SUN EARTH UNIVERSE / SOL TIERRA UNIVERSO

Development Process and Audiences

6. Development Process and Audiences

Contents

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Development Process

NISE Network Product Development Process

NISE Network products are created through an iterative, collaborative process that involves scientists with expertise in the content area, professionals in the field of informal science education, and targeted public audiences. This process helps to ensure that our programs, exhibits, and other products are scientifically accurate, represent best practices in educational product development, and are effective experiences for our visitors.

- **Scientist Review**
  Scientists are involved throughout the creation of NISE Net products, from the early conceptual development through prototyping and final review. Scientists help us to find interesting ideas and present them accurately and effectively. They also help us to communicate the excitement of this field of emerging science, and give it a human face. All products developed by the network are reviewed by a scientist with expertise in the content area before they are distributed.

- **Peer Review**
  NISE Network development teams include educators, exhibit developers, and other professionals from museums across the country. We work together to make sure our educational products achieve their educational goals, are well-crafted, and represent best practices. Our collaborative development process also helps to create new knowledge to advance the field of informal science education and builds capacity at partner organizations. NISE Net products all go through extensive peer review during development.
  Examples of topics covered during peer review include:
    - Content, messages, and learning objectives
    - Program format and appropriateness for setting and target audience
    - Engagement and relevance for target audience
    - Best practices for program design, delivery, and implementation
    - Inclusive audiences design approach to effectively engage underserved and underrepresented audiences, including girls, bilingual audiences, and persons with disabilities

- Universal design approach to create educational products that are as accessible as possible for museum visitors with a broad range of abilities and disabilities
- Safety and suggested risk mitigation
- Professional development facilitation and training resources for staff and volunteers
- Ease of sharing and reproducibility to allow for easy editing and adaptation for different audiences
- Cost and access to consumable materials
- Documentation of product
- Appropriate permissions, credits, and acknowledgement

- **Visitor Evaluation**
  NISE Network products for museum visitors are prototyped and evaluated with their target audience as an integral part of the development process. Formative evaluation and Team-Based Inquiry approaches help ensure that programs, exhibits, and other visitor experiences are accessible, engaging, and educationally effective. Many products go through several rounds of evaluation and improvement before they are distributed.

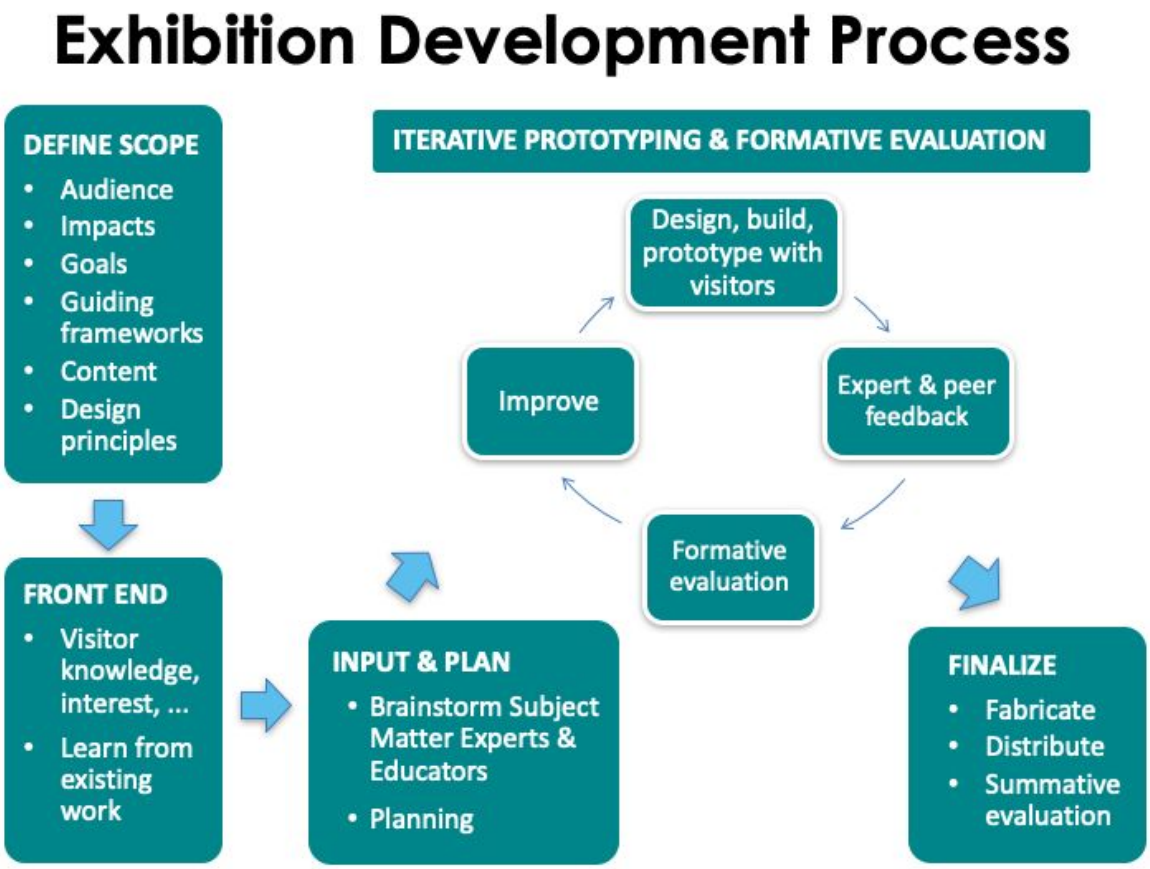
- **Partner Feedback**
  The NISE Network regularly solicits partner input and feedback about our educational materials to ensure future public engagement materials and professional development resources are useful for our partners.

