyby of Jupiter. At the time, the spacecraft was about 4,900 miles (7,900 kilometers) from the tops of the clouds of the gas giant planet. Scientists think the large-scale dark regions are places where the clouds are deeper, based on infrared observations. Citizen scientist, Kevin M. Gill, created this image using data from the spacecraft's JunoCam imager.

Credit: NASA and Kevin M. Gill.

NASA Mission Spotlight: Curiosity Rover

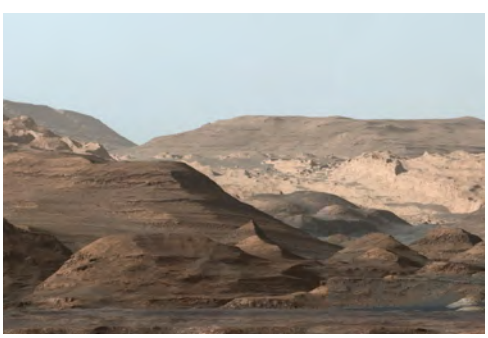


Credit: NASA

Curiosity is a car-sized rover designed to explore Gale Crater on Mars as part of NASA's Mars Science Laboratory mission (MSL). Curiosity was launched from Cape Canaveral on November 26, 2011 aboard the MSL spacecraft and landed on Gale Crater on Mars on August 6, 2012. The Bradbury Landing site was less than 2.4 kilometers (1.5 miles) from the center of the rover's touchdown target after a 560 million kilometers (350 million miles) journey. The rover's goals include an investigation of the Martian climate and geology; assessment of whether the selected field site inside Gale Crater has ever offered environmental conditions favorable for microbial life, including investigation of the role of water; and planetary habitability studies in preparation for human exploration.

Curiosity's design will serve as the basis for the planned Mars 2020 rover.

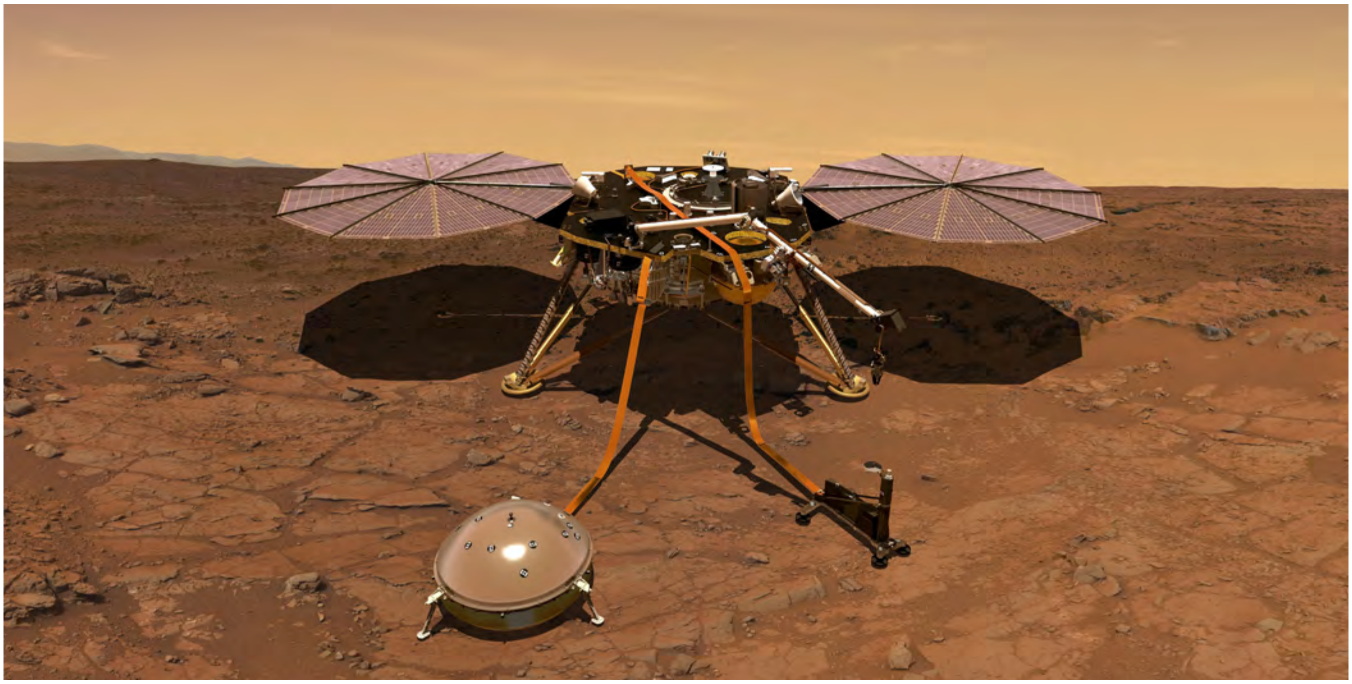
Mission Website: https://goo.gl/2x26M3



This composite image looking toward the higher regions of Mount Sharp was taken on September 9, 2015, by NASA's Curiosity rover. In the foreground – about 3 kilometers (2 miles) from the rover – is a long ridge teeming with hematite, an iron oxide. Just beyond is an undulating plain rich in clay minerals. And just beyond that are a multitude of rounded buttes, all high in sulfate minerals. The changing mineralogy in these layers of Mount Sharp suggests a changing environment in early Mars, though all involve exposure to water billions of years ago. The Curiosity team hopes to be able to explore these diverse areas in the months and years ahead. Further back in the image are striking, light-toned cliffs in rock that may have formed in drier times and now is heavily eroded by winds.

Credit: NASA/JPL-CALTECH

NASA Mission Spotlight: Mars InSight



Credit: NASA

InSight is a robotic lander designed to study the interior of the planet Mars. It was manufactured by Lockheed Martin Space Systems. The name is a backronym for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport. The mission launched from Vandenberg Air Force Base on California's Pacific coast aboard a two-stage Atlas V launch vehicle on 5 May 2018 and is expected to land on the surface of Mars at Elysium Planitia on 26 November 2018, where it will deploy a seismometer and burrow a heat probe. It will also perform a radio science experiment to study the internal structure of Mars. InSight includes scientists from institutions in the U.S., France, Germany, Austria, Belgium, Canada, Japan, Switzerland, Spain and the United Kingdom.

InSight's objective is to place a stationary lander equipped with a seismometer and heat transfer probe on the surface of Mars to study the planet's early geological evolution. This could bring new understanding of the Solar System's terrestrial planets — Mercury, Venus, Earth, Mars — and Earth's Moon.

Mission Website: https://goo.gl/A2dXV5

The solar arrays on NASA's InSight lander are deployed in this test inside a clean room at Lockheed Martin Space Systems, Denver. This configuration is how the spacecraft will look on the surface of Mars. The image was taken on April 30, 2015.

Credit: NASA/JPL-CALTECH

Section 2:

Activity Guides

Planet Party

Visitors view planets, the Moon, and stars in the sky with the naked eye and binoculars or telescopes. Planning resources and tips for partnering with a local astronomical society are provided.

Key Concepts

- Observing the Moon, planets and stars can show change and inspire wonder.
- Many planets in our solar system are easy to see in the night sky.
- Looking at a planet through a telescope will magnify the appearance, so we can see features.
- Telescopes are scientific tools.

Build a Program with Related Resources

Audiences will be amazed at what they can see with telescope and binoculars, which magnify small objects, especially once they learn about how to view the night sky. Start with a planisphere or use the Night Sky Planner (https://goo.gl/wxBikQ) to come up with a viewing plan before going outside with a telescope or binoculars at night. A viewing plan will help participants easily locate objects in the sky so that they can then use the tools to view them. Also, know in which direction you are looking or bring a compass to the Planet Party.

Get to know the telescope and binoculars you are going to use before going out at night too. See the Quick Facilitation Guides on the telescope, binoculars, and planisphere in this guide.

Loony Lunar Phases, *Pocket Solar System*, and *Art and the Cosmic Connection* are the other hands-on space science activities included in this kit that can help audiences gain a better understanding of our moon and solar system. Science models and art help hone observation skills.

Some additional STEM Activity Clearinghouse activities that use tools to help us expand our senses are *Blind Mice Go To Pluto*, *What Do You See in Today's Moon?*, and *Constellation Detective*.

Need more ideas? Visit our STEM Activity Clearinghouse (http://clearinghouse.starnetlibraries.org)

STEM ACTIVITY Clearinghouse

Add Your Review of This Activity

There are many STEM educational resources available to use in programs. We hope that you will give this activity a try! Then, **help others find the "best of the best" by writing a review** on the STEM Activity Clearinghouse. Email your favorite activities directly to a colleague!

Credit: Wiki Commons

Content Area – Astronomy and Space, Physics and Engineering

Ages – Family, Tweens, Teens and Adults

Activity Time – 20-40 minutes

Prep Time – 20-40 minutes

Difficulty Level – Medium

Mess Level – Easy

Materials List – Binoculars, telescope, flashlight, night sky map or moon map

Originating Source:
Planet Party was developed by the Lunar and Planetary Institute and is part of the *STAR Net* portfolio of field-tested activities developed for public library programs.

STAR★net

Hands-on

Tested & Approved STEM Activities

Planet Party

Activity Guide

STAR★net Science-Technology Activities & Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (STAR_Net) program.
Visit our website at www.starnetlibraries.org for more information on our educational programs.
Developed by the Lunar and Planetary Institute/Universities Space Research Association
May 2016

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Planet Party

Credit: Halfblue/Wikipedia

Overview

Visitors view planets, the Moon, and stars in the sky with the naked eye and binoculars or telescopes. Planning resources and tips for partnering with a local astronomical society are provided.

Activity Time

30 minutes or more

Intended Audience

Families or other mixed-age groups, including children as young as 5 years old *with assistance from an older child, teen, or adult*
School-aged children
Tweens
Teens
Adults

Type of Program

- ☑ **Facilitated hands-on experience**
- ☑ **Station, presented in combination with related activities**
- ☐ Passive program (if instructions are provided at the start of the course)
- ☐ Demonstration by facilitator

What's The Point?

- **Observing the Moon, planets, and stars can show change and inspire wonder.**
- **Many planets in our solar system are easy to see in the night sky.**
- **Looking at a planet through a telescope will magnify the appearance, so we can see features. The Moon's familiar face offers impact craters, dark, flat plains (maria), and mountains for closer inspection through binoculars or a telescope.**
- **Telescopes are scientific tools; they offered our first glimpses of other worlds when Galileo first used his telescope to study Venus, the Moon, Saturn, and Jupiter and its moons 400 years ago. Telescope optics have improved over time, allowing scientists to make more detailed observations of objects in the night sky.**

Materials

Facility needs:

- ☐ An outdoor viewing area, preferably away from bright lights and traffic
- ☐ Optional: Access to electricity and a well-marked extension cord, secured so it won't be a hazard in the dark
- ☐ Glow sticks to mark cords
- ☐ Access to drinking water
- ☐ Access to bathrooms

For each group of approximately 20 visitors:

- ☐ 1 telescope operated by an amateur astronomer
- ☐ 1 small step-stool for children to stand on to reach tall telescope eyepieces

Even from urban locations, telescopes can reveal surprising views of the planets:

- Venus often looks like the Moon — a crescent, quarter, or gibbous phase. Since Venus lies between us and the Sun, we are able to view both its day (sunlit) and night (dark) sides. Our perspective of Venus changes as the Earth carries us in its orbit around the Sun, revealing different angles of Venus. At different angles, Venus appears in different phases.
- Jupiter has faint bands of different colors, and sometimes a centuries-old storm, called the Great Red Spot, or some of its moons can be seen. Jupiter's four largest moons, Io, Europa, Ganymede, and Callisto, appear as bright dots on the sides of Jupiter, and disappear from view occasionally as they pass in front of or behind the planet.
- Saturn's rings are easily seen.
- Mars has a reddish appearance due to its rusty soil.

Telescopes are not necessary to enjoy the Moon. The basalt-filled impact basins and plains — maria — and ancient lunar highlands are easily seen with the naked eye. Binoculars reveal the Apennine Mountains, Copernicus Crater, and Tycho Crater.

A view through a telescope reveals Jupiter's banded atmosphere. You might also spot several or all of Jupiter's four largest moons. Callisto, Ganymede, and Europa appear here as small "dots" from far left to far right. Io is often also visible as a fourth "dot." – Credit: Modified from NASA/JPL/ Malin Space Science Systems.

For each facilitator:

- ☐ Flashlights for staff, preferably with red plastic wrap or red paper taped over the light
- ☐ 1 set of Our Solar System lithographs (NASA educational product number LS-2013-07-003-HQ)

Materials (continued)

For each visitor:

- ☐ Sky map for the current night
- ☐ Optional: An Earth-based Tour of the Moon and/or Skywatcher's Guide to the Moon.

Monthly sky charts or simple sky wheels are available free from a variety of websites, including the links offered here; note that the sky wheels require assembly but work year-round.

Supporting Resources

Consider setting up a digital device (such as a computer or tablet), speakers, and access to the Internet to display websites or multimedia before or after the activity.

Books:

Becker, Helaine, and Brendan Mullan. *Everything Space*. Washington, D.C.: National Geographic Children's Books, 2015. (ISBN-13: 978-1426320743)

Driscoll, Michael and Meredith Hamilton. *A Child's Introduction to the Night Sky: The Story of the Stars, Planets, and Constellations--and How You Can Find Them in the Sky*. New York: Black Dog & Leventhal Publishers, 2004. (ISBN-13: 978-1579123666) Grade 3 - 7

Yasuda, A. (2015). Astronomy: *Cool women in space*. White River Junction, VT: Nomad Press. (Hardcover ISBN 978-1-6193-0326-3, Paperback ISBN 978-1-6193-0330-0) Grade 4 – 6

Podcasts:

365 Days of Astronomy podcasts: Launched in 2009 as part of the International Year of Astronomy, this community podcast continues to produce day after day of content across the years. In 2013, they evolved to add video, and in 2015 they join the International Year of Light: http://cosmoquest.org/x/365daysofastronomy/

Solar System Exploration What's Up Podcast: What spacecraft and celestial events are happening each month are described in this video podcast http://solarsystem.nasa.gov/news/category/whatsup

Interactive Websites:

NASA's Eyes on the Solar System: Learn about our home planet, our solar system, the universe beyond, and the spacecraft exploring them with this downloadable application: http://eyes.jpl.nasa.gov

Moon Mappers (Planet Mappers, Moon Edition): Citizen science project mapping craters on the Moon: http://cosmoquest.org/?application=simply_craters

Supporting Resources (continued)

Handouts:

- Our Solar System lithographs (NASA educational product number LS-2013-07-003-HQ)
- Monthly sky charts or simple sky wheels
- An Earth-based Tour of the Moon
- Skywatcher's Guide to the Moon

Images:

Hubble Site (NASA/STScI)
http://hubblesite.org/gallery

NASA Solar System Exploration
http://solarsystem.nasa.gov

Planetary PhotoJournal (NASA/JPL)
http://photojournal.jpl.nasa.gov

Spitzer Space Telescope (NASA/JPL-Caltech)
http://www.spitzer.caltech.edu

Astronomy Picture of the Day
http://apod.nasa.gov

Preparation

Advanced Planning Tips:

- **If possible, incorporate additional science, technology, engineering, art, and mathematics (STEAM) activities into the event. See the STAR_Net resources listed at www.starnetlibraries.org for ideas.**
- **Prepare and distribute publicity materials for programs based on this event.**
- **Pull supporting resources out of circulation to feature during the program.**
- **Determine an appropriate date and time for the event:**
  - **Use online resources to determine a date at which one or more bright objects will be high in the evening sky.**
  - **Identify a start and end time for your program on your intended date. Best viewing times will begin about an hour after sunset. SunriseSunset and Stellarium provide sun set times for your location far in advance.**
  - **Optional: Contact your local astronomy club or other amateur astronomers. The Astronomical League, Sky and Telescope, and NASA Night Sky Network offer search tools to find a club near you. Let them know which planets or other objects you would most like for the public to see.**
- **Have a back-up plan in place before the announcement for inclement weather: Will the event be cancelled, postponed, or moved inside with different activities? If the event is cancelled or postponed, at what time or point will the decision be made to do so, and how will the audience hear about it?**
- **Identify ways to help persons with all abilities to enjoy the night sky. Tips are provided in the book: Grice, Noreen (2011). Everyone's Universe: A Guide to Accessible Astronomy Places, New Britain: Connecticut: You Can Do Astronomy, LLC. ISBN: 978-0-9833567-1-4.**

Preparation (continued)

- If appropriate, arrange to have the viewing area sprayed for mosquitoes or treated for fire ants in advance of the observing session.
- If possible, arrange for nearby bright overhead lights and sprinkler systems to be turned off during the period of the observing session.
- Become familiar with information about the objects that are in view, as well as current and future missions to explore them using the Our Solar System lithographs and reputable websites.
- Set out the step-stool(s) where needed.
- Set up the tables and pencils or crayons in a well-lit area nearby.

