SUN EARTH UNIVERSE
SOL TIERRA UNIVERSO

Museum Educator Guide

4. Museum Educator Guide

Contents

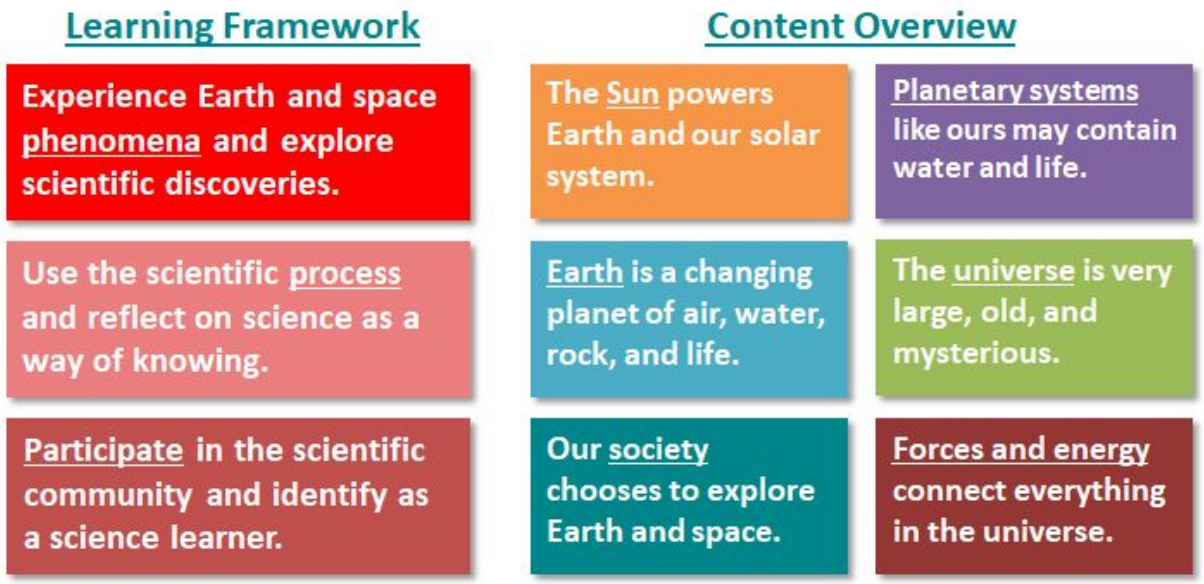
(please see Chapter 1 - List of Host Resources for complete table of contents)

Introduction

This chapter will present the guiding frameworks underlying the development of the Sun, Earth, Universe exhibition and the resulting learning objectives for visitors. Museum educators can use the observable visitor behaviors to structure future programing for visitor groups experiencing the exhibition and training for facilitation staff. Related NASA and NISE network educational resources are also included for quick access to optional exhibition extensions.

Guiding Frameworks

The *Sun, Earth, Universe* exhibition was created with the same guiding frameworks as the Explore Science: Earth and Space toolkits. The learning framework was based on the National Research Council's Learning science in Informal Environments (2009), and the content overview covered the four major areas of NASA's Science Mission Directorate.



Exhibition Visitor Learning Objectives

The design of exhibition components within the *Sun, Earth, Universe* exhibition was shaped by the visitor learning objectives listed below. These objectives reflect the fundamental steps taken by scientists working on NASA missions to explore Earth and space. Each step is represented by a range of fascinating discoveries, cutting-edge technology, and rich narratives highlighted throughout the exhibition content. Visitors also learn through experiencing by participating in the interactive elements that parallel the work of NASA scientists.

One option to quickly review the exhibition visitor learning objectives is to play the **Your mission to space board game**. This experience is a great opportunity to introduce the objectives to museum staff and volunteers.

- **Science Questions**
  - Earth and space science begins with meaningful questions.
  - Science helps us understand our planet, our solar system, and our universe.
- **Mission Planning**
  - NASA mission planning is a process that involves many team members with different skills.
  - NASA scientists and engineers work together planning missions and designing tools to help answer scientific questions that help us understand our planet, solar system, and universe.
- **Engineering Process**
  - NASA teams use creativity, problem solving skills, and an engineering design process to meet mission needs and constraints.
- **Data Collection and Analysis**
  - Earth and space missions use special tools to detect things we can't see with just our eyes.
  - NASA teams collect and analyze data to help answer Earth and space questions.
- **Explore More**
  - There are many opportunities to learn more and participate in Earth and space science.