- **Audiences and Content**
  - Content Maps: The NISE Network has developed content maps that articulate the key ideas for our educational products, including programs, exhibits, and media experiences.
  - Inclusive Audiences: Products are designed with an inclusive audiences approach using Universal Design principles.

- **Educational Products are Designed for Sharing**
  - Products are designed to be easily edited and adapted for different audiences under a Creative Commons Attribution Non-Commercial Share Alike license.

Development Process Stages

The exhibition was developed and fabricated between 2016 -2019 and included the following stages:



Scoping - Defining Audience, Content, Goals, and Frameworks

At the very beginning of the process, in consultation with team members, advisors, and subject matter experts, the project leadership team drafted documents defining exhibition target audiences, desired impacts, guiding frameworks and content, and learning goals**.** The exhibition development process leveraged the existing frameworks already created the for the NISE Network project's Explore Science: Earth and Space toolkits. These goals, criteria, frameworks, and themes were periodically revisited and refined during the first year of exhibition development process.

Front-end Evaluation - Review of Existing Similar Exhibitions

The exhibition development team conducted a front-end review of Earth and space science museum exhibitions including a selected review of available publications and evaluation reports relating to similar exhibitions on related topics.

Brainstorming - Meetings with Educators, Project Advisors, and Content Experts

Early in the project, brainstorming and scoping in-person meetings with advisors were held to refine the exhibition scope, review the draft content map, learning frameworks, and brainstorm potential exhibition content and focus, criteria, and attributes.

Formative Evaluation - Prototyping and Testing with Visitors

Throughout the exhibition development process, individual exhibition component prototypes and thematic groupings of components were iteratively tested with museum audiences ranging from young children through adults. This visitor testing was conducted to ensure that experiences were engaging to visitors, the desired observable visitor behaviors were achieved, and that the components were as effective as possible in meeting project goals. Formative evaluation methods included informal observation of visitor behavior, interviews, and written surveys. The formative and summative evaluation studies summarizing this work will be available on nisenet.org website.





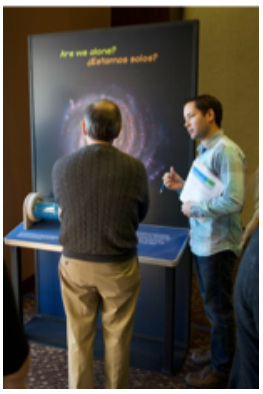

Feedback - Review of Prototype Components and Draft Signage

A group of subject matter experts, informal science educators, and project advisors iteratively reviewed exhibition concepts, interactive components, and draft signage; they provided feedback to the exhibition team through both in-person reviews and online meetings and review. A group of content experts carefully reviewed final exhibition signage text and imagery to ensure accuracy.

Three additional copies of the most interactive component of the exhibition (Design > Build > Test engineering activity) were fabricated and sent to three additional museum locations to get feedback from staff on durability after multiple months of use with their visitors.








Fabrication and Distribution

All exhibition copies were fabricated to be identical - but components were modular to accommodate additional and different floorplan layouts.

A competitive application process was conducted to select the locations to be awarded a copy of the exhibition; a complete list of awards is available on nisenet.org.

Summative Evaluation

The summative evaluation study conducted after fabrication explores how visitors of different ages interact with the exhibition at multiple locations.

Learning, Engagement, and Design Frameworks

The exhibition made use of the NISE Network Space and Earth projects's Content Map, Learning Framework, and Design Principles that were developed for the overall project including for the Explore Science: Earth & Space toolkits.

The exhibition was not large enough in scope to cover the entire Content Map, but did attempt to include all three major parts of the learning framework, a portion of the content map, and reflect the project's design principles.