There are many objects in the sky that can engage and inspire your visitors when viewed through a telescope or binoculars, including:

- **Planets:** Select a date when planets will be visible in the early evening sky. Venus and Jupiter are almost always bright when visible, Mars is often bright, and Saturn and Mercury are always a bit faint. Uranus and Neptune are too faint to see without telescopes or binoculars. Try to avoid dates when the Moon is full or nearly full (see below), as its light will wash out other nighttime objects. StarDate, Stellarium, the Planet Finder applet, or other planetarium programs are useful planning tools.
- **The Moon:** Select a date when the Moon is a crescent or in first quarter. SunriseSunset and Stellarium provide Moon phases far in advance. Observing the Moon while its near side is only partially lit, as in the crescent and first quarter phases, causes the terrain to cast longer shadows. The shadows make the features much easier to see! A full Moon is unpleasantly dazzling to view through a telescope — even the crescent Moon is bright.
- **Constellations:** While constellations are best viewed with the naked eye, these star patterns provide a map to finding nebulae, star clusters, and galaxies. A brief tour of the month's constellations, deep-sky objects, planets, and events is available through Tonight's Sky.
- **International Space Station (ISS):** Use "Spot the Station" (https://spotthestation.nasa.gov), a NASA service, to determine whether or not the ISS will be visible during the observation period or not. Visible to the naked eye, the ISS looks like a fast-moving plane (only it is much higher and traveling thousands of miles an hour faster).

Make sure that the objects you intend to view will be visible from your viewing location in the early evening. Over the course of the event, the objects will appear to move toward the west as the Earth rotates.

Activity

1. Share ideas and knowledge.

- Introduce yourself. Help the participants learn each other's names (if they don't already know each other).

- Frame the activity with the main message: Observing the Moon, planets, and stars can show change and inspire wonder.

- Invite the visitors to talk about what they already know about the Moon, planets, and stars. Use open-ended questions about how the Moon, planets, and stars appear in the sky. Invite visitors to recollect how those objects appear to change over time (e.g. setting in the west each night, planets are only sometimes visible, the Moon changes phase). Invite the visitors to talk with you and each other.

- Provide information about the objects that are in view, as well as current and future missions to explore them.

2. Facilitate equitable access to telescopes and/or binoculars.

- Invite visitors to form lines behind each telescope or pair of binoculars. Caution them to avoid the tripod legs and any cords.

- Ask each child to put her hands behind her back when it's her turn to look through the telescope (which will reduce the chances of moving the telescope.)

Facilitator's Notes:

- Stars appear to twinkle, but planets do not. The twinkling is caused by Earth's atmosphere. Light from a star passes through pockets of air that have different temperature and bend the light. Planets are much closer and appear as disks in the sky, rather than pinpoints. Even without the magnification of a telescope, the disk of a planet is larger than the air pockets. Starlight comes from a single point and is more readily distorted as it passes through air pockets.

- The Sun is the only star in our solar system; the others we see at night are much more distant than even Pluto.

- Planets don't make their own light. They appear bright because they are reflecting sunlight.

- Ancient civilizations studied the skies and noted the strange motions of "wanderers" ("planets" in Greek), which seemed to move against the background of familiar constellations.

- Jupiter is the biggest planet and Mercury is the smallest. Venus is the brightest planet because it is close to us, and so seems larger than Jupiter.

- Uranus is barely visible in very dark locations to observers who know where to look!
- The existence of Neptune was deduced mathematically and then confirmed by telescopic observations. It can be viewed through binoculars from a very dark location.
- Pluto is a tiny, distant dwarf planet and can be viewed through a small telescope from a very dark location.
- Galileo first used his telescope to study the Moon, Venus, Jupiter, and Saturn 400 years ago; his observations of depressions and mountains on the Moon, moons orbiting Jupiter, and the phases of Venus revolutionized our understanding of the solar system and Earth's place in it. Telescope optics have improved over time, allowing scientists to make more detailed observations of objects in the night sky.
- Telescopes allowed astronomers to view the surfaces of planets. Now, scientists can learn about planets and moons by sending spacecraft to fly by or orbit them. Spacecraft instruments now allow us to infer information about the interiors of planets.
- The Moon may appear "flipped" — as in a mirror image — through some kinds of telescopes.

3. Conclusion

Engage the participants in conversation about what they observed. What color was planet or star? Did they see any moons around other planets? If so, how were they arranged? Did the appearance of the planets surprise them? Which object was their favorite, and why?

Correlations to the Next Generation Science Standards

Disciplinary Core Ideas

ESS1.A The Universe and Its Stars

- Patterns of movement of the sun, moon, and stars as seen from Earth can be observed, described, and predicted.

ESS1.B: Earth and the Solar System

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

PS4.B Electromagnetic Radiation

- Object can be seen when light reflected from their surface enters our eyes.

The Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods and tools to make measurements and observations.

Scientific Knowledge is Based on Empirical Evidence

- Scientists use tools and technologies to make accurate measurements and observations.

Science is a Human Endeavor

- Science affects everyday life.
- Advances in technology influence the progress of science and science has influenced advances in technology.

Brief Facilitation Guide

Download the full activity guide at www.starnetlibraries.org

1. Share ideas and knowledge.

- Introduce yourself. Help the visitors learn each other's names (if they don't already).
- Frame the activity with the main message: Observing the Moon, planets, and stars can show change and inspire wonder.
- Invite the visitors to talk about what they already know about the Moon, planets, and stars. Use open-ended questions about how the Moon, planets, and stars appear in the sky. Invite visitors to recollect how those objects appear to change over time (e.g. setting in the west each night, planets are only sometimes visible, the Moon changes phase). Invite the visitors to talk with you and each other.
- Provide information about the objects that are in view, as well as current and future missions to explore them.

2. Facilitate equitable access to the telescopes and/or binoculars.

- Invite visitors to form lines behind each telescope or pair of binoculars. Caution them to avoid the tripod legs and any cords.
- Ask each child to put her hands behind her back when it's her turn to look through the telescope (which will reduce the chances of moving the telescope.)

3. Conclusion.

Engage the participants in conversation about what they observed. What color was planet or star? Did they see any moons around other planets? If so, how were they arranged? Did the appearance of the planets surprise them? Which object was their favorite, and why?

Pocket Solar System

Using a strip of paper, patrons construct a quick scale model of the distances between the orbits of the planets, the Asteroid Belt, and Pluto as part of the Kuiper Belt.

Credit: Night Sky Network

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
- Science models help us understand how space objects behave and make predictions about what we can't yet observe.

Build a Program with Related Resources

Explore other aspects of NASA planetary science through the activities *Planet Party* and *Investigating the Insides*. Or, use *Art and the Cosmic Connection* to explore NASA images of Earth. Encourage teens and adults to be citizen scientists using the GLOBE Observer app (https://observer.globe.gov/about/get-the-app).

Combine this activity with other activities from Kit 2: *Art and the Cosmic Connection* and *Pocket Solar System*. These activities introduce learners to our Solar System and the Moon through visual models.

Search the STEM Activity Clearinghouse using the keyword "scale" to find more related activities.

Need more ideas? Browse activities in the "Astronomy and Space" content area and the "Moon" and "Sun" collections on the STEM Activity Clearinghouse (http://clearinghouse.starnetlibraries.org)

STEM ACTIVITY Clearinghouse

Add Your Review of This Activity

There are many STEM educational resources available to use in programs. We hope that you will give this activity a try! Then, **help others find the "best of the best" by writing a review** on the STEM Activity Clearinghouse. Email your favorite activities directly to a colleague!

Content Area – Astronomy and Space

Ages – Family, Early Elementary, Upper Elementary, Tweens, Teens, Adults

Activity Time – 20-40 minutes

Prep Time – 10 minutes

Difficulty Level – Medium

Mess Level – Medium

Materials List – Pencils, adding machine paper

Originating Source:
Loony Lunar Phases developed by the Astronomy Society of the Pacific. It is part of a suite of resources on NASA's Night Sky Network website (https://nightsky.jpl.nasa.gov) .

Pocket Solar System

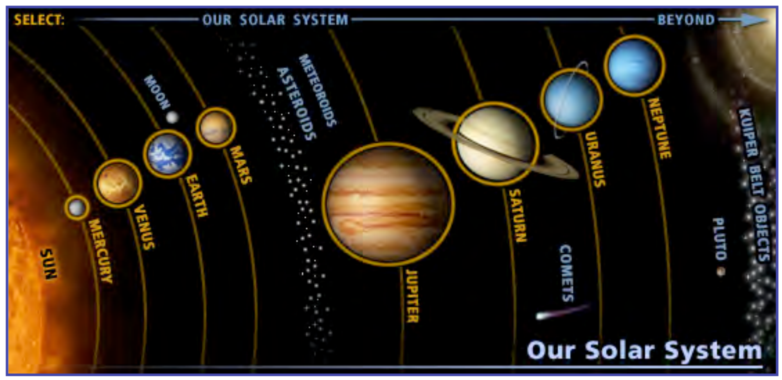
Make a Scale Model of the Distances in our Solar System

About the Activity

Using a strip of paper, construct a quick scale model of the distances between the orbits of the planets, the Asteroid Belt, and Pluto as part of the Kuiper Belt.

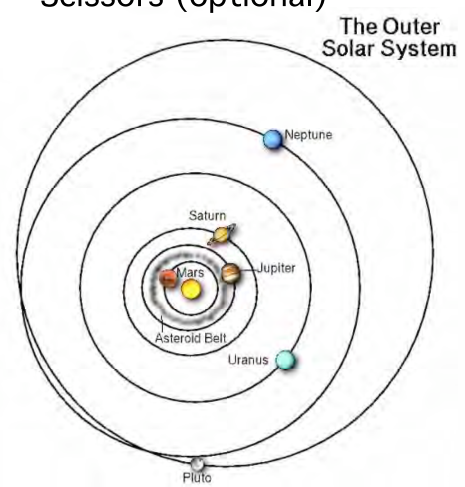
Topics Covered

- Scaled distances of orbits in the Solar System
- Types of objects in the Solar System
- Usefulness of models



Materials Needed

- Pencils
- Paper tape at least 2" wide (from a cash register)
- Scissors (optional)



Credit: National Schools' Observatory

Participants

This activity is appropriate for families, the general public, and school groups ages 7 and up. Any number of visitors may participate.

Location and Timing

This activity can be before a star party, in a classroom, or in a general presentation.
Warning: wind can present a challenge.

Included in This Activity
Detailed Activity Description
Helpful Hints
Background Information

Additional astronomy activities can be found here: http://nightsky.jpl.nasa.gov

Detailed Activity Description

Pocket Solar System

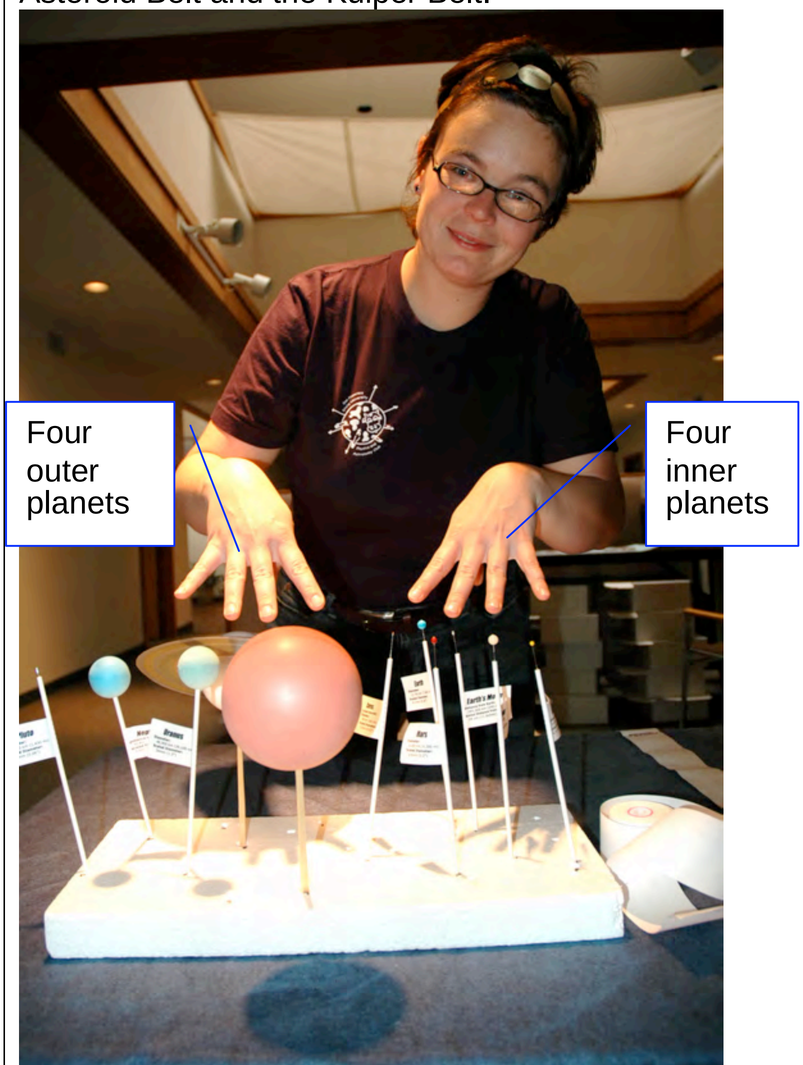
The order of the worlds of the Solar System going out from the Sun and their average distances are:			
Object	**Avg Distance in kilometers**	**Avg Distance in miles**	**Avg Distance in AU***
Mercury	58 million	36 million	0.4
Venus	108 million	67 million	0.7
Earth	150 million	93 million	1
Mars	228 million	142 million	1.5
Ceres ** (representing the Asteroid Belt)	414 million	257 million	2.6
Jupiter	778 million	484 million	5.2
Saturn	1,427 million	887 million	9.5
Uranus	2,870 million	1,784 million	19
Neptune	4,498 million	2,795 million	30
Pluto ** (representing the Kuiper Belt)	5,906 million	3,670 million	40 (range is 30 – 50 AUs)

*AU stands for "astronomical unit"and is defined as the average distance between the Sun and the Earth (about 93 million miles or 150 million kilometers).

**The International Astronomical Union (IAU), the organization in charge of naming celestial objects, classified these objects as "dwarf planets" in 2006.

Leader's Role	**Participants' Role (Anticipated)**
Objective: Building scale models of the Solar System is a challenge because of the vast distances and huge size differences involved. This is a simple little model to give you an overview of the *distances* between the orbits of the planets and other objects in our Solar System. • Provide a quick, easy-to-make and remember scale of the approx distances of the planet's orbits and orbital distance of other realms (asteroids, Kuiper Belt) from the Sun. • Introduce basic "realms" of the Solar System: the Sun at the center, the four inner terrestrial planets separated from the four outer gas giants by the asteroid belt, and all of it surrounded by Kuiper Belt. • Can be referred to and used in other activities.	

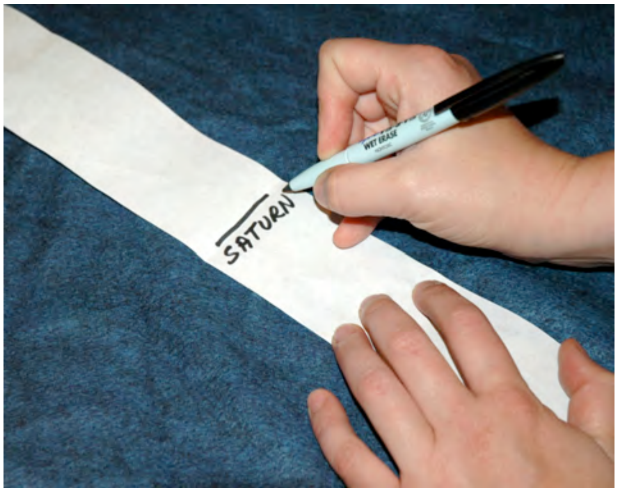
<table>
<tr><th>Leader’s Role</th><th>Participants’ Role (Anticipated)</th></tr>
<tr><td>
To say:
Let’s make a Solar System you can keep in your pocket!

To do:
First, establish with your audience the order of the planets. This provides a baseline to work from. List them on a sheet of paper, use the “Solar System to Scale” handout, the lithographs,
or the 3-D models of the planets. Be sure to include the Asteroid Belt and the Kuiper Belt.