Observable Visitor Behaviors

Listed below are desired visitor behaviors used to gauge the effectiveness of individual components and groupings of components. *21st Century learning skills are denoted for each visitor behavior.*

- **Overall Exhibition**
  - Visitors have conversations about Earth and space science while visiting the exhibition. *Learning skill: Communication*
- **Exterior graphic panels: (focus on science questions)**
  - Visitors actively interact with aspects of large format Earth and space imagery (e.g. pointing, gesturing). *Learning skills: Curiosity, Exploration*
  - Some visitors talk about the larger scientific questions and content featured on the large graphic panels. *Learning skill: Communication*
- **We ask questions about Earth**
  - Visitors actively interact with images of our changing Earth over time. *Learning skills: Curiosity, Exploration*
  - Some visitors talk about our changing Earth over time. *Learning skill: Critical thinking*
- **We ask questions about the Sun**
  - Visitors actively interact with images of how our Sun changes. *Learning skills: Curiosity, Exploration*
- **We ask questions about the universe**
  - Visitors interact with a physical model representing the vast size of our universe. *Learning skill: Exploration*
  - Some visitors actively may wonder about the size of our universe. *Learning skills: Curiosity, Exploration*
- **We ask questions about the solar system**
  - Visitors display data visually using representative color. *Learning skill: Data display*
  - Some visitors talk about data visualization. *Learning skills: Data display, Critical thinking*
- **Use tools to detect the invisible (focus on data collection and analysis)**
  - Visitors experiment with different tools to detect things they can't see with their eyes. *Learning skills: Curiosity, Exploration*
  - Some visitors talk about what the tools are used for. *Learning skill: Communication*
- **Design > Build > Test engineering activity (focus on engineering process)**
  - Visitors choose different instruments to include when building their model spacecraft in order to achieve their chosen mission. *Learning skills: Creativity and Problem Solving*
  - Visitors use their own creativity to build model spacecraft. *Learning skill: Creativity*

    - Visitors use problem solving skills to improve their model spacecraft in response to the results of tests they conduct. *Learning skill: Problem Solving*
    - Some visitors talk about their mission. *Learning skills: Engineering process, Communication*
    - Some visitors want to share images of their spacecraft creations. *Learning skill: Communication*
    - Some visitors can be observed moving from station to station through the engineering design cycle. *Learning skill: Engineering process*
- **Your Mission to Space board game (focus on mission planning)**
    - Visitors work together while learning about the mission planning process (e.g. helping each other, talking with each other). *Learning skill: Collaboration*
    - Some visitors talk about aspects of the mission planning process. *Learning skill: Communication*
- **Mars landscape play table (focus on play)**
    - Some visitors talk about the exploration of the planet Mars. *Learning skill: Communication*
- **Reading and seating area (encourage further exploration)**
    - Some visitors engage in further exploration. *Learning skill: Curiosity, Exploration*
    - Some visitors want to learn more about Earth and space science after they visit the exhibition (e.g., some visitors look at magnet board, use their own device). *Learning skill: Self-directed learning*
    - Some visitors explore books and other resources available in the reading area. *Learning skill: Self-directed learning*
- **Solar system stools**
    - Visitors notice the planetary images on the stool. *Learning skill: Curiosity*

NASA Online Resources for Educators

NASA has a rich set of resources for educators that can be used in combination with a visit to the *Sun, Earth, Universe* exhibition.

NASA Science Mission Directorate's Science Activation community

Explore national-level project support learning of current NASA Science Mission Directorate research and discoveries. This page contains introductions to each project and helpful links for educators.

https://science.nasa.gov/learners

NASA resources for educators

Search hundreds of resources by subject, grade level, type and keyword. These lesson plans and teaching materials support your STEM curriculum.

https://www.nasa.gov/audience/foreducators/index.html

NASA's BEST Educator's Guide to the Engineering Design Process

https://www.nasa.gov/audience/foreducators/best/edp.html

Educator guides are available for Grades K-2, Grades 3-5, and Grades 6-8

https://www.nasa.gov/audience/foreducators/best/activities.html

NASA EXPRESS newsletter

The NASA EXPRESS message features updates from NASA and STEM associates about workshops, internships, and fellowships; applications for grants or collaborations; promotions for student and educator opportunities; online professional development; and other announcements.

https://www.nasa.gov/audience/foreducators/Express_Landing.html

NASA Space Place

NASA's Space Place website engages upper-elementary-aged children in space and Earth science through interactive games, hands-on activities, fun articles and short videos.

https://spaceplace.nasa.gov

Books Accompanying the Exhibition

The following books are included with the exhibition. Feel free to add additional books and reading materials to the exhibition bookcase.