Project Content Map

"Big Ideas in Earth and Space Science"

1. The Sun powers Earth and our solar system.
2. Earth is a changing planet of air, water, rock, and life.
3. Planetary systems like ours may contain water and life.
4. The universe is very large, old, and mysterious.
5. Our society chooses to explore Earth and space.
6. Forces and energy connect everything in the universe.

Project Learning Framework

"Ways of Knowing, Ways of Doing"

1. Experience Earth and space PHENOMENA and explore scientific discoveries
2. Use the scientific PROCESS and reflect on science as a way of knowing
3. PARTICIPATE in the scientific community and identify as a science learner

Project Design Principles

- Engaging
    - Offer enjoyable and accessible experiences for multiple and diverse audiences, including underserved audiences
    - Promote social interaction among groups of learners
    - Provide layered and interrelated experiences that allow learners to explore in various ways and at various depths
- Authentic
    - Engage in science skills, practices, and ways of thinking
    - Incorporate NASA assets, including science content and data, space and airborne platforms, and scientific and technical personnel
    - Encourage interaction between learners and subject matter experts
- Current
    - Feature celestial and mission events
    - Address the latest discoveries
    - Focus on dynamic processes
- Relevant
    - Make connections to learners' everyday lives
    - Present Earth and space science as activities that multiple and diverse groups of people participate in (as students, citizens, and scientists)
    - Promote reflection about the social dimensions of science and technology
    - Connect to other ways learners can engage in STEM (including other experiences in museums, K-12 science education standards)
- Accessible
    - Repeat and reinforce key concepts
    - Provide multiple entry points and multiple ways of engagement
    - Offer physical and sensory access to all aspects of the experience
    - Produce equitable English and Spanish versions

Visitor Experiences

The exhibition was designed with the following intended visitor experiences:

- Visitors will engage in fun interactive Earth and space science experiences using skills essential to STEM learning in the 21 Century that are critical to the work of NASA in advancing new discoveries about our Earth, Sun, solar system, and universe. Visitors will:
    - collaboratively engage in scientific and engineering processes,
    - use their natural curiosity to explore phenomena and use a variety of tools to "see" forces and electromagnetic energy invisible to our eyes,
    - use creativity and problem-solving skills to design, build, test, and improve a model spacecraft,
    - use critical and analytical thinking to examine data,
    - examine authentic Earth and space imagery and visualizations, and
    - leave the exhibition understanding more about the process of exploring Earth and space and wanting to learn more.

Exhibition Themes and Messages

- **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*

Exhibition Design

In addition to the design principles for the project, more specific design criteria were developed for the exhibition:

Overall Design

- Look and feel inviting, comfortable, and engaging
- Be clean, appealing, and fit into many museum environments
- Create an immersive, unified experience within a small footprint
- Be compatible with the Explore Science: Earth & Space toolkit design
- Have a consistent visual vocabulary

Materials and maintenance

- Durable materials and mechanisms

- Minimal maintenance and minimal regular service required
- Minimal consumables

Accessibility

- Universal Design approach
- Bilingual English and Spanish
- Audio description for visually impaired / low-vision visitors

Exhibition Elements

The exhibition was designed to include the following elements:

- Hands-on interactive components
- Signage and supplementary reading materials
- Seating
- Bring-your-own-device (BYOD) elements

The exhibition intentionally did not include video and interactive multimedia components but hosts are provided with information on how to add existing components themselves particularly with existing interactive media products developed with NASA funding.

Matrix - Frameworks, Themes, Behaviors

The following is a simplified version of the exhibition matrix used throughout the exhibition development process. Other aspects of the more detailed matrix included physical attributes and level of interactivity of the components and connections to NASA missions and assets such as imagery and data. Please see Chapter 2 Introduction and Description for detailed descriptions of each component.

Component Title	**Content Areas:** P=Planetary Science H=Heliophysics A =Astrophysics E = Earth Science	**Learning Framework:** -Phenomena -Process -Participate	**Themes and Messages:** -Science Questions -Data Collection and Analysis -Mission Planning -Engineering Process -Explore More	**Behaviors Supported:** -Critical thinking -Creativity & problem solving -Collaboration & communication -Open-ended -Long dwell time -Extension at home
1. Design > Build > Test engineering activity	P, H, A, E	Process	Engineering Process	Critical thinking Creativity & problem solving Collaboration & communication Open-ended Long dwell time
2. Use tools to detect the invisible	P, H, A, E	Phenomena Process Participate	Data Collection and Analysis	Critical thinking Collaboration & communication
3. Your mission to space board game	P, H, A, E	Process	Mission Planning	Collaboration & communication Long dwell time