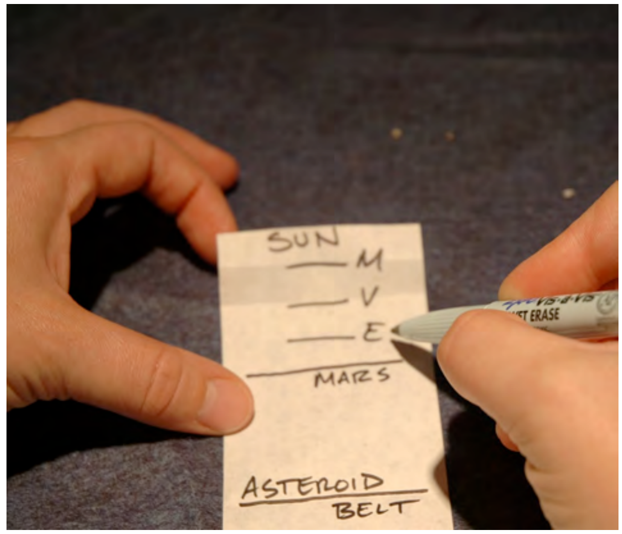
Pointing to the four inner rocky planets and the four outer gas giant planets.
</td><td>

Yeah!
</td></tr>
</table>

Leader's Role	**Participants' Role (Anticipated)**
To say: Pull off a strip of register tape about the length of the height of your body – that's about fingertip to fingertip. We're going to make a model that shows the average distances of various orbits from the Sun. Fold over (or cut) the ends so they are straight. Label one end "Sun" and the other end "Pluto/Kuiper Belt." That will be our baseline – the average distance between the Sun and Pluto's orbit. Next, fold the tape in half, crease it, open it up again and place a mark at the half-way point. Let's look at the list of planets in the Solar System. Which planet's orbit do you suppose is half-way between the Sun and the average distance of Pluto's orbit? Let me give you a hint.	Follows directions. Jupiter! Saturn!
Presentation Tip: You'll need to be careful about using this hint. It depends on your audience. Some people may be offended. It is quite popular with children, however. Alternatively, just have them guess from the list of planets. "Uranus" is often incorrectly pronounced as "yur-AY-nus." Correct pronunciation is "YUR-uh-nus." For more information: http://www.nineplanets.org/uranus.html	
To do: Turn around so your back is to the audience. Hold the Pluto end of the tape at your head so the tape falls down your back to the floor. *To say:* If you hold the Pluto end at your head and the Sun at your feet, what body part is halfway between? Right. Bet you'll never again forget which planet is halfway between the Sun and the average distance of Pluto.	Uranus!
To say: Draw a line on the fold and write "Uranus." Re-fold the tape in half, then in half again so you have	

Leader's Role	**Participants' Role (Anticipated)**
quarters. Then unfold it. Now you have the tape divided into quarters with the Sun at one end, Pluto's orbit on the other, and Uranus' orbit in the middle. Label the fold closer to Pluto as "Neptune" and the fold closer to the Sun as – OK everyone guess. Saturn – draw a line and write Saturn on that orbit.  Here's an easy way to remember the order of the orbits of these three planets. There's a Sun at the center of the Solar System. *<u>To do:</u>* Point to the Sun end of the tape. *<u>To Say:</u>* And there's a "SUN" in the outer planets: (S)aturn (U)ranus (N)eptune S-U-N!	Jupiter? Mars?

<table>
<tr><th>Leader’s Role</th><th>Participants’ Role (Anticipated)</th></tr>
<tr><td colspan="2">Presentation Tip:
Encourage your visitors to draw a line along the fold marking the orbit and write the name of the planet along that line. This will help keep the writing small enough so the names are less likely to overlap orbits for other planets, especially for the inner planets.

An alternative, to speed things up when visitors may not know how to spell all the names of the planets, is to just have them write the initial letter of the planet on each orbit line.

</td></tr>
<tr><td><u>To Say:</u>

You’ve mapped out 3/4 of the Solar System and you still don’t have all the gas giants. Which gas giant is missing?

So we have to fit everything else in that last quarter between the Sun and Saturn! Let’s keep going.

Place the Sun end of the tape at Saturn’s orbit and crease the tape at the fold. What’s the next planet in?
Label that fold.

Fold the Sun out to meet Jupiter’s orbit. This is a little tricky. What structure is inside Jupiter’s orbit?

Right, the Asteroid Belt. Label that.

How many more planets do we need to mark?

At this point, things start getting a little crowded and folding is tough to get precise distances. Fold the Sun to the Asteroid Belt mark and crease it. Next planet in?

Right – Mars. Label that.</td><td>Jupiter!

Jupiter.

Asteroids?

Four!

Mars!</td></tr>
<tr><td>How many more planet orbits do we need to place?</td><td></td></tr>
</table>

Leader's Role	**Participants' Role (Anticipated)**
Yes, three. Fold the Sun up to meet the orbit of Mars. Leave it folded and fold that section in half again. (See the "Schematic of the Pocket Solar System" on the next page) Unfold the tape and you should have three creases. Mark Earth on the crease nearest Mars, then Venus, then Mercury closest to the Sun. Stretch out your model and take a good look at what you've made. What surprises did you have? Now, just roll it up and put it in your pocket – the Pocket Solar System.	Three – Earth. Venus, and Mercury. Variety of comments.
Misconception Tip: Many people are unaware of how empty the outer Solar System is (there is a reason they call it space!) and how close, relatively speaking, the orbits of the inner Solar System are.	

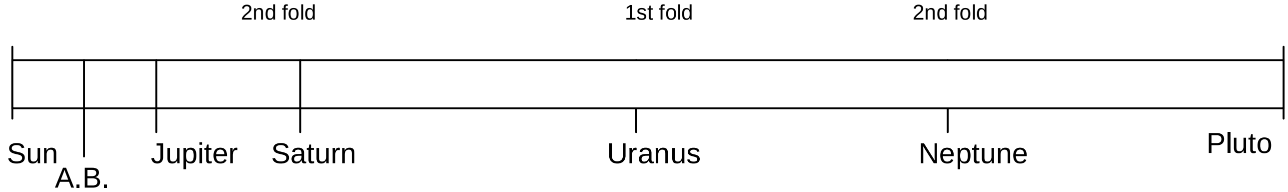
<u>Here are some questions to consider while discussing your Pocket Solar System:</u>

1. If your model is 1.5 meters long (about 5 feet), where would the nearest star be? (1.5m = 40 AUs, Proxima Centauri is 4.3 light years from the Sun, and 1 light year = 63,250 AUs)
2. How big would the Sun and planets be if your model were one and a half meters long?

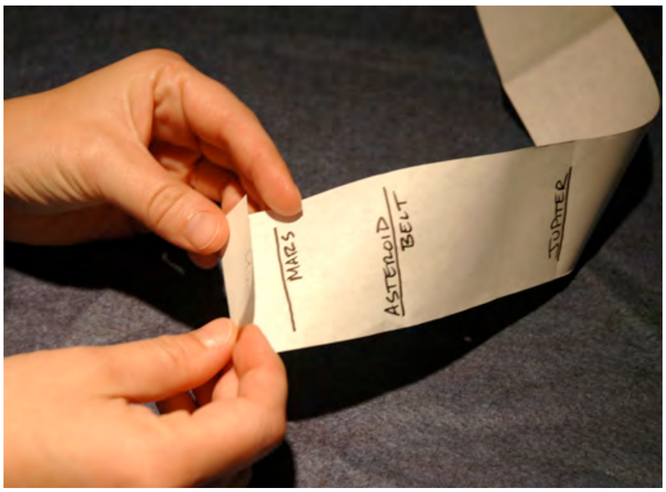
<u>Answers:</u>

1. The nearest star would be about 10 kilometers or about 6 miles away.
2. The Sun would be smaller than a grain of sand – about the size of the period at the end of this sentence. You couldn't see any of the planets without a strong magnifying glass on this scale!

Schematic of the Pocket Solar System:



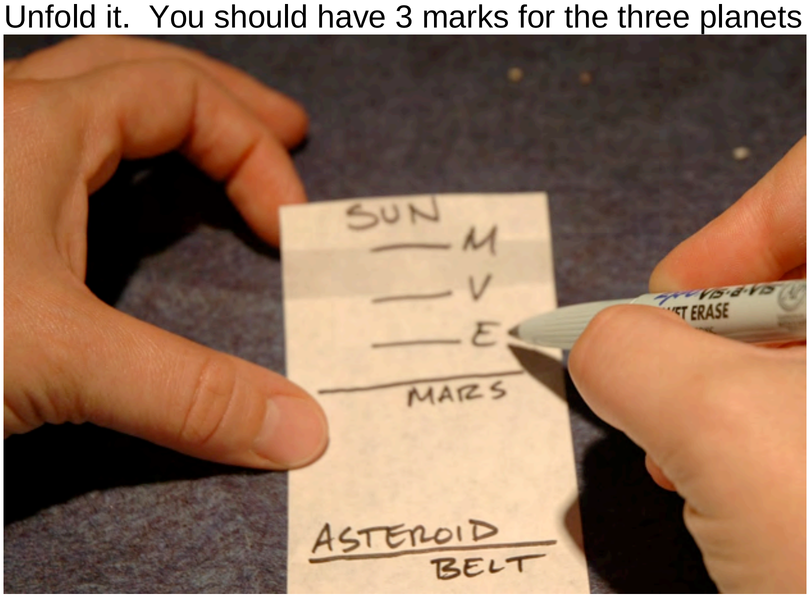
Fold Sun to Asteroid Belt, (“A.B.”) mark “Mars” on fold.



Fold Sun to Mars and leave it folded.

Then fold that section in half again.

Unfold it. You should have 3 marks for the three planets closest to the Sun.



Helpful Hints

Discussion of Models and their Usefulness

Models are useful, but their utility is always limited in some ways. It is often helpful to discuss the strengths and limitations of models with your visitors. For example, the paper tape represents the scaled distances to objects in our Solar System. What are some of its strengths as a model? How is it useful? Where does this NOT represent reality? What can't it be used for? These are questions you may want to include in your discussions with your visitors as they explore the Solar System with this model.

Common Misconceptions:

- Planets are perceived to be much larger than they really are
- The distances to the planets are perceived to be much smaller than they really are
- The orbits of the planets are perceived to be evenly spaced between the Sun and Pluto

Background Information

Website:
For additional information on the worlds of the Solar System, use NASA's Solar System Exploration website:
http://solarsystem.nasa.gov/planets/index.cfm

Website:
A useful web site for **calculating scale models of the Solar System** is available from the Exploratorium:
http://www.exploratorium.edu/ronh/solar_system/

Pocket Solar System and Bode's "Law"

The progression followed for the positions of the orbits for the planets of our Solar System, as illustrated by the Pocket Solar System activity, is really just an interesting coincidence.

Bode's Law, also known as the Titius-Bode Law, was developed in the 1700's before the discovery of Uranus, Neptune, Pluto, or the Asteroid Belt. This "Law" is a mathematical way to describe the approximate spacing of the planets from the Sun. It is not a scientific law and does not work for all the planets of the Solar System, Neptune being a notable exception. It also does not appear to work for planetary configurations around other stars.

For more information on this "Law," try one of these websites:
http://en.wikipedia.org/wiki/Titius-Bode_law
http://milan.milanovic.org/math/english/titius/titius.html

Activity Guide

Loony Lunar Phases

Learners hear a story, song, or (silly or serious) poem that celebrates the Moon's different phases. They recreate the shapes of the lunar phases using the frosting from cookies, and then they place them in correct order to reveal the repeating pattern.

Access online version of activity at: https://goo.gl/bocbkw

Credit: Lunar and Planetary Institute

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
- Science models help us understand how space objects behave and make predictions about what we can't yet observe.

Build a Program with Related Resources

Explore other aspects of NASA planetary science through the activities *Planet Party* and *Investigating the Insides*. Or, use *Art and the Cosmic Connection* to explore NASA images of Earth. Encourage teens and adults to be citizen scientists using the GLOBE Observer app (https://observer.globe.gov/about/get-the-app).

Use NASA's Moon Trek (https://moontrek.jpl.nasa.gov) website to explore the surface of the moon.

Combine this activity with other activities from Kit 2: *Art and the Cosmic Connection* and *Pocket Solar System*. These activities introduce learners to our Solar System and the Moon through visual models.

Need more ideas? Browse activities in the "Astronomy and Space" content area and the "Moon" collection on the STEM Activity Clearinghouse (http://clearinghouse.starnetlibraries.org)

Add Your Review of This Activity

There are many STEM educational resources available to use in programs. We hope that you will give this activity a try! Then, **help others find the "best of the best" by writing a review** on the STEM Activity Clearinghouse. Email your favorite activities directly to a colleague!

Content Area – Astronomy and Space

Ages – Family, Early Elementary, Upper Elementary, Tweens

Activity Time – 20-40 minutes

Prep Time – 20-40 minutes

Difficulty Level – Easy

Mess Level – Medium

Materials List – "Oreo" type sandwich cookies, paper towels, plastic spoons or knifes, *Cookie Moon Phases* sheets, pencils or pens

Originating Source:
Loony Lunar Phases developed by the Lunar and Planetary Institute and is part of the NASA portfolio of educational resources available on NASAWavelength.org.

LPI

MENU

Education and
Public Engagement
at the Lunar and Planetary Institute

Loony Lunar Phase

Overview

Children ages 8 to 11 discover the Moon's influence on our culture through this 30-minute, light-hearted investigation of lunar phases. The children hear a story, song, or (silly or serious) poem that celebrates the Moon's different phases. They recreate the shapes of the lunar phases using the frosting from Oreo® cookies, and then they place them in correct order to reveal the repeating pattern. As they eat the cookies, they consider how our culture would differ without the Moon changing shape in the sky over time. They use words inspired by the Moon to write a short poem.

Materials

For the group:

- One or more videos, books, songs, or poems about the Moon, such as (refer to resources for other suggestions):

  SkyTellers: "Moon Phases" Chapter
  The activities and resources found here will help children further explore the phases of our Moon after they have listened to the Native American tale of "The Girl Who Married the Moon" and the science story.Appropriate for ages 5 and up.

  Faces of the Moon
  Bob Crelin, Charlesbridge, 2009, ISBN 9781570917851

A great way to help children ages 4–8 learn about the phases of the Moon! Cut-outs in the pages help illustrate that phases are merely the result of light and shadow.

The Best Book of the Moon
Ian Graham, Kingfisher, 2005, ISBN 0753459027
Lunar cycles and eclipses, features, landings, and myths are presented for children ages 4 to 8.

How the Moon Regained Her Shape
Janet Heller, Sylvan Dell, 2007, ISBN 1934359025
The author uses a native American folk myth to teach children 4–8 about the moon's phases and encourage children's self-esteem. There is also an end section of science ideas.

Dot to Dot in the Sky: Stories of the Moon
Joan Marie Galat, Whitecap Books, 2004, ISBN 1552856100
The author shares with children age 9–12 stories about the Moon from other cultures. Moon facts, including information about geology, tides, Moon phases, eclipses, are listed with each story presented.

The Moon
David Jefferis, Crabtree Publishing Company, 2008, ISBN 0778737314
This book provides children ages 9–12 with a lot of great information about the Moon, its phases, surface characteristics and how you can observe the Moon. Also provided are interesting facts and a glossary.

The Moon: Earth's Companion in Space
Michael D. Cole, 2001, Enslow Publishers, ISBN: 0766015106
Children ages 9 to 12 learn about lunar orbits and phases, human exploration, and the mystery about how our Moon formed.

The Earth and the Moon
Linda Elkins-Tanton, Chelsea House, 2006, ISBN 0816051941
Written for young adults and adults, this book discusses Earth's size, orbit, mass, seasons and more as well as the evolution of the Moon.

"Moon-catchin' Net," *Shel Silverstein*

"Half Moonshine," *Judith Viorst*

"New Moon," *D.H. Lawrence*

"You know that Portrait in the Moon," *Emily Dickinson*

"The Moon And The Yew Tree," *Sylvia Plath*

"The Harvest Moon," *Ted Hughes*

"Under the Harvest Moon," *Carl Sandburg*

"The Crescent Moon," *Amy Lowell*

"Moon River," "Moonriver" *by Henri Mancini*

"Moonlight Sonata," *Ludwig Von Beethoven*

For each child:

- 6 Oreo® cookies (round cream cheese sandwich crackers can also be used instead)
- Paper towels
- A plastic spoon and/or a plastic knife
- *Cookie Moon Phases*
- Optional: *Phrases for Phases*
- *Moon in My Own Words* poetry template
- His/her *Marvel Moon comic book* and binder clip
- 1 pencil or pen

For the facilitator:

- Background information
- Shopping list

Preparation

- Review the background information.
- Provide tables for the children to sit at and create the lunar phases as shown in *Food Phases Guide*.

Facilitator's Note: This activity is not meant to model why the Moon has phases, only to assist in connecting the names and shapes, and to help the children remember the order. Attempts to model the three-dimensional nature of Moon phases with these two dimensions may lead to confusion.
Although there are other activities that place the phases in a circular formation, this may confuse children if they attempt to conceptualize the location of the Sun or Earth in relation to the Moon's orbit. We recommend that children first learn to correctly match the names with the appearances of each phase and to place them in order.