Book Title	Author	Grade level, Description	ISBN-10	ISBN-13	Publisher
Here We Are: Notes for living on Planet Earth	Oliver Jeffers	PreK-2, Creative Non-Fiction	399167897	978-0399 167898	Philomel Books
Cosmos: The Infographic Book of Space	Stewart Lowe	7-Adult. Non-Fiction	1781314500	978-1781 314500	Aurum Press
Hello World! Solar System	Jill McDonald	Pre-K and up, Creative Non-Fiction	553521039	978-0553 521030	Doubleday Books for Young Read-ers
Earth and Space: Photographs from the archives	Nirmala Nataraj	Adult, Non-Fiction	1452134359	978-1452 134352	Chronicle Books
Light: The Visible Spectrum and Beyond	Megan Watzke	8-Adult, Non-Fiction	163191006X	978-1631 910067	Black Dog & Leventhal
Pluto's Secret: An Icy World's Tale of Discovery	Margaret A. Weitekamp	K-5, Non-Fiction	1419715267	978-1419 715266	Abrams Books for Young Readers

Max and the Tag-Along Moon	Floyd Cooper	PreK-2, Fiction	399233423	978-0399 233425	Philomel Books
How Many Stars in the Sky?	L. Hort & J.E. Ransome	K-3, Fiction	068815218X	978-0688 152185	HarperColl ins
Little Kids' First Big Book of Space	Catherine Hughes	PreK-3, Non-Fiction	1426310145	978-1426 310140	National Geo-graphic Children's Books
Breakfast Moon	Meg Gower	preK-3, Fiction		978-1-58 381-918-0	Astronomi cal Society of the Pacific

Current events / Visitor Feedback Board Resources

The reading and seating area gives visitors the chance to learn more on their own as well as express their own thoughts. The magnetic graphic and series of magnets allows exhibition hosts the flexibility to post information about local events and astronomical happenings, direct visitors to a website for citizen science opportunities, or ask visitors to reflect on a space-themed question. Post-it notes and pencils can be provided to allow visitors to share their thoughts.

The magnets for posting celestial events, observing opportunities, and news:

- Night Sky News
- Earth and Space News

The citizen science magnet directs to:

- Visit SciStarter.org to learn how you can participate in astronomy and Earth science projects!

Visitor question magnets ask:

- What do you wonder when you look up at the stars?
- How would you feel if life was discovered on another planet? Why?
- What would you name a newly discovered planet?

The following resources are good sources of content for customizing your magnetic bulletin board with current celestial events, local astronomy club events and observing opportunities, and NASA news.

Astronomy group and observing opportunities

Post news about local star parties and night sky observing events hosted by local astronomy groups. Night Sky Network for astronomy groups in your area

- Search Night Sky Network to find astronomy clubs and events in your area
  https://nightsky.jpl.nasa.gov/clubs-and-events.cfm

Celestial calendars - events in the night sky

Post calendars and news observable night sky events including, phases of the moon, meteor showers, lunar eclipses, planetary events, and more; the following resources each offer calendars in different formats by day, week, month, and year:

- https://spaceplace.nasa.gov/search/calendar/
- http://www.skyandtelescope.com/observing/sky-at-a-glance/
- https://www.timeanddate.com/astronomy/
- https://stardate.org/nightsky
- https://nightsky.jpl.nasa.gov/planner.cfm
- https://in-the-sky.org/newscal.php
- http://earthsky.org/tonight
- https://www.nytimes.com/interactive/2017/science/astronomy-space-calendar.html#

NASA News

Good resources for current NASA news:

- Science@NASA
  https://science.nasa.gov/science-news

- NASA's latest news releases
  https://www.nasa.gov/news/releases/latest/index.html
- NASA TV
  https://www.nasa.gov/multimedia/nasatv/index.html#public

NASA Resources

Please see Chapter 4 - Museum Educator Guide of the Host Resources for more NASA resources.

- NASA Space Place
  - Educators:
    https://spaceplace.nasa.gov/menu/parents-and-educators/
  - Printable posters, postcards, bookmarks:
    https://spaceplace.nasa.gov/posters/en/
  - Newsletter:
    https://spaceplace.nasa.gov/subscribe/en/

- NASA Museum Alliance
  https://informal.jpl.nasa.gov/museum/

Hands-on Activities

NISE Network Explore Science: Earth & Space hands-on activities

In collaboration with NASA, the NISE Network has assembled a multiple toolkits of engaging, hands-on Earth and space science experiences with connections to science, technology, and society. An up-to-date list of all Earth & Space hands-on activities from the NISE Network can be found at this link.