4. Mars landscape play table	P	Phenomena	Explore More	Open-ended
5. Reading and seating area	P, H, A, E	Participate	Explore More	Open-ended Long dwell time Extension at home
6. We ask questions about Earth	E	Phenomena	Science Questions	Critical thinking
7. We ask questions about the Sun	H	Phenomena	Science Questions	Critical thinking
8. We ask questions about the solar system	P	Phenomena	Science Questions & Data Analysis	Critical thinking
9. We ask questions about the universe	A	Phenomena	Science Questions	Critical thinking
10. Solar system stools	P	Phenomena	Explore More	Seating encourages longer dwell time
11. Companion website	P, H, A, E	Phenomena Process Participate	Explore More	Long dwell time Extension at home

Audiences

NISE Network Audiences

The NISE Network creates educational products for a wide range of public audiences in informal learning settings. The NISE Network also creates a variety of professional development materials for scientists and educators to raise their capacity to engage the public in current science, technology, engineering, and math (STEM).

NISE Network Inclusive Audiences Approach

The NISE Network seeks to increase professional and institutional capacity to effectively engage underserved and underrepresented audiences, including girls, bilingual audiences, and persons with disabilities, in informal learning experiences related to STEM content.
The NISE Net strives to reach a diverse audience with regard to geography, dis/ability, gender, race/ethnicity, language and income. Some examples of this work include:

- Geography: building partnerships with existing regional networks and other informal learning organizations that serve rural areas
- Dis/Abilities: using Universal Design principles when designing programs and exhibits, making video materials more accessible through the use of video captions, and using audio labels and audio descriptions for exhibits
- Gender: partnering with informal learning organizations that serve girls
- Race/Ethnicity: partnering with diversity-serving organizations
- Language: translating many public education materials into Spanish
- Income: encouraging partners to collaborate locally with community partners

Exhibition Target Audience

The exhibition is intended for indoor use by visitors at children's museums, science centers, science museums, natural history museums, nature centers, public planetariums and observatories, and NASA visitor centers in the United States. Target audiences were defined as:

- Visitors to science and children's museums
    - Primary: Families with children ages 6-12
    - Secondary: Additional museum audiences; school groups grades K-6
    - Underserved audiences (as defined by local host sites)

Design for Multiple Settings and Audiences

The NISE Network is committed to making our exhibits and programs as accessible as possible for all museum visitors, including many ages, multiple languages, and a broad range of abilities and disabilities. This interactive, hands-on exhibition is designed to be usable by the greatest range of audiences possible given the nature and constraints of the project. This exhibition is fabricated relatively inexpensively so that we can reach and engage millions of people at many institutions across the United States. The team worked to maximize limited resources across multiple copies intended for long-term, low-maintenance display in museums.

Given the wide-ranging constraints of designing a small exhibition meant to work in multiple settings across the United States, careful attention was given to the many audiences that might encounter the exhibition and how to best make the exhibition welcoming and accessible to as many people as possible.

The following section explains some of the design and development decisions made to optimize use for all audiences, which hosts may find useful if customizing the exhibition for audiences and challenges specific to host communities. Hopefully this information will help hosts to take advantage of work already done to make the exhibition accessible, and perhaps make more changes to further this goal.

Considerations for Different Audiences

Significant efforts were made to increase the capacity of the exhibition to reach a wide variety of visitor audiences. The following chart provides an overview of our strategies for reaching as many different audiences as possible and the exhibition design decisions that were implemented to better serve those audiences.

Table - Considerations and Mitigation for Different Audiences

Audience	Exhibition design for accessibility	Components not accessible	Visitor group mitigation
All audiences	• welcoming environment that stimulates learning and social interaction • key concepts and graphics are meaningful and relevant across visitor experiences and cultures • easy to use, hands-on components • multi-sensory approach • repeating and reinforcing key concepts • clear and concise text	n/a	n/a
Multi-age groups	• multiple ways to engage in experiences • experiences appropriate for adults located near those for children	n/a	n/a
Young children (non-readers)	• signage has attractive imagery • use-drawings on navigation signage • easy-to-use, hands-on components • age-appropriate books in reading area	• complex concepts in signage and exhibits	• adults in group may read navigation signs to young children • adults may interpret more complex material for young children

	• component height accessible to small children		
Children (early readers)	• signage has attractive imagery • text has easy to read font, large font size, and very limited use of italics and “all caps” text • layered and chunked signage information • easy to use, hands-on components • age-appropriate books in reading area	• complex concepts in signage and exhibits	• adults may interpret more complex material for young children
Elderly visitors and others with limited stamina	• seating throughout • signage text has easy-to-read font and large font size • reading materials in seating area	n/a	n/a
Spanish readers	• bilingual English and Spanish signage • bilingual English and Spanish reading boards • bilingual English and Spanish language audio description	n/a	n/a
Speakers of languages other than English and Spanish	• signage has attractive imagery • use-drawings on navigation signage • easy to use, hands-on components	• text for non-English and non-Spanish speakers	• English and Spanish readers within visitor’s group could interpret for other visitors • host museum could translate into another language (refer to translation guide)