For very young children, you may want to model only four Moon phases (new moon, first quarter Moon, full Moon, and third quarter Moon). Older children should be able to model all eight phases.

The Moon's phases are a natural example of a recurring predictable cycle. They have been used as a calendar by many different cultures throughout history.

Activity

1. Invite the children to describe what the Moon looks like, and how it changes shapes.

- What shapes does the Moon take? *Depending on the age level, the children will describe the shapes generally (crescent, semicircle/half Moon, circle) or by their proper names: new Moon, waxing crescent, first quarter, waxing gibbous, full Moon, waning gibbous, third quarter, and waning crescent.*

2. Explain to the children that they will be using Oreo cookies to draw the phases and to put them into order. Demonstrate how to twist and open a cookie so that the frosting is all on one side.

- Which side looks like the full Moon? *The cookie that has all the frosting on one side.*
- Which side looks like the new Moon? *The cookie that has no frosting.*

3. Provide six cookies, a paper towel, a plastic spoon or knife to each child, and invite him or her to follow the pictures shown in *Food Phases Guide*. (Each cookie should be able to make two Moon phases, but some will break, and some of the frosting will go "missing.")

4. Invite the children to twist their cookies open and scrape the Oreo cookies to illustrate Moon phases, and ask them to arrange cookies on top of the *Food Phases Guide* in order.

5. Read one or more of the books while the children work.

6. Optional: Sing a song about lunar phases! Hand out copies of *Phrases for Phases* and sing the song together to the tune of "The Ants Go Marching." Alternatively, lead the children in singing "When the light is on the right" (sung to the tune of "If you're happy and you know it"):

When the light is on the right it's getting bright (snap, snap)
When the light is on the right it's getting bright (snap, snap)
When the light is on the right,
Then the Moon is getting bright
When the light is on the right it's getting bright (snap, snap)

7. Have the children eat their cookies and consider what Earth would be like without the Moon's light. Discuss the cultural artifacts that would be missing in a world without the lunar phases.

- There would be no stories of werewolves or lunar fables since there would be no Moon growing to full. What stories would we tell instead?
- There would be no music or rhymes about the Moon. What songs do you know about the Moon?
- Our language would be different. What words can you think of that have some form of th words "Moon" or "lunar"? *Month, honeymoon, lunatic, etc.*

Conclusion

Invite the children to complete the *Moon in My Own Words* poem and add it as the next page in the *Marvel Moon* comic book by clipping the book together at the upper left corner.

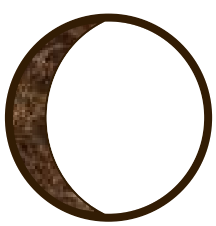
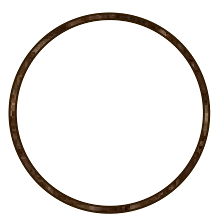
Facilitator's Note: The *Moon in My Own Words* poetry template directs children to write a cinquain (pronounced sing-**keyn** or **sing**-keyn), a short poem of five lines.

For children ages 8 to 9, announce the next activity, Moon Mythbusters. Ask children 10 and older to return to discover the reason for the Moon's phases in Lunar Phases: A Dance under the Sun.

Cookie Moon Phases

Materials:
6 Oreo® cookies (round cream cheese sandwich crackers can also be used instead)
Paper towel
A plastic spoon and/or a plastic knife

Instructions:
Carefully twist the Oreo® cookies open and scrape off the frosting to create each lunar phase. Place each cookie half in the correct order below to reveal the repeating pattern. Then, eat your cookies and celebrate the Moon!

1	2	3
 **New Moon** Completely (or almost completely) dark.	 **Waxing Crescent** A small sliver of light on the right.	 **First Quarter (or Half) Moon** The right half of the Moon is light.
4	5	6
 **Waxing Gibbous** Over half of the right side of the Moon is light.	 **Full Moon** The entire Moon is bright.	 **Waning Gibbous** Over half of the ***left*** side of the Moon is light.
7	8	
 **Third Quarter (also Half) Moon** The ***left*** half of the Moon is now light.	 **Waning Crescent** A small sliver of light now appears on the ***left*** side.	Activity modified from Chuck Bueter, Paper Plate Education

Art and the Cosmic Connection

This activity appeals to learners of all ages, including adults, and participants get to take their artwork home with them. View facilitation tips and art techniques from educator/artist, Monica Aiello, at goo.gl/kMNtgk and goo.gl/p51T2D.

Credit: Space Science Institute/NCIL

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
- Science models help us understand how space objects behave and make predictions about what we can't yet observe.

Build a Program with Related Resources

Explore additional aspects of NASA planetary science through the activities *Planet Party* and *Investigating the Insides*. Or, use *Art and the Cosmic Connection* to explore NASA images of Earth. Encourage teens and adults to be citizen scientists using the GLOBE Observer app (https://observer.globe.gov/about/get-the-app).

Combine this activity with other activities from Kit 2: *Pocket Solar System* and *Loony Lunar Phases* that introduce learners to our Solar System and the moon through visual models.

Or, combine this activity in learning stations with other hands-on activities relating to the Moon or Mars, sucha as *Tour the Moon and Mars Using Google Earth*, to explore digital imagery. Art and the Cosmic Connection activity pares well with *The Secret Galaxy* book provided.

Need more ideas? Browse activities in the "Astronomy and Space" and "Earth Science" content areas on the STEM Activity Clearinghouse (http://clearinghouse.starnetlibraries.org)

Add Your Review of This Activity

There are many STEM educational resources available to use in programs. We hope that you will give this activity a try! Then, **help others find the "best of the best" by writing a review** on the STEM Activity Clearinghouse. Email your favorite activities directly to a colleague!

Content Area – Astronomy and Space, Earth Science

Ages – Family, Early Elementary, Upper Elementary, Tweens, Teens, Adults

Activity Time – 1-2 hours

Prep Time – 10-60 minutes

Difficulty Level – Medium

Mess Level – Medium

Materials List – Drawing paper, 2 packs of colored pencils, 1 pencil box, space and earth images

Originating Source:
Art and the Cosmic Connection was developed artists and educators Monica and Tyler Aiello in partnership with the Mid-continent Research for Education and Learning (McREL) and NASA Jet Propulsion Laboratory and is part of the NASA portfolio of educational resources available on NASAWavelength.org.

National Aeronautics and
Space Administration

ART & THE COSMIC CONNECTION

Elements of Art Inspire Planetary Image Analysis

Created by Monica & Tyler Aiello, Artists & Educators
for NASA's Discovery and New Frontiers Programs

Cool new images arrive from NASA missions to planets, asteroids, comets, moons. What do they tell us? Using the elements of art—shape, line, color, texture, value—make sense of what you see, honing observation skills and inspiring questions. Learners of all ages create a beautiful piece of art while learning to recognize the geology on planetary surfaces. We start with what we know here on Earth and use that awareness to help us interpret features on distant objects in the solar system. *Art & the Comic Connection* offers a terrific bridge between Earth and Space Science, as well as a wonderful dive into the potential of science to inspire art—and art to empower science!

PROGRAM OVERVIEW

For the past three decades, NASA has sent many space missions to the planets, moons and small bodies of our solar system. Spacecraft have acted as robotic explorers, capturing images of mysterious alien landscapes using a range of instruments: spectrometers, gamma ray neutron detectors, cameras. These pictures are studied using a variety of techniques including visual analysis, or "looking to understand." Similarly, visual artists depend on their sense of sight to guide their creativity. Both artists and scientists are keen observers of the natural world and engage in creative problem solving.

Artists utilize a system of concepts to make sense of visual information called the elements of art—line, shape, color, value, and texture. Planetary scientists utilize analogous concepts, and the elements of art can be a valuable tool in planetary image analysis. Fusing art and science education proves an exciting and effective method for inspiring students to explore both disciplines.

PROGRAM FEATURES:

Flexible, can be scaled for K-12 students and informal education settings of all kinds.

Art & the Cosmic Connection **PowerPoint Presentation**

- Easy to follow presentation notes and science notes for expanded content

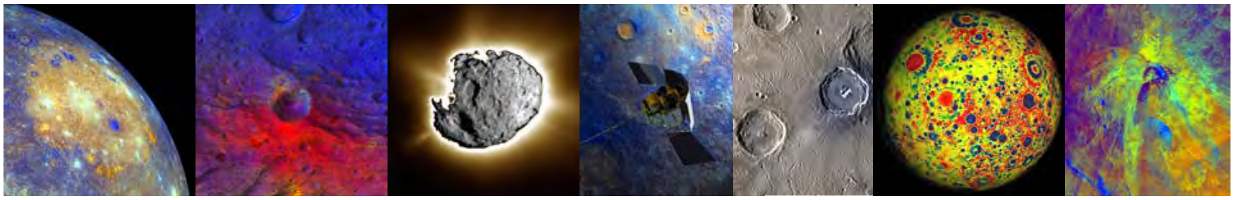
- Pastel Art Activity to engage students and reinforce concepts

- Beautiful and inspiring NASA images you can print
- **NASA images correlate with current and recent missions to highlight space exploration**
- **Downloadable from the NASA Discovery Program website**

- Program can be a one day or two day activity

-Works with both science and art curricula, providing opportunities for cross-curricular collaboration

-Curriculum has proven success with both youth and adults via schools, universities and museums



Courtesy NASA/JPL

PRESENTATION + ART ACTIVITY

Art & the Cosmic Connection is a 2-part interdisciplinary program developed by artists and educators Monica & Tyler Aiello. Learn more about their work at http://www.studioaiello.net. Designed to engage students in space science education by becoming artist explorers, the project incorporates the use of the elements of art as a tool to investigate and interpret the mysterious surfaces of our celestial neighbors. Students learn to analyze images of planets and smaller bodies such as moons, comets and asteroids with basic art concepts which parallel scientific practice. The project includes a PowerPoint presentation and pastel art activity which teachers can incorporate into their classroom curriculum or out-of-school time program. The project is scalable for different grade levels and blends artistic concepts with the investigation of planetary studies and storytelling. Utilizing art-making as a vehicle for scientific inquiry both inspires and engages students—preparing them for a more rigorous exploration of space science and art theory, while gaining a broader perspective of their own planet, Earth.

MATERIALS & SUPPLIES

- PowerPoint presentation

- NASA image prints

- Artist drawing paper

- Soft pastels or other drawing media

- Gummy erasers

- Hand wipes

- Q tips

- Fixative, either artists' or hair spray (prone to wrinkling the paper) (optional but very helpful)

LEARNING OBJECTIVES

Space Science

- Explore the basic structure of the solar system
- Appreciate the diverse planets and small bodies within the solar system, including moons, dwarf planets, asteroids, comets, and Kuiper Belt Objects (KBOs are similar to main asteroid belt objects, beyond the orbit of Neptune)
- Introduce current and recent NASA space missions
- Appreciate the concept of remote sensing and how it is used in scientific research
- Apply the Elements of Art (shape, line, color, value, texture) to planetary image analysis and learn how they can be used to recognize geologic processes in Earth science
- Learn about basic geologic processes including impact cratering, volcanism, erosion, and tectonic activity
- Begin to interpret more complex geologic stories
- Create a beautiful piece of artwork inspired by planetary images!

BACKGROUND INFORMATION

CORE CURRICULM CONCEPT: Art Elements Correspond to Geological Features

The elements of art—shape, line, color, value, texture—offer an amazing way to make sense of the geology of planetary surfaces. The core curriculum connects the elements of art to planetary image analysis. This simple concept shows how basic art forms can be sign posts for specific geologic processes – art depicts geology. The Elements of Art can provide a road map for students to interpret planetary images. When there are exceptions to these rules, or if these rules have multiple interpretations, students can learn to use other factors to infer results, just like scientists. As these concepts build, students can combine these elements to understand more complex images, thus discovering geologic narratives and engaging in storytelling.

SLIDE/PRESENTATION RECOMMENDATIONS

GRADES 3-5
Break the presentation into several lessons.

Lesson 1 60 120 min
Introduction to the Solar System: Slides 1-13
- **Have student teams create a KWL chart, and then build one for the entire class.**
- **Explore books to help students develop understanding of celestial bodies**

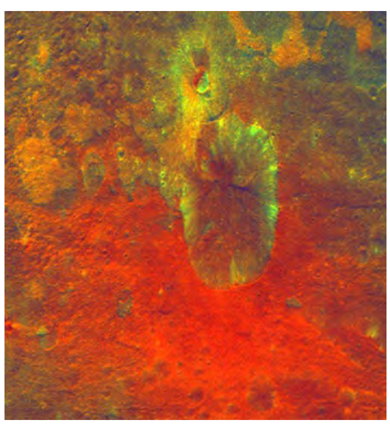
Lesson 2 60 120 min
- **Have each child choose a favorite image. Introduce the elements of art**
- **Choose 2-3 examples of each element of art from Slides 14-58 to illustrate concepts, hiding the rest.**

Pastel Art Activity
- **Suggest a focus on just shape, color, and line to start.**
- **Children are able to appreciate value and texture, too, but try it in context of kids' art creation to keep from overwhelming them with content/talk.**

GRADES 6-10
90-120 min
- **Encourage students to engage actively in the PowerPoint; noting features and writing down ideas are ways to keep participation lively.**
- **Use the PwPt notes to familiarize yourself with the content ahead of the presentation.**
- **Encourage interested students to use the many PwPt links to investigate further.**
- **It is also effective to have small discussions with students about art elements in their particular images in lieu of an extended presentation – the art making leads to rich scientific discourse!**

Elements of Art and their Geology Matches

- **Circle:** When circles are viewed on a planetary image, it often indicates an impact feature, a crater. The size, shape, ejecta blanket (stuff thrown away or ejected from the impact site, material from both the impactor and the area impacted) and number of craters give important clues as to the history of a planetary body. Sometimes circular features are volcanic or tectonic in origin, such as volcanic pancake domes found on Venus, for example.
- **Blobs:** Organic shapes, or blobs, can often be interpreted in two ways. Blobs frequently mean that one is viewing volcanic processes and lava flows. Blobby shapes can also indicate existing bodies of surface liquid (rivers and seas) or ancient bodies of liquid that left remnants of dried beds.
- **Straight Lines:** The presence of straight lines on a planetary body is often indicative of tectonic activity, including faults, ridges, cracks and mountains. On Earth tectonic activity is thought of as a land phenomenon; it can also be present in icy worlds.
- **Squiggly Lines:** The presence of squiggly lines on the surface often tells us forces of erosion are at work, including that of liquid and wind.
- **Color:** In addition to visible light, scientists image planetary bodies in many different frequencies of the electromagnetic spectrum (infrared, radio waves, X-ray, ultraviolet, etc.) They also create colorized images, adding and often exaggerating color differences to show subtle differences that the eye cannot detect otherwise, highlighting distinct aspects of a planet: topography, mineral composition, even gravity! Light and color are critical tools in interpreting and understanding planetary surfaces.
- **Value:** Value is the contrast of light and dark. Its scientific counterpart is called *albedo* - the measure of the reflectivity of a surface (think of snow vs. charcoal—which reflects more light?). Value/Albedo is a critical tool for understanding a planetary body.
- **Texture:** Implied texture is the tactile quality of a two-dimensional surface which we can see with our eyes, yet not touch. Images of planetary bodies are replete with various textures corresponding to eons of geologic history. Geologic processes build over time to create complex textures which can be deciphered with the aid of the other art elements.



TEACHING PART 1: Art & the Cosmic Connection PowerPoint Presentation

The presentation uses many beautiful NASA planetary images to illustrate concepts. It is flexible and scalable for various ages, experience levels, and time requirements. To prepare, teachers are encouraged to review the PowerPoint and make appropriate revisions for their particular students (see sidebar page 3), depending on the curriculum you would like to cover. The PowerPoint includes extensive ***Presentation Notes*** to guide teachers through the curriculum. The notes serve as a basic script and also include question prompts to encourage class discussion. There is also a ***Science Notes*** section with links to NASA web resources for educators who wish to expand their lesson plans.

Courtesy McREL

Show the PowerPoint
After reviewing the PowerPoint and the *Presentation Notes*, show the PowerPoint presentation to your students. The PowerPoint has an introduction to the solar system, an overview of remote sensing and space exploration, and the core concept that describes planetary image analysis using the elements of art.

Getting Started: What Do You Know About the Solar System?
Begin by making a KWL (Know, Wonder, Learn) table on the board or chart paper. Take notes (or invite students to) on the chart paper as students answer the following about the solar system:

- What do we ***know***?
- What do we ***wonder*** about?
- What have we ***learned***?

This forms a baseline of classroom knowledge, helps you be aware of your students' prior knowledge, and promotes inquiry. The KWL can be done in pairs or small groups initially to engage participants actively.