- http://nisenet.org/search/product_type/programs-and-activities-10/kit/explore-science-earth-space-toolkit-2820

- Explore science Earth & Space toolkits may be downloaded here: http://www.nisenet.org/earthspacekit

Companion website

In addition to the physical components, visitors can also learn more about Earth and space with their mobile devices while they explore the exhibition.

A companion website features answers to questions posed throughout the exhibition; the website features beautiful video footage from NASA giving visitors the opportunity to explore in more depth at the museum on their phones or at home.

http://www.explorescience.org/sun

Celebrating STEM and Celestial Events

Using the *Sun, Earth, Universe* exhibition as the focal point of related STEM and celestial events is a good opportunity to highlight its content and learning goals for visitors, staff, and volunteers. Special events can also be used to foster participation from local partners and secure a slot in the annual programming and training schedules for museum educators. A range of potentially paired events with the exhibition are listed below.

- **Celestial event listings including equinoxes & solstices, meteor showers, lunar eclipses, full moons, planetary events, and more**
    - http://earthsky.org/tonight
    - https://in-the-sky.org/newscal.php
    - https://nightsky.jpl.nasa.gov/planner.cfm
    - https://stardate.org/nightsky
    - http://www.timeanddate.com/astronomy
    - http://www.skyandtelescope.com/observing/sky-at-a-glance/

- **Earth- and space-themed STEM events**
    - STEM events organized by date at http://www.nisenet.org/seasons
    - Historical NASA Anniversaries: https://history.nasa.gov/annivforecast.htm
    - World Water Day: http://www.worldwaterday.org
    - Earth Hour: http://www.earthhour.org
    - Global Astronomy: http://www.gam-awb.org/
    - Yuri's Night: http://yurisnight.net
    - Earth Day: http://www.earthday.org
    - National Environmental Education Week, week of Earth Day: http://www.neefusa.org/greening-stem/environmental-education-week
    - Astronomy Day (Spring): http://www.astroleague.org/al/astroday/astrodayform.html
    - Astronomy Week (Spring): http://www.astroleague.org/al/astroday/astrodayform.html
    - World Oceans Day: http://www.worldoceansday.org/
    - Asteroid Day: http://asteroidday.org
    - International Observe the Moon Night: http://observethemoonnight.org

- World Space Week: http://www.worldspaceweek.org
- Astronomy Day (Fall): http://www.astroleague.org/al/astroday/astrodayform.html
- Astronomy Week (Fall): http://www.astroleague.org/al/astroday/astrodayform.html
- Earth Science Week: http://www.earthsciweek.org/

Connecting with experts

The NISE Network strongly encourage you to collaborate with local experts consisting of Earth and space science professionals as well as science enthusiasts in your area. Volunteer experts are a key ingredient to many successful public engagement efforts and can add to visitor experience in the *Sun, Earth, Universe* exhibition. It is up to your organization to choose your local collaborators.

Your regional hub leader can assist you in finding local partners in your geographic area beyond the sources listed below. How to find your regional hub leader: http://nisenet.org/contact

Solar System Ambassadors Program (SSA)

This is a public outreach program designed to work with motivated volunteers across the nation. These volunteers communicate the excitement of the NASA Jet Propulsion Lab's (JPL) space exploration missions and information about recent discoveries to people in their local communities. As of 2016, there are 700 ambassadors in 50 states, Washington DC, Puerto Rico, US Virgin Islands, and Guam. Volunteer ambassadors bring the excitement of space to the public. Ambassadors are space enthusiasts from various walks of life who are interested in providing greater service and inspiration to the community at large.

http://solarsystem.nasa.gov/ssa/home.cfm

Night Sky Network

This is a nationwide coalition of amateur astronomy clubs bringing the science, technology, and inspiration of NASA's missions to the general public. Night Sky Network members share their time and telescopes to provide unique astronomy experiences at science museums, observatories, classrooms, and under the real night sky.

http://nightsky.jpl.nasa.gov/index.cfm

AAS Astronomy Ambassadors

The American Astronomical Society (AAS), in partnership with the Astronomical Society of the Pacific (ASP), members of the Center for Astronomy Education (CAE), and other organizations active in science education and public outreach (EPO), has launched a series of professional development workshops and a community of practice designed to help improve early-career astronomers' ability to effectively communicate with students and the public. Called Astronomy Ambassadors, the program provides mentoring and training experiences for young astronomers, from advanced undergraduates to new faculty. It also provides access to resources and a network of contacts within the astronomy EPO community.

http://aas.org/outreach/roster-aas-astronomy-Ambassadors

Colleges and Universities

Many colleges and universities have astronomy and Earth science departments. Others may have clubs or local chapters of professional societies. Once you connect with a faculty or staff member they should be able to also suggest undergraduate and graduate students who could volunteer at you museum to help facilitate the exhibition.