Learning disabilities	• repeating and reinforcing key concepts • layered and chunked signage information • text has easy-to-read font, large font size, and very limited use of italics and “all caps” text	n/a	n/a
Blind/ low-vision	• text has high-contrast, easy-to-read font, large font size, and very limited use of italics and “all caps” text • tactile and multi-sensory exhibit components • brightly-colored, high-contrast images, signage, and fonts • brightly-colored, high-contrast interactive components and loose parts • audio descriptions of experiences and exhibition content • raised decals for audio description	• some visual graphics • some printed signage • some activities • some activities with color coding	• other members of visitor’s group may interpret and assist
Colorblind	• signage and color palette accessible to colorblind visitor • interactive activity loose parts color palette selected specifically for colorblind visitors	n/a	n/a
Deaf/hearing impaired	• use of images, text and labels (rather than audio)	n/a	n/a
Wheelchair users	• experiences at accessible heights and reach distances • signage at appropriate heights • recommended floorplan layouts ensure wheelchair access to different components	n/a	n/a

Limited physical mobility	• some components designed to work with limited reach and mobility • seating provided throughout	• some activities require coordination and dexterity	• other members of visitor's group may assist and work cooperatively

Universal Design Approach

The NISE Network is committed to making our educational experiences as accessible as possible for museum visitors of a broad range of abilities and disabilities. Information provided here about our Universal Design (UD) approach may help you make the exhibition work best for your setting and your visitors. The Network developed the following framework for use in developing all educational products:

- Repeat and reinforce the main ideas and concepts by communicating the message through multiple media and representing these ideas in different ways.
- Provide multiple entry points and multiple ways of engagement.
- Provide physical and sensory access to all aspects of the exhibition.

These principles guided the design and development of the exhibition.

Key concepts, exhibition prototypes, exhibit component final designs and signage were reviewed by educators, content experts and advisors at multiple points in the development process. These reviews and feedback sessions helped ensure that the exhibition is engaging, accessible, and appropriate for a broad public audience. These reviewers offered a range of perspectives; each drew from their own personal experience as well as broader expertise on accessibility issues.

Project staff and advisors made specific recommendations to improve access for visitors with limited mobility, many of which were incorporated. All reviewers specifically emphasized the importance of maintaining easy clearance between elements for visitors with limited mobility, whether or not they are using wheelchairs. They expressed hope that institutions would plan for high capacity usage when developing layouts, and plan clearance allowances that will work during high traffic times.

Reviewers commented specifically on the need for communicating content and instructions for use to visitors with low- or no vision, confirming the need for an audio accompaniment to the exhibition, which is detailed below.

Additional Resources

This exhibition was developed to make the exhibition experience accessible to as many people with varying abilities as possible. The following websites feature resources about Universal Design principles for museum settings:

- **NISE Network Universal Design for programs:**
  http://www.nisenet.org/catalog/universal-design-guidelines-programs

- **NISE Network Universal Design workshop resources:**
  http://www.nisenet.org/catalog/universal-design-educational-programs-workshop-resources

- **Recording of Online Workshop - Universal Design for public programs presentation:**
  http://www.nisenet.org/events/online-workshop/universal-design-public-programs-online-workshop-recorded

- **Smithsonian Guidelines for Accessible Exhibition Design**
  https://www.si.edu/Accessibility/SGAED

- **NASA - Space Science Is for Everyone: Creating and Using Accessible Resources in Educational Settings - Lessons from the Field**
  https://www.nasa.gov/pdf/259240main_Space_Science_Is_for_Everyone.pdf

Bilingual Approach

The NISE Network is committed to making our products and resources accessible to non-English-speaking audiences. The Network provides Spanish language educational materials because Spanish is the second most commonly spoken language in the United States, and it is anticipated to continue to be the second most common language nationwide. English and Spanish are used side-by-side throughout the exhibition signage. The text is presented in different colors to assist visitors.