➢ If a student states something others are uncertain about, or you believe is inaccurate, post it in the Wonder section to return to for verification later.

Avoid major discussion of the structure of the solar system (including the inner terrestrial planets, outer gas giants, and small bodies including moons, asteroids, comets, dwarf planets, and Kuiper Belt Objects [or KBOs]) until after the main presentation. Images there will help support your discussion.

- Make special note that our activity focuses on worlds with visible geology. Thus, the presentation does not focus on the gas giants themselves, but does appreciate their marvelous moons!

Introduction: Science Inspires Art
The beginning of the presentation briefly introduces students to the painting and sculpture of project authors, Monica and Tyler Aiello. The husband and wife artist team collaborate with NASA and the scientific community in the development of their artwork and educational programs. Students are intrigued to view professional artists inspired by science, and are encouraged to become "artist explorers."

Remote Sensing & Space Exploration
A brief discussion of remote sensing incorporated in the PowerPoint explains how NASA sends robotic explorers to planetary bodies and takes pictures of their surfaces. The images used are shown from the aerial or "birds-eye" view. The planetary images provided correlate to recent and current NASA missions to provide an opportunity to build student interest and excitement in space exploration. The beautiful and often unfamiliar images keep students engaged with the content.

Elements of Art & Planetary Image Analysis
The core concept section relates how the Elements of Arts can be used to interpret planetary images. It is useful to have students define (or for the educator to review) the definitions of the Elements of Art. The remainder of the presentation includes sections for each of the Elements of Art and illustrates the how these relate to specific geological processes using examples of gorgeous NASA images.

- Circle – Crater
- Blobs – Volcanoes or Lakes
- Straight Lines – Tectonic Activity
- Squiggly Lines – Erosion
- Color, Value, Texture – Critical Scientific Tools

TEACHING PART 2: Art Activity

The *Pastel Art Activity* is designed to be a simple, yet fun and engaging way for students to explore the concepts they've learned from the PowerPoint presentation. Students enjoy making art in science class or exploring science in art class, depending upon how the project is taught. This reinforces the connections between the arts and the sciences and engages the students in an interdisciplinary learning environment. The art project can be taught during the same session as the presentation or in subsequent sessions.

Time Recommendations

Grades K-5: two or three 45-minute periods
Grades 6-12: one or two 45-60 minute periods

Supplies

- **Drawing paper –** A larger-sized, fine artist drawing paper is recommended, budgets allowing (22"x28" is great, at least 9"x12"). Students enjoy working with fine art materials and tend to take their projects more seriously. The drawing paper should be appropriate for the drawing media.
- **Drawing media –** Soft pastels are recommended for their ease of use and blend-ability. However, they should not be ingested. Water colors, crayons, markers and pencils are more appropriate for K-2 students.
- **NASA Planetary Prints –** Download from the NASA Discovery Program website, http://discovery.nasa.gov. The prints inspire the students' artworks.
    - Images are both in black and white and in color. Slipping them into sheet protectors is essential for future use; laminating them is more costly but more durable.
- **Gummy erasers –** Can be used effectively with soft pastels to lift pigment and create highlights
- **Q-tips –** Are a great blending tool
- **Cleaning or Hand Wipes –** Pastels are messy but easy to clean up, especially with cleaning wipes
- **Fixative (optional)** - A pastel spray fix can be used; however, it is toxic and should only be used by a teacher or with older or experienced students, and by all in a ventilated area. For other students, aerosol hairspray can be used. A light coating will help fix the pastel pigment to the drawing paper.
    - Drawings can also be spray-fixed between layers if they get too heavily loaded with pigment or muddy so that students may work on top of the drawing. This process should be completed or supervised by the educator. A fixative is not necessary.

Implementing the Art Activity

- Have all students select a NASA planetary image to work from; pass out paper.
- Ask students to make pastel drawings inspired by their image.
- Discuss or share images prior to the project, if desired.
- Ask students to pay special attention to the Elements of Art and how they relate to interpreting the geologic history of their image. They may choose to focus on one or two images.
- Explain that students do not have to make their artwork exactly like their image. They are making "art" and should feel free to interpret their image by altering their composition, cropping, color, orientation, etc. This is effectively done using question prompts, such as, *"Do you have to make your artwork black and white like your image? No, feel free to explore color!" or, "Focus on the details that intrigue you."*
- Encourage artists to explain their interpretation. For example, a student may have noticed especially bright areas and picked them out in a certain color.

> **TIP:** Distribute drawing supplies AFTER you explain the assignment above so that students do not work ahead or get distracted. ☺

Artists and activity authors at work, Monica & Tyler Aiello



Wrap Up and Formative Assessment

- At the conclusion of the art activity, display artwork and discuss the project. Here are two possible approaches.
    a) Conduct a **gallery walk**, where student art is hung up, with its inspiring image beside it, and students spend time viewing all. Ask all present, kids and adults, to offer observations about what strikes them about the drawing on sticky notes to leave for the artist.
        - Examples: "Really nice example of texture!" "What is your interpretation of that feature?" "Your blending really made those colors pop out!"
    b) Break students into small groups (mix up the class so kids see others' work). Ask students to do a **think-pair-share**, where they write about their experience for a couple of minutes on a sticky note, share their ideas with a partner, and then with a small group.
        - Reflect on the selected planetary image: interpret the geology of their image, and discuss how they used that image to inspire their artwork.
- Ask students to share something new they have learned from the activity with the entire group.
- Conclude by returning to the KWL chart to record:
    - What have we ***learned***?
    - What do we ***wonder*** **–** what **new** questions do we have?
- Clean up studio or classroom.

Storytelling & Geologic History

- Interspersed within the Elements of Art sections are images with multiple art elements/geologic features. These examples provide students with the opportunity to combine what they have learned to decipher more complex geologic history *(i.e., circles and blobs might be interpreted as craters and volcanoes)*.

NATIONAL EDUCATION STANDARDS
ART & THE COSMIC CONNECTION
Elements of Art Inspire Planetary Image Analysis

SCIENCE
Source:
http://www.nap.edu/openbook.php?record_id=4962

K-4
Earth and Space Science
- Objects in the Sky
- Changes in the Earth and Sky

History and Nature of Science
- Science as Human Endeavor

5-8
Unifying Concepts and Processes
- Evidence, models and explanation
- Form and Function

Earth and Space Science
- Structure of the Earth System
- Earth in the Solar System

ART
Visual Arts

K-4 **Source: http://artsedge.kennedy-center.org/teach/standards/standards_k4.cfm**
- Content Standard #1: Understanding and applying media, techniques, and processes
- Content Standard #2: Using knowledge of structures and functions
- Content Standard #5: Reflecting upon and assessing the characteristics and merits of their work and the work of others
- Content Standard #6: Making connections between visual arts and other disciplines

5-8 **Source: http://artsedge.kennedy-center.org/teach/standards/standards_58.cfm#04**
- Content Standard #1: Understanding and applying media, techniques, and processes
- Content Standard #3: Choosing and evaluating a range of subject matter, symbols, and ideas
- Content Standard #5: Reflecting upon and assessing the characteristics and merits of their work and the work of others
- Content Standard #6: Making connections between visual arts and other disciplines

Investigating the Insides

This space-themed activity uses the senses and scientific tools to engage learners of all ages! NASA scientists were involved in the development and testing of this activity, and they appreciated how it reflects the nature and practice of science.

Credit: Space Science Institute/NCIL

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
- There's more to the universe than meets the human eye.
- Magnetism is all around us.
- Science models help us understand how space objects behave and make predictions about what we can't yet observe.

Content Area – Astronomy and Space

Ages – Family, Early Elementary, Upper Elementary, Tweens, Teens, Adults

Activity Time – 20-40 minutes

Prep Time – 20-40 minutes

Difficulty Level – Medium

Mess Level – Low

Materials List – IR Thermometer, ornament balls, earth ball, magnets, marbles, paper clips, pony beads, scale

Build a Program with Related Resources

Consider introducing the idea that planets have magnetic fields using the *Magnetic Globe*. Also refer to *Magnetism 101* for background information about magnetism in space.

Develop the key concepts around using scientific tools and magnetism with the *Magnet Science Kit*. Or, continue practicing this type of "scientific" detective work with *Taking Earth's Temperature*.

Attract audiences by incorporating technology into this activity! Demonstrate how to use the *Infrared Thermometer*, then provide the tool for patrons.

Use this activity to explore how scientists learn about the interiors of planets with scientific tools on spacecraft, then model what planets look like on the inside with the edible activity, *Recipe for a Planet* on the STEM Activity Clearinghouse. *The Secrets of Our Earth* book is a great addition to the *Investigating the Insides* activity, which helps "shine a light" on what you cannot see.

Need more ideas? Visit the "STAR Net Hands-on Activities" collection on the STEM Activity Clearinghouse for more field-tested activities, or browse activities in the "Astronomy and Space" content area.

STEM ACTIVITY Clearinghouse

Add Your Review of This Activity

There are many STEM educational resources available to use in programs. We hope that you will give this activity a try! Then, **help others find the "best of the best" by writing a review** on the STEM Activity Clearinghouse. Email your favorite activities directly to a colleague!

Originating Source:

Investigating the Insides was developed by the Lunar and Planetary Institute and is part of the *STAR Net* portfolio of field-tested activities developed for public library programs.

STAR net

Hands-on

Tested & Approved STEM Activities

Investigating the Insides

Activity Guide

STAR net

Science-Technology Activities & Resources For Libraries

A product of the Science-Technology Activities and Resources for Libraries (STAR_Net) program.
Visit our website at www.starnetlibraries.org for more information on our educational programs.
Developed by the Lunar and Planetary Institute/Universities Space Research Association
January 2018

NSF

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Investigating the Insides

Activity Time

Up to 40 minutes, this activity can also be modified to serve as a short simple engagement.

Intended Audience

Families or other mixed-age groups, including children as young as 5 years old *with assistance from an older child, teen, or adult*
School-aged children ages 5 and up
Tweens
Teens
Adults

Type of Program

- ☑ **Facilitated hands-on experience**
- ☑ **Station, presented in combination with related activities**
- ☐ Passive program (if instructions are provided)
- ☐ Demonstration by facilitator

Overview

Investigate the composition of unseen materials, using a variety of tools, as an analogy to how scientists discover clues about the interiors of planets using spacecraft.

What's The Point?

- **The interior of a planet cannot be studied directly; scientists must infer the composition and structure from their observations.**
- **Different instruments provide different forms of indirect evidence.**
- **Scientists use their observations (evidence) and to build on what they already know about the universe.**
- **Scientific explanations are built on existing evidence and models. New technologies help scientists find new evidence and construct new models. Science advances when these are incorporated into our knowledge of the universe.**
- **Models offer a useful way to explore properties of the natural world.**

Materials

Facility needs:

- ☐ A freezer if "planets" will include cold or frozen materials

For participant or group of 3-4 participants:

- ☐ Optional: 1 copy of *Investigating the Insides* worksheet and pencil
- ☐ Optional: poster-sized paper and markers to record observations as a group

For each group of 20 to 30 participants:

- ☐ 5 to 7 "planets" (or "asteroids") to be filled with assorted materials (listed below) made from large plastic eggs or balls plastic "jumbo egg containers" (at least 3 inches wide)
  OR fillable craft ornament (at least 80 millimeters wide)
  OR 10 to 14 extra-large, dark colored balloons

Optional Materials to include in "planets":

- ☐ A handful of small objects such as beads or pieces of gravel or marbles (for each of 3 planets)
- ☐ A handful of small metal objects such as paper clips or ball bearings (for each of 2 planets)
- ☐ Magnets (round or elongated, such as cow magnets, for 2 planets)
- ☐ Small balloons filled with water
- ☐ Outer covering to hide the contents, such as aluminum foil or other materials

Optional instruments for studying "planets" or "asteroids":

- ☐ 2 magnets or other instruments for detecting metal
- ☐ 2 compasses or paper clips or Magnaprobes (https://www.arborsci.com/magnaprobe.html) to test for magnetic fields
- ☐ Optional: electronic devices with magnetometer apps to test for magnetic fields (such as the Space Science Institute Magnetometer app)
- ☐ 2 small scales (such as postage scales)
- ☐ Optional: 2 ear thermometers, or liquid crystal temperature strips (available where aquarium supplies are sold), or infrared thermal cameras that work with smartphones and tablets (such as a Seek Thermal Compact camera)

Preparation

Before the activity

- Review the background information (at the bottom of this activity).
- If using the magnetometer app or the thermal camera, review the notes on these items within the background information.
- Practice using any technology, including compasses, temperature strips, ear thermometers, tablets, and cameras.
- Prepare the "planets." For each, include two different types of materials: for instance, one might include a magnet and 5 beads, another might include paper clips and a small tied balloon filled with water.
- If using oversized plastic eggs or balls, tape them closed when finished and wrap them in aluminum foil or other materials to keep the contents hidden.
- If using balloons to make the "planets:"
  – stretch out the balloons
  – place one balloon inside of another of a different color
  – place desired objects inside of the inner balloon (dampening the balloon if needed to keep objects from sticking in its neck)
  – partially inflate the inner balloon and tie a knot in the balloon's neck, then partially inflate the outer balloon and tie a knot in its neck.
- If desired, place one or more of the "planets" into a freezer.
- **Optional:** use a marker to number each "planet" and make a note for yourself about what is inside each "planet."

Activity

1. Share ideas and knowledge.

- Introduce yourself. Help the participants learn each other's names (if they don't already know each other).

- Invite the participants to share their thoughts on what planets are made of, and how we study planets.

Facilitator's Note: As much as possible, encourage the participants to offer their own ideas as well as questions, and to share their ideas in response to others' questions. This model can be used to answer questions such as:
- What is a planet?
- What tools to we use to study planets?
- How do we study what's inside a planet?

Take personal note of participants' expressed concepts and be prepared to address misconceptions at the end of this activity, particularly the common belief that gas giant planets like Jupiter are simply composed of gases without any structure. See the background information for more details.

2. Share that spacecraft can take measurements of a planet (or moon or asteroid) to help determine what's inside.

Examples might include the Juno mission orbiting Jupiter and the InSight mission that will land on Mars.

- Magnetometers work like a compass to study a planet's magnetic field. (See https://www.youtube.com/watch?v=ITPizr7Pqgg for more info about Jupiter's magnetic field.)
- Cameras and sensors can study planets in visible light and other wavelengths, to help determine what the outside of a planet is made of.
- Missions orbiting a planet or moon can track slight changes in their orbits due to changes in the gravitational pull by the object, which provides clues about the gravity field and the layers and densities below.

While some of these instruments will provide clues about the inside of planets, none of them will be able to see inside the planet.

3. Show the "planets" created beforehand and tell the children that they are going to explore how we study planets, using models.

- What's a model?
- How does a planet compare with these models? We can only see the surfaces or outer layers of planets, just like we can only see the outside of these models.
- What are some ways we can determine what is inside of these "planets"? We can feel their weight and shake them. We can use tools like thermometers, scales, magnets, and compasses to learn more about what's inside.

4. Demonstrate the tools available and give everyone time to explore them.

- Demonstrate how thermometers or infrared "thermal" cameras can be used to measure temperatures.
- Demonstrate how scales can be used to measure weight.
- Demonstrate how a magnet can show whether there is a metal inside, such as iron ball bearings or paper clips.

- If magnetometers, compasses, or even paper clips have been provided, show how they can be used to measure the presence of a magnetic field. For instance, paper clips will be attracted to a "planet" that has a magnet inside. A compass or magnetometer will show changes in magnetic field direction or intensity, helping to demonstrate the magnetic field's orientation.

(See Background Information for further tips on some of these tools.)

Facilitator's Note: This activity serves as an open-ended engagement activity on how we study the planets. Scientists are able to directly observe some of a planet's characteristics, such as location in the solar system, size, mass, density, gravity, external composition, and more. Telescopes and tools that measure invisible wavelengths of light, called spectrometers, allowed scientists a closer look at the planets' external compositions.

Scientists study the interiors through models they create, which are based on a planet's observable characteristics. Earth's interior is studied in part through seismic data. The giant planets and Earth all have magnetic fields, which are detectable by the radio signals they emit. Magnetic fields are generated deep within planets, so they provide clues to the internal structure and composition. Orbiting spacecraft experience slight variations in their trajectories that help scientists understand a planet's gravity well. By measuring the gravitational pull, scientists can tell more about how a planet's heavy material is distributed in its interior. That information will help them make educated inferences about a planet's composition.

5. **Divide the participants into small groups and provide each with one or two "planets" to investigate using their senses and the tools in the room.** They must be careful not to break or pop the planets.

- Have each team record their observations and form a hypothesis (on their student sheets or on poster-sized paper for the entire group to see) about what is inside their "planet."

- If time permits, invite them to exchange planets with other groups and compare their hypotheses.