Training Staff and Volunteers

The *Sun, Earth, Universe* exhibition can be greatly enhanced with skilled facilitators. While experienced museum educators may be trained in facilitation techniques, here is a list of tips to help engage visitors in the exhibition.

Tips for Engaging Visitors

- Greet visitors – Say ”hello”; make eye contact, and smile. Simply looking like you’re available and friendly will bring visitors to your station.
- Let visitors do the activities – As much as possible, let visitors do the hands-on parts of the activity, and let them discover what happens. (If your activity has a surprise, don’t give it away!)
- Share what you know – Use clear, simple language. Focus on one main idea – don’t feel that you need to tell visitors everything at once! Keep the information basic for starters, and be willing to expand on an idea for interested learners.
- Use examples from everyday life – Familiar examples can help explain abstract concepts. Be aware of visitors’ abilities, keeping in mind that children do not have the same skills or vocabulary as adults.
- Ask questions – Help visitors observe and think about the activity. Try to use questions that have more than one answer, such as:
    - What do you see happening?
    - Why do you think that happened?
    - What surprised you about what you saw?
    - Does this remind you of anything you’ve seen before?
- Be a good listener – Be interested in what visitors tell you, and let their curiosity and responses drive your conversation forward. Offer positive and encouraging responses. If visitors haven’t quite grasped a concept, you might say, “That’s a good guess,” or “Very close, does anyone else have something to add?” Don’t say, “No” or “Wrong” in response to visitors’ observations or explanations.
- Share accurate information – If you aren’t sure about something, it’s OK to say, “I don’t know. That’s a great question.”
- Nonverbal communication is important, too – Try to maintain an inviting face and body language.

- Thank visitors – As your interaction ends, suggest that visitors explore other Sun, Earth, Universe activities.
- HAVE FUN! A positive experience will lead to learning.

Exhibition walkthrough video for staff and volunteers

A comprehensive 11-minute video that walks the museum staff and volunteers through the exhibition. This video is an excellent way to introduce the exhibition to visiting experts and partners.

- https://vimeo.com/283112123

Explore Science: Earth & Space toolkit activity training videos

Explore Science: Earth & Space toolkits come with short content training videos on topics similar to those covered by the *Sun, Earth, Universe* exhibition. To see the most up-to-date collection of these videos use the link below.

- http://www.nisenet.org/catalog/explore-science-earth-space-activity-and-content-training-videos

Facilitation training and general exhibition orientation videos

NISE Network has created videos that model good facilitation strategies for educators sharing Earth and space science concepts and other complex STEM content. These videos can be shared as part of a *Sun, Earth, Universe* exhibition staff and volunteer training program or as stand-alone preparation for visiting experts and partners.

- **Edu-Cathalon**
  A comedic training video that follows three competitors as they try to navigate through an obstacle course of museum visitors, including an adult-only group, a school group and a mixed-age family.
  http://www.nisenet.org/catalog/educathalon-facilitation-strategies

- **Addressing common misconceptions**
  A training video series highlighting strategies that facilitators can use to handle the intuitive knowledge visitors apply to scientific concepts. Simulated visitor-facilitator interactions featured in the video are centered around two popular Explore Science: Earth & Space toolkit activities: Pocket Solar System and Filtered Light.

http://www.nisenet.org/catalog/explore-science-earth-space-strategies-addressing-common-misconceptions-videos

NISE Network professional development tools and videos

Many more NISE Network professional development and training tools and videos can be found here:

- http://www.nisenet.org/About_Professional_Development

Special Event Planning

If you are planning an event related to the Sun, Earth, Universe exhibition some helpful resources include:

- **Chapter 7 - Promotional and Marketing Materials** of the Host Resources.

- **Explore Science: Earth & Space toolkit event planning and promotion guide**
  This guide includes suggested timelines, how to find volunteers and experts, and more
  http://www.nisenet.org/catalog/explore-science-earth-space-event-planning-and-promotion-guide

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