Additional Resources

The NISE Network offers some additional resources in this area:

- **Bilingual Design Guide:** This guide presents the variety of interpretive and design strategies the NISE Network has used for different bilingual products, including exhibits, programs, and media. The guide focuses on NISE Net educational products offered in English and Spanish, but the considerations and solutions presented are more generally applicable to bilingual and multilingual museum experiences. http://www.nisenet.org/catalog/bilingual-design-guide

- **The Translation Process Guide:** This guide is intended to help you navigate through the process of creating quality translated educational products. It includes a suggested process model that will help to ensure that your translations maintain an appropriate interpretive tone and a high level of scientific accuracy. Additionally, you will find helpful tips and considerations that will assist you in planning for translation work in terms of timeline, budget, and human resource requirements. http://www.nisenet.org/catalog/tools_guides/translation_process_guide

- **NISE Network resources in Spanish:**
  A listing of all other materials translated into Spanish: Based on input from NISE Network partners, we have adapted our most popular programs for Spanish-speaking audiences. We have placed the highest priority on translating products that directly serve public audiences. http://www.nisenet.org/catalog/spanish

Audio Description

The audio description that accompanies the exhibition was developed to increase access for visitors with low- or no vision. It may also be able to support visitors with learning disabilities, and others for whom reading is challenging. The overall approach for this process is described as follows:

- **Goals**
  - Make the experience accessible for visitors with low-vision, and for blind visitors with a sighted companion (following American Council for the Blind's definition of an audio description as an assistive technology)
  - Help visitors understand and appreciate the exhibition's most important messages (following statements by American Council for the Blind and Audio Description Coalition)
- **Audience**
  - Visitors with varying degrees of vision loss, from congenitally blind to low-vision
  - English and Spanish speakers
- **Scope**
  - Exhibition overview: key features and main ideas
  - Interactive components: general description, use instructions, and concepts
  - Text and graphics: general description and concepts
- **Access to Audio Descriptions**
  - Visitors may download audio description text onto personal smartphones or mp3/audio players.
  - Host museums are encouraged to incorporate the audio descriptions into their existing audio systems platforms or add to any handheld systems in use at their facility. Exhibition audio description is available at explorescience.org/sun
  - Audio description text is available for download on explorescience.org/sun in multiple formats to increase accessibility for assistive technology readers.
  - Text in English and Spanish is also included in this document.

Audio Description Tactile Labels

High contrast numbered custom tactile labels using the “AD” symbol were installed on tabletop surfaces throughout the exhibition. Please see Chapter 9 - Signage and Graphics - Appendix Graphics Packet for exact placement locations on each of the components

3.25 x 2 inches

Audio Description Scripts and MP3 Audio files

English and Spanish versions of the scripts and mp3 audio files are available on nisenet.org and on explorescience.org/sun websites.

Audio Description Text

Side-by-Side translations in English and Spanish are included in the appendix.

Additional Resources

- Art Beyond Sight
  https://artbeyondsight.wordpress.com
- American Council of the Blind - Audio Description Project
  http://www.acb.org/adp/
- Audio Description Coalition
  http://www.audiodescriptioncoalition.org

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Appendix - Audio Description Text

Side-by-Side Audio Description Text in English and Spanish

English	Spanish
1 Bookshelf/Exhibit Introduction	**1 Estante de libros y juegos/Introducción a la exposición**
Welcome to Sun, Earth, Universe! In this exhibit, you will explore some of the big questions NASA scientists are working to answer. What is it like on other planets? Are we alone in the universe, or is there life beyond Earth? How is our planet changing? How do storms and other activity on the Sun affect life here on Earth? Addressing these questions takes careful planning, engineering, and lots of teamwork. Here, you may design and build your own model spacecraft, or lead a research team as it works together to plan and execute a mission in the exhibit's tabletop board game. In Sun, Earth, Universe, you can also experiment with some of the tools NASA scientists use to explore and study the universe as well our own planet. This exhibit also includes a play table for young children, where they can pilot models of the Spirit, Curiosity, and Opportunity	¡Bienvenidos a Sol, Tierra, Universo! En esta exposición, usted va a explorar algunos de los interrogantes fundamentales que los científicos de la NASA intentan responder. ¿Cómo son los otros planetas? ¿Estamos solos en el universo, o hay vida más allá de la Tierra? ¿Cómo está cambiando nuestro planeta? ¿Cómo afectan las tormentas y otra actividad solar la vida aquí en la Tierra? Para abordar estas preguntas se requiere cuidadosa planificación, ingeniería y una gran cantidad de trabajo en equipo. Aquí, usted podrá diseñar y construir su propio modelo de nave espacial, o liderar un grupo de investigación mientras éste se encarga de planear y llevar a cabo una misión en el juego de mesa de la exposición. En Sol, Tierra, Universo, usted también podrá experimentar con algunas de las herramientas que utilizan los científicos de la NASA para explorar y estudiar el universo y nuestro propio planeta. La exposición también incluye una mesa de juego para niños, en donde es posible pilotear modelos de los rovers Spirit,

rovers across a Martian landscape. The image covering the surface of the play table shows an area of Mars previously explored by the real Spirit rover. The shelves in front of you contain additional resources on space exploration, as well as toys and activities for young learners. The vertical panel above the shelves is multi-purpose: it may display current Earth and space science news and events, or it may be used to post space-related questions and visitor responses.	Curiosity y Opportunity a través del paisaje de Marte. La imagen que cubre la superficie de la mesa de juego muestra una zona de Marte previamente explorada por el verdadero rover Spirit. En los estantes de enfrente hay recursos adicionales relacionados con la exploración espacial, así como juguetes y actividades para los niños. El panel vertical sobre los estantes cumple varias funciones: se puede usar para presentar noticias y eventos científicos de actualidad en la Tierra y el espacio, o para publicar preguntas relacionadas con el espacio y lo que responden los visitantes.