Activity (continued)

6. One at a time, invite each group to share their observations with the others.

- Did they infer that the materials are solid, sloshy (liquid), or primarily gas?
- Were the materials light or heavy?
- Do the materials attract metal, indicating a magnetic field?
- Are they cold or hot?
- What was the group's hypothesis for the make-up of their planet, and how did it compare to other groups'?

Conclusion

Ask the participants to compare their models to planets.

- How are the planets like the models? We can't see inside a planet or inside the models. We inferred what was inside.
- What tools did you use to tell what was inside your planet?
- Can scientists do all of these things to a distant planet? Can they shake it, or pick it up, or weigh it? No.
- How might a scientist study a planet? What kind of tools should a spacecraft have to study a planet? They can see if the planet has a magnetic field with something like a compass or magnet. They can measure its mass by seeing how much it pulls on an object like a spacecraft. The strength of a planet's gravitational pull for its size can help scientists understand whether gases, liquids, or solids make up the planet's insides. They can examine the outside to study its composition.

Share with the children that scientists can never see exactly what is a planet or how its inside materials are arranged. Scientists cannot "pop" the planet to see if they are right! Their interpretation is based on the evidence they gathered. Their interpretation may be altered in the future as more evidence is collected, or new instruments are created.

Correlations to the Next Generation Science Standards

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

Science and Engineering Practices

Developing and Using Models

- Develop and/or use models to describe and/or predict phenomena.
- Evaluate limitations of a model for a proposed object or tool.

Analyzing and Interpreting Data

- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.

Constructing Explanations and Designing Solutions

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Engaging in Argument from Evidence

- Support an argument with evidence, data, or a model.

Crosscutting Concepts

Structure and Function

- Students observe the shape and stability of structures of natural and designed objects are related to their function(s).

The Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- Scientists use drawings, sketches, and models as a way to communicate ideas.

Facilitator Background Information

Earth has a global magnetic field, which we can detect with smartphones and compasses to help us navigate. This magnetic field is generated from the electric current caused by the flow of molten metallic material within its outer core.

Like the Earth, several of the planets in our solar system have global magnetic fields. Mercury, Jupiter, Saturn, Uranus, and Neptune have magnetic fields, detectable with compasses. Each of these planets' magnetic fields originate from processes deep in their interiors. Scientists can use data from these fields to infer what the planet is like inside. Inside of Jupiter, Saturn, Uranus, and Neptune, the planets' gases are crushed to such incredible pressures that they are forced beyond the common states of liquid, solid, or gas that we find on Earth. One such a layer inside Jupiter and Saturn is *metallic* hydrogen, and the electric current caused by swirling movements in this substance produces an enormous magnetic field.

A common misconception is that the giant planets, sometimes referred to as "gas giants," are solely made of gases. Jupiter, Saturn, Uranus, and Neptune do have thick atmospheres of gas, but inside they have layers made of highly compressed fluids and they likely have solid cores.

The Juno mission in orbit around Jupiter is using sophisticated instruments (https://goo.gl/tNkfwX) to spy deep into Jupiter's atmosphere and to infer its interior structure and composition. Similarly, the MESSENGER mission (https://goo.gl/MahSbB) used observations to determine that Mercury has a large core with an inner, middle, and outer layer, as well as a thin mantle and crust, with large amounts of iron sulfide instead of iron-nickel like Earth's. The GRAIL mission (https://goo.gl/WsBfGb) used the Moon's gravitational field to map interior structures. The InSight mission (https://goo.gl/9yMU3s) will land a probe on Mars to use instruments, including seismometers, to infer Mars' interior structure and composition.

Tips for Using Tools

Different tools will be appropriate for different participant ages.

- Children ages 5 to 7 can use magnets and their senses, but may not be able to make inferences using data from scales, magnetometers, and thermometers. They may also have difficulty using some of the technology and apps, but might still enjoy observing the images from an infrared camera.
- Children ages 8 to 12 can be shown how to use scales, magnetometers, and thermometers. They may have difficulty inferring whether a "planet" that attracts a magnet, but not a paper clip, has a magnetic field.
- Participants older than 12 may enjoy determining how to use the technology for themselves, as well as making inferences based on their observations.

Activity Tools

The Space Science Institute's Magnetometer App
This app would best be used by participants comfortable with both the concept of a magnetic field and comfortable with graphs; possibly ages 10 and up.

When opened and initiated, the app will generate a graph, indicating how the magnetic field intensity is changing over time. The graph automatically scales to fit the data. Intensities ranging between 0 and 120 fall within error ranges and can be ignored; participants can note whether the intensity increases significantly higher (between 200 and 1000) as the tablet or smartphone is moved close to and around their "planet," indicating that their planet has a magnetic field.

The Seek thermal infrared camera
This camera and app have a variety of modes. Setting the app to "Hi/Lo Mode" will automatically provide the highest and lowest temperatures in the camera frame, which may be the most useful mode for this activity.

Participants should be allowed to view objects other than their planet models first (such as ice cubes, a cup of warm water, or their faces) to learn the significance of the colors and how the camera works.

For participants younger than 10, program facilitators may want to use the camera themselves in real time, taking pictures of different objects based on the participants' requests and then showing or even printing the images for the participants.

Depending on the size of the group, older participants might be able to use the camera responsibly; facilitators should use common sense with this, as with any technology, and monitor the camera's use.

Activity Worksheet

As a scientist, you are going to use various tools and senses to study what is inside of a model of a planet.

Use your senses! What do you feel and hear when you pick up and move the "planet"?

The planet seems ____

____

Investigate with tools (such as a scale, a magnet, a paper clip, a magnetometer, a thermal heat sensor).

Tool Used	My Observations

(HINTS: is the planet heavy or light? Is there more than one thing inside of it?
What does it sound like? Is it magnetic? Is it attracted to a magnet?)

Based on my observations, I **infer** that there is or are ____

____ inside my planet.

Taking Earth's Temperature

Participants are introduced to a type of energy, infrared radiation, which we can't see with our eyes but we can feel as heat. Then, they explore their outdoor environment using an infrared thermometer (also known as an IR thermometer) to measure the temperatures of concrete, asphalt, grass, and bare soil. Participants consider how the temperatures of different surfaces might have an influence on a global scale.

Credit: NASA, Langley Research Center

Content Area – Earth Science

Ages – Family, Early Elementary, Upper Elementary, Tweens, Teens, Adults

Activity Time – 10-20 minutes

Prep Time – 10-20 minutes

Difficulty Level – Medium

Mess Level – Low

Materials List – See below

Key Concepts

- By taking careful measurements, patrons can record differences in temperature between concrete, asphalt, grass, soil, and other surfaces in their local environment.
- NASA takes measurements of Earth from space, using satellites. (Scientists refer to this as "remote sensing.")
- By taking measurements of Earth from space, NASA scientists study changes in Earth's dynamic systems – to help us learn more about climate, weather, and even the health of our crops!
- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe (e.g., infrared detectors).
  - Different tools are used to observe objects of different sizes and types (e.g., a telescope can magnify small objects)
  - Different tools used to observe the same object can provide us with a more detailed understanding of the object

Materials

- 1 or more infrared thermometers
- Batteries (fully charged)
- Optional: 1 thermometer (to compare with air temperature) per 6 learners
- Optional (recommended): poster-sized paper and markers to record observations as a group
- Optional: paper, pencils or pens, and clipboards to record observations individually

Tip: Infrared thermometers can be purchased from various online retailers starting at around $25 and up. Some example models include: Etekcity Lasergrip 800, Kintrex IRT0421, and Omega OS543. You may be able to borrow infrared thermometers from heating and cooling specialists or auto mechanics. Infrared thermometers are commonly used in those jobs.

Ideally, have one infrared thermometer for every two to four participants, or combine this activity with other activities as learning stations. See below for related activities.

Preparation

Credit: Space Science Institute

- Decide if you want the laser pointer on. Most infrared thermometers have an optional laser pointer to help you see where you are pointing the thermometer. You may turn the laser pointer off and/or cover it with tape. Alternatively, allow the use of the laser pointer to take aim, but make sure that facilitators are monitoring their use.
- Test that the infrared thermometer is measuring accurately. This can be done by testing the temperature of ice water. Ice water should be 32° F (0° C). An infrared thermometer is measuring correctly if it reads the temperature of the ice water bath within the range of 28-36° F (+/- 2° C). If the infrared thermometer shows a temperature of more than 36° F (+2° C), or less than 28° F (-2° C), try changing the battery. If the calibration still is off, the thermometer needs to be replaced.
- Go outside and take note of the different types of surfaces that participants could measure. Look for a bare soil, short grass, tall grass, concrete, asphalt, sand, forest litter, or other types of surfaces. Make sure to have a safe route for participants to enter and exit the building. A satellite image of your location might be helpful (you can see satellite imagery of your location using Google Maps Satellite View).

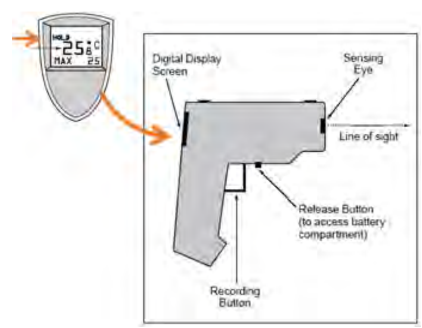
Procedure

1. Set the stage. Say:

- Imagine that you are outside on a hot day and you are barefooted. What surfaces would you want to walk on and why? Why are some surfaces cool to your touch? Why are some hot to your touch? Where did the hot surfaces get their energy? Those surfaces received this energy from the Sun and can become quite hot.
- All matter (you, a table, cars, apples, and the ground) emits energy. At the temperatures we usually experience in our daily life on Earth, that energy is emitted as infrared radiation. We can use a special infrared-detecting thermometer to measure this energy and tell us the temperature of the object.
- Heat rising off Earth's oceans and landscapes influences – and is influenced by – weather and climate patterns (e.g., water cycle, winds, storms, draught). Scientists track these changes using information from satellites. Satellite information can also help commercial farmers choose which crops need extra water during the summer to cope with the heat or find where to look for frost-damaged crops in the winter.
- You can use an infrared thermometer to measure the infrared energy (heat) coming from different surfaces outside.

2. Demonstrate how to use the infrared thermometer.

- **Warn participants that the laser beam should NOT be aimed directly at eyes** or off surfaces where it could reflect into anyone's eyes.
- Hold your arm at arm's length and point the instrument at the ground. Briefly press the Recording Button to record the temperature.
- Be sure to have the instrument's Sensing Eye pointed directly at the surface you want to measure. Be careful to not inadvertently record the temperature of your shoe or the surface in your own shadow.



3. Give participants time to try measuring various surfaces with the infrared thermometer.
See the facilitation guide, *Using an Infrared Thermometer to Measure Surface Temperatures from Afar*, for tips.

4. Invite participants to go outside and investigate what happens to different surfaces when they are exposed to the Sun.

- Once outside, look for a bare soil, short grass, tall grass, concrete, asphalt, sand, forest litter, or other surfaces to measure. (Any surface can be used!)

Procedure (continued)

- Optional (recommended): invite participants to record the type of surface and temperature they record for that surface on poster-sized paper. Encourage participants to compare their measurements with others.'
- Optional: invite participants to draw a map of the area and note where they took their observations and record their temperature measurements.
- Prompt participants to take different measurements that will help them investigate questions such as:
  - How does surface temperature compare with current air temperature?
  - How do the temperatures compare for different surfaces?
  - How does surface temperature vary with surface soil color?
  - How does surface temperature change for different cover types (grass vs. asphalt for instance) on a cloudy day?
  - How does the surface temperature change for different cover types when it is wet versus when it is dry?

5. Conclude.

Have a discussion about how the temperatures of different surfaces might have an influence on a global scale. Explain that NASA and other scientists use temperature measurements of different surfaces to help them answer the following science questions:

- How do urban areas affect the temperature around them?
- What is the contribution of changing land use and land cover on local energy budgets?
- How are land surface temperatures changing over the long-term?
- NASA satellite data is combined with ground data to provide an accurate picture of how our planet changes over time.

Connections to Other Kit Materials

- Begin with open-ended exploration with the infrared thermometer. See the facilitation guide, *Using an Infrared Thermometer to Measure Surface Temperatures from Afar*, for tips.
- Introduce the infrared thermometer along with the *Secrets of Our Earth* book.
- Encourage adults to extend the learning at home on their mobile devices by downloading the GLOBE Observer app at https://observer.globe.gov/about/get-the-app. Adults and their families can use the app to note what types of clouds are in the sky, then share their observations online through the app. GLOBE Observer cloud observations are helping NASA scientists understand clouds from below (the ground) and above (from space).

Connections to Other *STAR Net* Activities

- Please visit the *STEM Activity Clearinghouse* at www.clearinghouse.starnetlibraries.org to find other remote sensing and Earth observing activities!

Extensions

Everyone can be a citizen scientist and share observations of their environment with NASA scientists! You can collect and share surface temperature measurements as part of a worldwide citizen science effort through *The GLOBE Program* (www.globe.gov). To join this effort, you'll need to become GLOBE Trained at: http://www.globe.gov/get-trained/protocol-etraining

Then, follow the GLOBE Surface Temperature Protocol and enter the data into the GLOBE database. https://goo.gl/esyqmm.

SciStarter is also a great resource for finding Citizen Science projects that are right for your patrons and community.

Section 3:

Quick Facilitation Guides

Using Your Telescope

The 76mm Fun Scope Telescope by Orion is a small, but engaging tool that provides a great introduction to the world of astronomy and magnification. Used as part of an indoor activity during the day or for a nighttime viewing event, this telescope is powerful enough to magnify objects that are very far away and provides hours of fun for all age levels and interests (not for solar viewing). The Fun Scope Telescope is ready to use with only a few minutes of set-up.

Credit: Space Science Institute

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
  - Different tools are used to observe objects of different sizes and types (e.g., telescopes and binoculars can magnify small objects)
  - Different tools used to observe the same object can provide us with a more detailed understanding of the object

Ages – Families, Youth with adult supervision, Teens, Adults

Activity Time – 10-60 minutes

Type of Program – Stations, stand –alone activity, facilitated program, outdoor activity

Materials List – FunScope 76mm Table Top Reflector Telescope, 20mm Kellner eyepiece 1.25" in a container, 6mm Kellner eyepiece 1.25" in a container, 2x Barlow lens, Red-dot Finder reflex sight, Orion MoonMap 260, Instruction Manual, optical tube dust cover, and focuser dust cover

Setup Hints

NOTE: THIS TELESCOPE IS NOT SET UP FOR SOLAR VIEWING AND NO SOLAR FILTER IS PROVIDED! DO NOT LOOK AT THE SUN.

- Review the Fun Scope Instruction Manual before set-up and use.

- Unpack the telescope and accessories to make sure all the parts are available (notice how they are packed so that they can be easily repacked for shipping). See the Materials List to the right.

- Always set-up and use the telescope on a sturdy surface such as a table, picnic table, chair, stool, ground, etc. Using the telescope on an unstable or wobbly surface will cause unsatisfactory results and limited success in finding objects.

- Remove the front dust cover from the optical tube and the dust cap from the focuser when you are ready to use the telescope. Keep these dust covers on when the telescope is not in use and when it is stored or packed.

- The Red-dot Finder scope may or may not be attached to the telescope when you receive it. If needed, attach it to the telescope by sliding the Red-dot Finder scope into the Finder scope base located on the telescope. See Figure 2 and 5 in the Instruction Manual of the telescope for correct orientation of the Red-dot Finder scope. NOTE: This is not a laser. It is just a red LED light projecting in the small tube of the sight. The Red-dot Finder scope should not need to be realigned often. If you are having trouble finding an object in the eyepiece once you have oriented the red-dot on a distant object then you may need to follow the instructions for Aligning the Red-dot finder in the Instruction Manual to have the best success at viewing objects in the telescope.

- Start with the 20mm eyepiece (low-power or low magnification) and only use the 2X Barlow lens and the 6mm eyepiece (high-power or high magnification) if viewing conditions are optimal. NOTE: Higher magnification does not always lead to a better image (See the *Using Your Telescope* section of the Fun Scope Instruction Manual). Insert the chrome part of the 20mm eyepiece into the focuser and secure the small thumbscrew. You may need loosen the thumbscrew and remove a dust cap on the focuser first.

Directions and Usage Hints

WARNING: THE TELESCOPE IS NOT SET UP FOR SOLAR VIEWING! DO NOT LOOK AT THE SUN.