2 Your Mission to Space board game	**2 Juego de mesa "Tu misión al espacio"**
The low table in front of you features the "Your Mission to Space" board game, in which players can compete in a fun, simplified version of the process of planning and executing a mission to space. A segmented path curves across the tabletop, surrounded by stories of challenges and successes in real-life missions. Players must choose a game piece representing a team exploring one of the following questions: "How is the Sun changing?"; "How do distant galaxies compare to our own?"; "Where in our solar system might we find life?"; and, "How is Earth's climate changing?" The pieces proceed along the tabletop path in turns, moving from one to six spaces at a time, according to the number each player spins on the tabletop number wheel. Text on	En la mesa baja de enfrente está el juego "Tu misión al espacio", en el cual los jugadores pueden competir en una divertida y simplificada versión del proceso de planear y llevar a cabo una misión en el espacio. Un recorrido dividido en segmentos serpentea a lo largo del tablero que está acompañado de historias de retos y de triunfos en misiones de la vida real. Los jugadores deben elegir una ficha para representar al equipo que va a explorar una de las siguientes preguntas: "¿Cómo está cambiando el Sol?"; "¿Cómo se comparan las galaxias distantes con las nuestras?"; "¿Dónde podríamos encontrar vida en nuestro sistema solar?"; y, "¿Cómo está cambiando el clima de la Tierra?" Las fichas se mueven por turnos a lo largo del recorrido del tablero, moviendo de uno a seis espacios a la vez, según el número que cada jugador saque al girar la rueda de números

the spaces presents achievements or obstacles in the missions, directing players to advance, go back, lose a turn, or spin again. Near the end of the game, the path becomes a loop. Players must collect ten “data points” before exiting the loop and completing the game. Data points are gained or lost depending on which spaces the players land on. Players can tally their data points on sliders at the center of the loop, sliding one bead along a metal rod for each point gained. The player whose team exits the loop and reaches the end of the path first is the winner of the game, but any team that gathers sufficient data will also successfully complete their mission. And, in real life, answers gained from successful missions almost always raise new questions, starting the “game” all over again.	en el tablero. El texto en los espacios presenta los logros u obstáculos en las misiones y dirige a los jugadores a avanzar, retroceder, perder un turno, o girar la rueda. Hacia el final del juego, el recorrido se convierte en un círculo. Los jugadores deben acumular diez “puntos de información” antes de salir del círculo y completar el juego. Los puntos de información se ganan o se pierden dependiendo dónde aterricen los jugadores. Los jugadores pueden anotar sus puntos deslizando una cuenta a lo largo de la varilla de metal en el centro del círculo, por cada punto ganado. El jugador cuyo equipo logre salir del círculo y llegue primero al final del recorrido es el ganador del juego, pero cualquier equipo que reúna suficiente información también completará su misión con éxito. Y, en la vida real, las respuestas obtenidas mediante misiones exitosas casi siempre plantean nuevas preguntas e inician de nuevo el “juego”.

3 Design > Build > Test engineering activity	**3 Actividad de ingeniería Diseña > Construye > Prueba**
In front of you are three connected tables that offer a chance to explore the design, build, test process of engineering through imaginative play. Each mission to space presents both familiar requirements and new challenges. Scientists and engineers must design spacecraft to fit	Enfrente hay tres mesas conectadas que ofrecen la oportunidad de explorar el proceso de ingeniería de diseñar, construir y poner a prueba por medio de un juego de imaginación. Cada misión al espacio representa exigencias familiares y retos nuevos. Los científicos e ingenieros deben diseñar naves espaciales