- Review the Fun Scope Telescope Instruction Manual before using the telescope.
- Set-up the telescope as described above and choose an observation site. If indoors during the day, choose an area where you can see things in the distance, or if outdoors at night, choose a large open area preferably with no or low light pollution.
- Next, follow the instructions for Operating the Red-dot Finder Reflex Finder in the Instruction Manual. Remember to turn off the Red-dot Finder when done with your viewing session.
- Once you have decided an object to observe and have set the red-dot on that object using the Red-dot Finder, tighten the telescope tube(optical tube) using the altitude adjustment knob to keep the tube from moving up and down.
- Next, look through the 20mm eyepiece and slowly move the focuser wheel (located near the eyepiece) to get the object in focus. NOTE: If the object is not in the eyepiece then the telescope may have moved left or right (azimuth) or up or down (altitude). The 20mm eyepiece gives you a wide field of view and a magnification of 15x magnification and the 6mm give a narrow field of view and 50x.
- Viewing daytime terrestrial objects are seen through the eyepiece as upside down and flipped. Reflector telescopes cause this type of image, but allow for a much more compact optical tube than refractor telescopes. When viewing round objects in the sky at night, this factor will not be a problem.
- What to Observe? The moon, planets, stars, and deep sky objects are fun to locate and observe. Do not look at the Sun with this telescope since this kit does not include a solar filter. Make a viewing plan before going out at night by choosing a couple of items to locate and observe that night. Use the planisphere to help with this plan or another night sky chart (see Objects to observe in the Instruction Manual). Use the red-light flashlight (provided with this kit) when you need light at night to look at the Instruction Manual or planisphere. White-light flashlights or other lights will impede your eyes sensitivity or ability to dark-adapt.
- Have a fun "observing party" in the library during the day by posting up images of the planets around the library at a distance. Use the binoculars and the telescope. What details do you see?
- Observe a night sky object with your eyes, then with the binoculars, and then with the telescope. Notice the differences. Is one better than the other? Does the telescope always give you the clearest image?

Setup Hints (continued)

- Learning about what is up in the night sky and knowing where things are located will help you be successful at finding them with the telescope! Remember: the night sky changes throughout the night and with the seasons.

- Here are some frequently asked questions.
  - "What is the magnification of this telescope?"
    The 20mm eyepiece gives you a wide field of view and a magnification of 15x magnification and the 6mm give a narrow field of view and 50x. Using the 2x Barlow lens with each eyepiece will double their power.
  - "A few minutes ago, I saw the object in the eyepiece, but now it is gone. Why?" The earth is moving so you will need to adjust the telescope's position on an object every few minutes or so if you are observing that object for an extended period. (See Tracking Celestial Objects in the Instruction Manual)
  - "Why can't I see the objects in the telescope as I see them in pictures?"
    You will be able to see many cool things with your own eyes using this telescope, but they will be in black and white. The colorful images in magazines and online of celestial objects are from high-powered sensitive tools with lots of filters that can "see" the many things in deep space that we cannot see with our own eyes.

Advanced Activities

- Use the Moon Map 260 to identify places on the moon.
- Use the planisphere to identify objects you want look at in the evening and track them across the sky over time
- Learn the moon phases
- Use the 2x Barlow lens and/or the 6mm eyepiece lens
- Get to know when there are good "seeing" and transparency conditions

Connections to Other Kit Materials

This activity works well with:
- Planet Party
- Pocket Solar System
- Looney Lunar Phases
- Planisphere
- Binoculars
- Red-light flashlight

Connections to Other *STAR Net* Activities

Blind Mice Go To Pluto
https://goo.gl/FEBHXJ

What Do You See in Today's Moon?
https://goo.gl/Ma6Qq5

Constellation Detective
https://goo.gl/w2fyAR

Using Your Binoculars

The Celestron Cometron 7x50mm lens binoculars provided in this kit are lightweight and have a wide field of view that allows for good night sky viewing. By letting in a good amount of light, offering a wide area to see through the eyepieces, and great magnification of small objects, these binoculars help users successfully view the Moon, planets, and other astronomical objects at night.

Credit: Space Science Institute

Key Concepts

- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe.
  - Different tools are used to observe objects of different sizes and types (e.g., telescopes and binoculars can magnify small objects)
  - Different tools used to observe the same object can provide us with a more detailed understanding of the object

Ages – Families, Elementary ages with adult supervision, Tween, Teens, Adults

Activity Time – 10 mins. - 1 hour

Type of Program – Indoor practice, outdoor night sky viewing

Materials List – Celestron Cometron 7x50 binoculars, two eyepiece caps, two optical lens caps, neck strap, bag, lens cloth, planisphere, red light flashlight, Moon map

Simple Instructions

WARNING: THESE BINOCULARS ARE NOT FOR SOLAR VIEWING!

- Review the Celestron Cometron Binoculars Guide provided with the binoculars and get familiar with the parts of the binoculars on page 2.
- First, adjust the binoculars for the distance between your eyes, and then use the focuser knobs to bring the object into focus, this will be different for different patrons.

  Follow these steps:
  1) Adjusting the binoculars to your eyes: Using both hands, hold the two barrels of the binoculars and bring it up to your eyes. Adjust the distance of the eyepieces by pulling the barrels closer together or farther apart depending on how far apart your eyes are. You have set them correctly when you see a single clear image.

  2) Focusing the image: After you have adjusted the binoculars to your eyes, while looking through the binoculars, cover the front right lens with your hand or lens cap and slightly rotate the Focus Wheel (round wheel located in the middle of the binoculars) to get a clear image. Remove your hand or cap from the right lens, and then cover the left lens with your hand or lens cap and slightly move the right eyepiece adjustment (Diopter Adjustment) to achieve a clear crisp image.

Guiding Questions

3) Once the binoculars are adjusted and focused then you will only need to use the Focus Wheel to make small adjustments for focusing on objects.

4) Each person using the binoculars will need to go through steps 1-3 for adjusting and focusing the binoculars for their face and eyes.

- Practice outside during the day or indoors with the binoculars by looking at things at a distance before using them outside at night. Point on an object at a distance with your eyes first and then bring the binoculars to your eyes.

- Here are some frequently asked questions.
  - How magnified is the object in the binoculars?
    The object you are seeing through the binoculars is seven times magnified than what you would see with your regular eyes. They are 7x50 binoculars, which mean they have seven times the magnification with a 50mm aperture.
  - How far away is the moon from Earth?
    On average, the distance from Earth to the Moon is about 238,855 miles (384,400 km). According to NASA, "That means 30 Earth-sized planets could fit in between Earth and the Moon."
    https://www.space.com/18145-how-far-is-the-moon.html
  - Should I remove my glasses to use the binoculars?
    No! Keep your glasses on and just fold back the rubber cups on the eyepieces. These eyepiece cups are for both eyeglass and non-eyeglass wearers. Users with astigmatism may find using the binoculars harder, and may be better off removing their glasses.

Advanced Activities

- Use the Moon Map 260 and the binoculars to identify places on the Moon.
- Use the planisphere to identify objects you want look at in the evening and track them across the sky over time
- Learn about Moon phases

Connections to Other Kit Materials

This activity works well with:
- Planet Party
- Planisphere
- Looney Lunar Phases
- Telescope

Connections to Other *STAR Net* Activities

What Do You See in Today's Moon?
https://goo.gl/seoEjV

Constellation Detective
https://goo.gl/SGVW1Y

Using Your Infrared Thermometer

This *NASA@ My library Facilitation Guide* provides tips on using the Infrared Thermometer (also known as an IR Thermometer), and provides suggestions for engaging activities. The IR Thermometer offers an engaging way for learners of all ages to take temperature measurements of the environment around them.

Credit: Space Science Institute

Key Concepts

- Most objects in nature have characteristics that can be measured (e.g. mass, size, electrical charge, temperature).
- Scientists use many different tools to measure the world around them.
- NASA scientists use tools to observe everything from Earth to the farthest reaches of the Universe (e.g., infrared detectors).
  - Different tools are used to observe objects of different sizes and types (e.g., a telescope can magnify small objects)
  - Different tools used to observe the same object can provide us with a more detailed understanding of the object

Ages – Families, Elementary-aged children, Tweens, Teens, Adults

Activity Time – 5-30 minutes

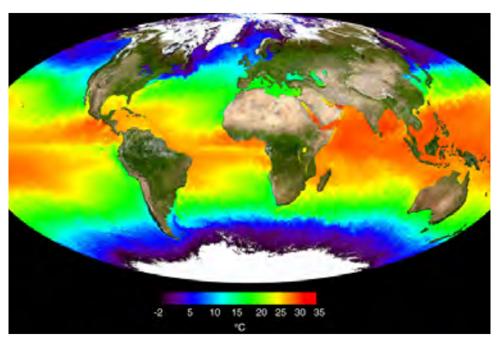
Type of Program – Stations, stand-alone activity, facilitated activity

Materials List – Infrared Thermometer, objects of varying temperatures (e.g., ice water, a heating pad, sunny and shaded concrete)

Simple Instructions

How to operate the IR Thermometer and suggested uses:

- This IR Thermometer has a laser pointer to help you see where you are pointing the thermometer. Decide if you want the laser pointer on. **Warn participants that the laser beam should NOT be aimed directly at eyes or off surfaces where it could reflect into anyone's eyes.** You may turn the laser pointer off and/or cover it with tape. Alternatively, allow the use of the laser pointer to take aim, but make sure that facilitators are monitoring its use.
- The laser is only used to guide your aim, it is not actually taking the measurement. Consider doing this activity with the laser off first, so that participants do not get confused as to how the temperature is being measured.
- The IR Thermometer can take the temperature of objects at a distance. To determine the temperature of an object, simply point the thermometer in that direction (using the laser guide to confirm you're pointing correctly) and briefly press the button. The temperature will read out on the display.



Global Sea Surface Temperature (in IR) from NASA's Terra Satellite. Credit: NASA

Guiding Questions

- Some easy items to point the thermometer at are: people (mind the laser – do NOT point the device at someone's eye), air ducts, car exhausts, hot pavement, insulated coffee mugs, etc.
- Patrons will want to "play" with the infrared thermometer; it's exciting! If you're using the thermometer for a structured activity, consider giving them an opportunity to explore and play with it first.
- Ask participants what they already know about infrared thermometers. They may be aware that heating and cooling specialists and auto mechanics use them for their jobs.
- Ask participants who else may want to take temperature measurements from a distance. If a vet was checking in on an animal who was stressed and didn't want to be touched, would this tool help them do their job safely?
- Show images of what infrared detectors – like the infrared thermometer – can "see".
- Ask participants, "*what is the thermometer 'seeing'?*," if they are having a hard time grasping what is happening. The pictures below illustrate a normal view of an object, and then a view taken with an infrared camera, which highlights the temperature changes being represented in the measurements being taken by the thermometer.

Photo on the right was taken with an IR Camera.
Credit: IPAC

Photo on the right was taken with an IR Camera.
Credit: Space Science Institute

Advanced Instructions - Taking Earth's Temperature

- Once you are comfortable using the IR Thermometer, consider facilitating the *Taking Earth's Temperature* activity (full write-up in Section B of the binder). This activity allows patrons to use the IR Thermometer, while also providing a context for why remote sensing is so vital to the work NASA does every day.

Connections to Other Kit Materials

- This device works well in a station activity with other kit items as a stand-alone exploration activity, and also pairs with the *Taking Earth's Temperature* or *Investigating the Insides* activities.
- Introduce the IR Thermometer along with the *Secrets of Our Earth* book.
- Encourage adults to extend the learning at home on their mobile devices by downloading the GLOBE Observer app at https://observer.globe.gov/about/get-the-app. Families can use the app to note what types of clouds are in the sky, then share their observations online through the app. GLOBE Observer cloud observations are helping NASA scientists understand clouds from below (the ground) and above (from space). This site also includes other citizen science projects, such as measuring mosquito populations.

Connections to Other *STAR Net* Activities

- Please visit the *STEM Activity Clearinghouse* at www.clearinghouse.starnetlibraries.org and check out the "Earth Science" and "Weather and Citizen Science" collections to find other remote sensing and Earth observing activities!

Using Your Planisphere to Explore the Night Sky

In conjunction with your Orion telescope, this *NASA@ My library* Facilitation Guide provides tips on using the Planisphere, and provides suggestions for engaging activities.

Credit: Space Science Institute

Key Concepts

- Science models help us understand how space objects behave and make predictions about what we can't yet observe.

Ages – Families, Elementary-aged children, Tweens, Teens, Adults

Activity Time – 5-30 minutes

Type of Program – stations, stand-alone activity, facilitated activity

Materials List – Planisphere

Simple Instructions

How to use the planisphere

- The Planisphere is useful in helping you identify planets, stars, constellations, and even the Milky Way in the night sky.

- To begin using your Planisphere, you'll first need to find your approximate bearings. You'll need to know which direction is North, and which is South. Once you've identified North, try to find the North Star (Polaris) in the night sky. A neat trick to finding the North Star, is that it's at the same height in the sky as your latitude. So if you live in Hawaii, it's around 19 degrees from the horizon. In the Midwest, it might be closer to 40 or 50 degrees from the horizon! The North Star is indicated by the hole on your Planisphere.

Credit: Space Science Institute

- Once you've gotten yourself pointed the right way, you'll want to make sure your date is correct. Spin the white part of the planisphere, until the date and time matches yours. This one is showing August 15th at 9pm (see white circle above.)

- The line running across the planisphere is your Northern horizon (see white "x" in above figure). So the constellations you see along that line, should match the ones near the horizon where you are!

- The front of the planisphere shows you the night sky from the Northern horizon to a little past straight over-head.

- When you turn the Planisphere over and face South, you're seeing the objects in the sky from the southern horizon to almost straight overhead.

Simple Instructions (continued)

Objects listed on the planisphere

- You'll note that the planisphere can help you find quite a few objects in the night sky.
- The easiest objects to locate are the constellations that change with the seasons. Try to find the pictures in the sky you already know, and identify more from there.
- The planisphere can also help you find telescope objects, like Globular Clusters, Nebulas, Galaxies and Open Star Clusters. Use the key on the back side to figure out which object you're looking at!

Credit: Space Science Institute

- You can easily find the Milky Way using this tool. On the planisphere, you'll see a blue cloudy area, once you know what you're looking for, it may be easier to see in the sky for you! Unfortunately, many parts of the country have too much light pollution to see the Milky Way or other dimmer objects. Start with planets and Globular Clusters as the brightest objects.
- You can identify planets with this tool. Although they don't appear on the Planisphere itself (because the planets move independently of the stars), you can use the dotted line labeled "ecliptic" on the planisphere to try to find planets! How do you tell the difference between a planet and a star? First, if you see a bright star that doesn't belong to a constellation on your planisphere, that might be a planet! Another clue is whether or not it twinkles. Stars almost always twinkle, because they're so far away so we receive very little light from them, and the light we get is distorted by the atmosphere. In comparison, planets only twinkle if you have an extremely disturbed atmosphere (e.g., right before a storm. We get more light from them, so the atmosphere doesn't affect them as greatly!

Connections to Other Kit Materials

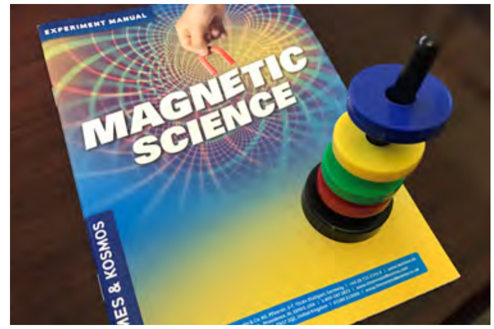
- We recommend the planisphere be used in conjunction with the telescope or binoculars, but it also works great by itself to better learn the constellations!

Connections to Other *STAR Net* Activities

- Please visit the *STEM Activity Clearinghouse* at www.clearinghouse.starnetlibraries.org and check out the "Space Science" collection to find great activities on constellations and other stellar objects!

Magnetic Science Kit

This *NASA@ My library* facilitation guide provides tips on using the *Magnetic Science Kit*, and provides suggestions for engaging activities. The suggested activities below are based on testing conducted at other public libraries. Please feel free to explore, and try other activities in the kit, based on the interest level of your patrons!



Credit: Space Science Institute/NCIL

Key Concepts

Magnetism is all around us (see *Magnetism 101* for more info)

- A magnet is an object that produces a magnetic field that is invisible, but we can feel its force when other magnets are placed close to it. Magnets and magnetism are very important in our everyday life. Examples include compasses, motors, and high-speed transportation systems.
- A magnet has a north and south pole that attracts and repels another magnet depending on the north/south orientation of each magnet.
- The magnetic force is much stronger than gravity.
- Electrically charged particles interact strongly with magnetic fields.

Ages – Families, Elementary-aged children, Tweens, Teens. (Note: schools typically cover magnetism in 2nd or 3rd grade, so students in these grades or higher will have an easier time, and are usually familiar with the vocabulary)

Materials List – Magnetic Science Kit, Magnetic Globe and unclamped staples (you will need to clamp them)

Activity Time – 5-30 minutes

Directions and Suggested Activities from Kit

- If you have a younger audience, or you are unsure about the comfort level of your group with concepts about magnets, consider doing a free-form exploration before encouraging more complicated activities. Take all of the non-magnet items out of the box and place on the table (you can add other objects too!) Have patrons use the bar magnet to determine which items respond to a magnet (you can let them know that they respond because they contain iron). Have them do the same test with the ball magnets, the horseshoe magnet, and the bar magnet.

- Once you do the above activity, have participants take turns choosing magnets and placing them at a distance from one another, then slowly move them closer until they interact. Do they come straight together? Do they flip or move to come together? That's because most magnets (like Earth!) have a north and south pole. Two similar poles will repel, and opposites will attract!

Directions and Suggested Activities from Kit

- For older groups, or once participants are comfortable with the above experiments, we recommend the following activities from the kit's instruction book (in testing, we framed them as "I need you to help me do this magic trick, can you….."
  - From Page 8 "Iron turns into a magnet": Lay out the block magnet, plastic chips and the iron rod, and ask participants to use the iron rod to pick up the plastic chips. They should deduce that if they attach the iron rod to the block magnet, it becomes magnetic and will pick up the chips.
  - From page 15 "Hovering Magnets". Lay out the ring magnets and the ring magnet stand. Ask participants to place all the rings on the stand not touching one another (floating).
  - From page 27 "Hidden Forces Made Visible". Lay out the bar magnet, block magnet, ball magnet, ring magnet, horseshoe magnet, and box with iron powder. Ask participants to create different patterns in the iron powder using the magnets. They can create a circle, an oval, or barbells of different sizes with the provided magnets.
  - Use the "Magnetic Globe" to see how these forces work on a model of Earth. Spread the clamped staples out (you will need to staple them before the activity so they are not sharp) and have patrons roll the globe over the staples. Magnetic field lines will start to form on the ball (patrons may need to adjust or un-bunch the staples).

Guiding Questions

- Ask participants what they use magnets for in daily life. What would their life be like without magnets?

- Ask participants what they already know about magnets. If they're not providing answers, lead them with words like "poles", "polarity", "north" and "south" to elicit a response. These responses will help you determine how much guidance is needed for the activities!

- Ask patrons if they are familiar with the Northern lights. Tell them to keep this phenomenon in mind as they explore, as it's caused by magnetism!

Connecting to Other Kit Materials

- Other activities to consider using with this kit include *Investigating the Insides.*

Connecting to Other *STAR Net* Activities

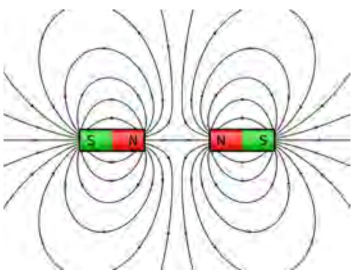
Please visit the *STEM Activity Clearinghouse* (www.clearinghouse.starnetlibraries.org) and search "Magnet" for additional activities around magnetism! We especially recommend the squishy circuits activity to increase the fun (and mess!) level.

What's a Magnet?

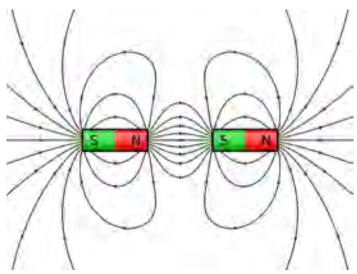
We encounter magnets all the time: there are probably some on your refrigerator right now! Magnets can attract or repel each other, as well as attracting iron and some other metals. Scientists would say that the magnet produces a *magnet field* that extends into the space around it. We can't see that field, but it's what allows it to affect objects at a distance.

Magnetism is all around us. Magnets and magnetism are very important in our everyday life: compasses, motors, sound systems, and high-speed transportation systems all require magnets to function. There's even magnetism in space: some planets, and even the Sun, produce enormous magnetic fields. And of course, we're surrounded by Earth's magnetic field. Without that, compasses couldn't work.

Magnets have 2 poles, called north and south. If the same pole of two magnets are placed near each other they will push away (repel), while if different poles are placed near each other they will pull together (attract). See diagrams below (Credit: Geek3).

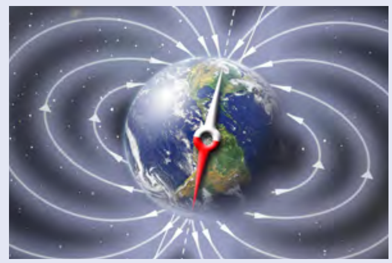


Magents Repel

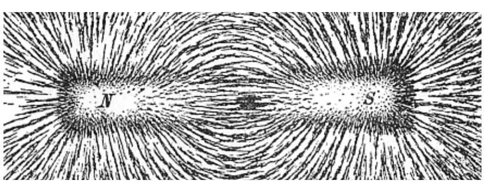


Magents Attract

Fun Fact



Earth is a Giant Magnet!
It too has a magnetic north and south pole. But unlike a bar magnet, Earth's magnetic field is created by electrical currents deep in its molten core. Credit: NASA



You can use iron fillings to show the magnetic field of a bar magnet. See photo on the left (Credit: Black and Davis).

Metals such as iron, nickel and cobalt are attracted to magnets, and some, like iron, can become magnets themselves. Most metals, however, are not attracted to magnets. These include copper, silver, gold, magnesium, and aluminum. Explore what objects in the library are attracted to the magnets you received in Kit B.

Electrically charged particles (negative and positive) interact strongly with magnetic fields. Explore this interaction on the *NASA@ My Library* tablet.

Fun Fact

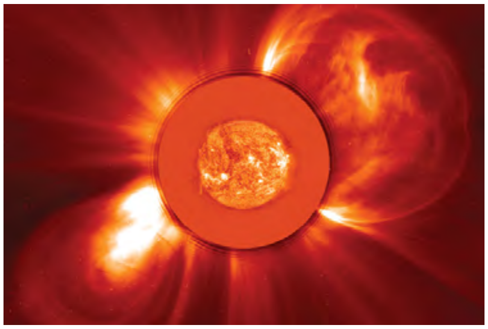
Magnetism is much stronger than gravity.
Use "Hovering Magnets" in the *Magentic Science Kit* to demonstrate that this is true.

Magnetic Fields in Space

Living in the Sun's Magnetic Field

The Sun's magnetic field stretches far beyond Earth to the edge of the Solar System. It's filled with the Solar Wind, a continuous stream of ionized gas, or plasma, that pours out of the Sun at 200 tons per second and a million miles per hour. This gas is made up of positive and negative electrically charged particles whose motions are guided by the Sun's magnetic field.

The shape on the right in the photo (to your right) is called a coronal mass ejection (CME). The hot, expanding plasma from the Sun is being shaped by the Sun's magnetic field.

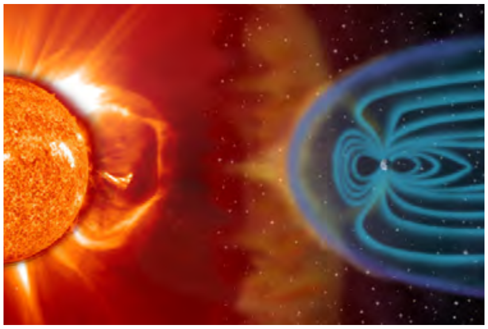


Credit: NASA

Earth's Protective Shield

What happens when the Sun's magnetic field meets Earth's? The Sun's magnetic field and the Solar Wind combine to push and stretch Earth's magnetic field into a vast, comet-shaped region called the magnetosphere.

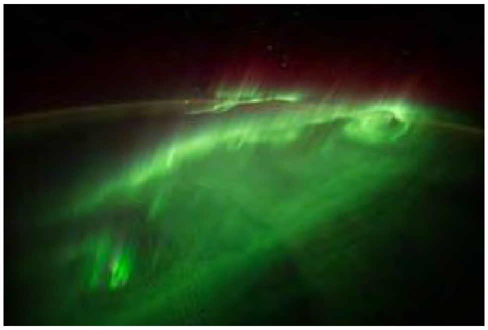
The magnetosphere and Earth's atmosphere protect us from the Solar Wind and other kinds of solar and cosmic radiation.



Credit: NASA

Cosmic Light Show

We can detect the magnetosphere's presence when charged particles from the Sun become trapped inside it and travel along its field lines. These high latitude regions can light up like a neon sign to create the mysterious and beautiful aurora. In the northern hemisphere, we also call them "Northern Lights."



Aurora taken from the International Space Station
Credit: NASA

Section 4:

Science Books and Related Resources

Below you will find the list of six books, as well as some tips for use.

1) **Secrets of Our Earth** (Carron Brown) - A Shine-A-Light Book

   Suitable for use during story time for pre-k to grade 3 audiences in a smaller group setting

   Reading and facilitating the use of this book provides a fun way to learn about many natural changes that take place on Earth. "Discover a world of amazing surprises" by shining the included flashlight behind the page in order to answer the questions posed in the book about our home planet

   Consider using this resource with the "Investigating the Insides" activity in Section 2

2) **The Secret Galaxy** (Fran Hodgkins)

   Suitable for use during story time for k to grade 3, and library programming for grades 3-5

   The lyrical writing, stunning photographs, and artist renditions of the night sky and other astronomical objects in this book offers the full package to help readers understand more about the history, beauty, and science of our galaxy. An example of this is how the Milky Way speaks to the reader about its formation and the many cultural interpretations of the galaxy over time. In addition, sidebars of scientific information on each page provide a way for the reader to learn more about the topic if they choose.

   Consider using this resource with "Art and the Cosmic Connection" activity and the "Planet Party" activity in Section 2, or other astronomy related activities

3) **Starry Skies: Learn about the constellations above us** (Samantha Chagollan)

   Suitable for use during story time for pre-k to grade 3 audiences in a smaller group setting

   A fun storybook with unpretentious illustrations that is sure to engage those budding stargazers in our midst. Young readers can "see" prominent constellations in the night sky and relate them to things in their world.

   Consider using this resource with the "Planet Party" activity in Section 2 and the planisphere

4) **Find the Constellations** (H. A. Ray)

Suitable for use during library programming for grades 3- 6, and family programming

A great book for learning how to pick out the constellations in the night sky and how the night sky changes with the seasons. This easy to understand book is sure to be a go-to reference book for people of all ages.

Consider using this resource with the "Planet Party," and "Pocket Solar System" activities in Section 2, and the binoculars, and planisphere.

5) **Understanding Small Worlds in the Solar System: A Tactile View** (NASA)

This book includes tactile graphics that illustrate several important small body objects in our Solar System. These include comets, asteroids, planetary satellites that orbit Mars and even Pluto along with a mysterious collection of small bodies at vast distances from the Sun called the Oort Cloud. This resource is suitable for use by the visually impaired and by the sighted. Visit https://goo.gl/bH9ntQ for more information about these fascinating objects.

Consider using this resource in combination with "Planet Party", "Pocket Solar System" and "Investigating the Insides", detailed in Section 2.

6) **Getting a Feel for Lunar Craters** (NASA)

This book includes tactile graphics that illustrate the landscapes of the Moon, including their craters. It is suitable for use by the visually impaired and by the sighted. Visit https://goo.gl/CqLACF for more information about this fascinating object.

Consider using this resource in combination with your binoculars and the "Loony Lunar Phases" activity, detailed in Section 2

Web Links to Kit Materials

Below you will find a list of web links to resources for your kit. Note: Prices are subject to change.

Planet Party Activity

Fun Scope 76mm Tabletop Reflector Telescope Kit. Item #10033 from Orion $69.99
https://goo.gl/w17B5p

Celestron 7x50 Cometron Binoculars from Amazon $34.99
https://goo.gl/3myNRW

Orion Star Target Planisphere, 30-50 degree. Item #04110 from Orion $9.99 (sometimes this item comes free with a telescope kit purchase)
https://goo.gl/UMo8Tq

Red light flashlight from Amazon $9.38
https://goo.gl/9WBbuL

Pocket Solar System Activity

2 1/4 in. x 150 ft. Adding machine paper (12 pack) from Amazon $11.58
https://goo.gl/fL3WNR

Pens or pencils from the library or purchased locally

Loony Lunar Phases Activity

Oreo® cookies available at your local supermarket

Art and the Cosmic Connection Activity

Staedtler Colored Pencils, Noris Color, soft break resistant core, ultra smooth, set of 24 - 2 Pack from Amazon $11.22
https://goo.gl/ebMzDk

Pencil Box from Amazon $5.99
https://goo.gl/ycS3N8

Paper for drawing can be any regular paper at the library or purchased locally

Investigating the Insides Activity

60mm Clear Acrylic Ornament Baubles from Amazon $6.99 for 12 pack
https://goo.gl/WLgeZE

Magnets can be purchased locally, on-line, or used from the Magnetic Science Kit provided

Marbles from Amazon $2.99/bag
https://goo.gl/jhX7sR

6 Qt. storage box from Amazon $7.93
https://goo.gl/p7eyRL

Digital Scale from Amazon $7.38
https://goo.gl/QcC39r

Storage bags available locally

Taking Earth's Temperature/Investigating the Insides
Infrared Thermometer from Amazon $25.38
https://goo.gl/dApwhs

Magnetic Science Kit
Magnet Science Kit from Amazon $24.99
https://goo.gl/Q9aa9F

Earth Ball from Spacetoys.com $5.89 for 6 balls
https://goo.gl/xG6d9z

Books
Secrets of Our Earth (Carron Brown) – A Shine-A-Light Book from Amazon $16.96
https://goo.gl/TqoXRC

Flashlight for Shine-a-light book from Amazon $7.99
https://goo.gl/ayk5gD

The Secret Galaxy (Fran Hodgkins) from Amazon $14.81
https://goo.gl/UcH9g9

Starry Skies: Learn about the constellations above us (Samantha Chagollan) from Amazon $17.98
https://goo.gl/XBDFd6

Find the Constellations (H.A. Rey) from Amazon $13.99
https://goo.gl/LxQ8wW

Tote for Kit
Plastic Storage and Distribution Container
https://goo.gl/5bkXXi

NASA @ My Library

Connect with Your Local Astronomy Club to Learn More About the Night Sky

Source: GoodFreePhotos.com, Photo by Greg Rakozy

INSTITUTE of Museum and Library SERVICES

This state library project was made possible in part by the Institute of Museum and Library Services

NASA's Night Sky Network

The Night Sky Network is a nationwide coalition of amateur astronomy clubs bringing the science, technology, and inspiration of NASA's missions to the general public.

With numerous clubs in each state, many of them are excited to share their time and telescopes to provide your community with unique astronomy experiences at the public library and under the real night sky.

Astronomy clubs will bring a wealth of knowledge and resources to your library. Whether you're looking for a speaker, a display, or a star party, these volunteers are equipped with NASA activities and information to share.

To find a club near you:

1) Go to the Clubs and Events page at the Night Sky Network website: bit.ly/FindNSN
2) Type in your zip code and submit

For other space science activities:

1) Go to *STAR Net*'s STEM Activity Clearinghouse: clearinghouse.starnetlibraries.org
2) Go to the Outreach Resources page at the Night Sky Network website: http://bit.ly/nsnresources

Credit: Grand Canyon National Park
23rd Annual Star Party 2013

Disclaimer: Astronomy club members are volunteers and excited to share their telescopes and knowledge at events when they are able, but may not be able to accept all requests.

NASA@ My Library is a national STAR Library Network (*STAR Net*) initiative that connects NASA, public libraries, state libraries, and their communities. Together we are working to increase STEM learning opportunities for millions of library patrons nationwide, particularly those underserved in STEM education.

NASA@ My Library is based upon work funded by NASA under cooperative agreement No. NNX16AE30A. Any opinions, findings, and conclusions or recommendations expressed in this material are those of *NASA@ My Library* and do not necessarily reflect the views of the National Aeronautics and Space Administration.

Cornerstones of Science connecting libraries with science · Space Science Institute · NCIL National Center for Interactive Learning · Chief Officers of COSLA State Library Agencies · EDC Education Development Center · STAR net Science-Technology Activities & Resources For Libraries

NASA @ My Library

Connect with a Solar System Ambassador Volunteer to Aid in Your Space Science Program

Credit: NASA

INSTITUTE of Museum and Library SERVICES

This state library project was made possible in part by the Institute of Museum and Library Services

NASA's Solar System Ambassadors

The Solar System Ambassadors (SSA) program works with motivated volunteers across the nation to share the latest science and discoveries of NASA's space exploration missions through a variety of events that inspire their communities.

To find a local ambassador near you:

1) Visit the Solar System Ambassadors Program's website at: solarsystem.nasa.gov/ssa
2) Click on the "Directory" link
3) Search by Name, State and/or Country
4) Contact a SSA Volunteer for your program

Credit: NASA/Jenny Mottar

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Cornerstones of Science — connecting libraries with science | Space Science Institute | NCIL National Center for Interactive Learning | Chief Officers of State Library Agencies (COSLA) | EDC Education Development Center | STAR net Science-Technology Activities & Resources For Libraries