the unique needs of their mission. Where will the spacecraft go? What will it do, and what equipment will the spacecraft need to do it? What should it look like? The table nearest to you, the Design station, holds materials to inspire the mission and design of the model spacecraft you will build at the next station. A large flip book mounted vertically on this table contains images and details of sample spacecraft and missions—both real and imagined. A display case to the left of the flip book features a model spacecraft constructed of the same materials that will be available to you. The next table is the Build station. This is the largest of the three tables, and it connects to both the Design and Test stations. Recessed trays on either side of the table contain the materials and components you will need to assemble your craft. All spacecraft need a container, or basic structure. Square foam rubber tiles with interlocking teeth can be used to construct your container. It can be a simple cube or a more complex shape, depending on what you have imagined for your mission. Your spacecraft will also need tools. The smaller pieces at this station represent tools and equipment—these can be inserted into the holes in your spacecraft's body, or attached through plastic extenders and joints. Your spacecraft should have at least one tool from each of the following categories: yellow-colored power tools, blue	que se ajusten a las necesidades particulares de la misión. ¿A dónde irá la nave espacial? ¿Qué hará, y qué equipo necesitará para hacerlo? ¿Qué apariencia debe tener? En la mesa más cercana, la estación de Diseño, hay materiales para inspirar la misión y diseñar el modelo de la nave espacial que se construirá en la siguiente estación. En la mesa hay imágenes grandes que penden de un soporte de metal vertical, con detalles y muestras de naves espaciales y misiones tanto reales como imaginarias. Una vitrina de exhibición al lado izquierdo de las imágenes presenta el modelo de una nave espacial construida con los mismos materiales que hay a su disposición. La siguiente mesa es la estación de Construcción. Esta es la mesa más grande de las tres y está conectada a las otras dos estaciones, la de Diseño y la de Prueba. Las bandejas empotradas a ambos lados de la mesa contienen los materiales y componentes necesarios para armar su modelo. Todas las naves espaciales necesitan un contenedor o estructura básica. Para construir el contenedor se pueden usar placas cuadradas de espuma con dientes que encajan. Puede ser un cubo sencillo o una forma más compleja, dependiendo de lo que tenga en mente para su misión. La nave espacial también necesitará herramientas. Las piezas más pequeñas en esta estación representan las herramientas y equipos. Se pueden insertar en los agujeros del cuerpo de la nave, o sujetarse con piezas plásticas de extensión y uniones. La nave debe por lo menos tener una herramienta de cada una de las siguientes categorías: amarilla para energía, azul para

communication tools, orange navigation tools, and purple science tools. Once you have built and equipped your spacecraft, you will need to test its readiness for space. The final table, the Test station, is connected to the far side of the Build table. The Test station contains three tests that your craft must pass before it's ready for launch. First is the checklist. This is on the left side of the table. Use this to verify that you have included all of the necessary components in your spacecraft. In the middle of the table is the spin test. All spacecraft must be carefully balanced to ensure steady flight and stable navigation. Test your craft's balance by securing it to the circular platform at the center of the table using the attached Velcro straps. Once the spacecraft is secure, spin the platform. If any parts of your spacecraft were not attached tightly enough, they may fly off! The final test, on the right side of the table, is the shake test. Launching to space is a shaky experience, and spacecraft must be built to withstand that stress. Use the Velcro straps to secure your model craft to the rectangular vibration platform, and then turn the adjacent crank. This will cause the platform to vibrate aggressively—only a well-constructed spacecraft will survive.	comunicación, naranja para navegación y morada para ciencia. Una vez construida y equipada, la nave se debe poner a prueba para ver si está lista para ser lanzada al espacio. La mesa final, la estación de Prueba, está conectada al extremo de la mesa de Construcción. En la estación de Prueba la nave debe pasar tres pruebas antes de estar lista para el lanzamiento. Primero revise la lista de control, ubicada en el lado izquierdo de la mesa. Úsela para verificar que todos los componentes necesarios de la nave hayan sido incluidos en la nave. En el centro de la mesa está la prueba de giro. Las naves deben estar debidamente equilibradas para asegurar un vuelo constante y una navegación estable. Ponga a prueba la estabilidad de la nave asegurándola a la plataforma circular que se encuentra en el centro de la mesa, utilizando las tiras de velcro allí pegadas. Una vez la nave esté asegurada, gire la plataforma. Si algunas partes de la nave no están bien sujetas, ¡quizás salgan volando! La prueba final, en el lado derecho de la mesa, es la prueba de vibración. El lanzamiento al espacio implica un fuerte sacudón, y la nave debe estar construida para resistir ese esfuerzo. Use las tiras de velcro para asegurar la nave a la plataforma rectangular de vibración, y después dele la vuelta a la manija adyacente. Esto hará que la plataforma vibre fuertemente. Sólo una nave espacial bien construida sobrevivirá. ¿Pasó su nave espacial cada una de las pruebas? Si no fue así, vuelva a las estaciones

Did your spacecraft pass each test? If not, just head back to the Design or Build stations to improve your craft. After all, the design, build, test process is a cycle—each test may require improved design or construction before your spacecraft is ready for its mission.	de Diseño y de Construcción para perfeccionarla. Después de todo, el proceso de diseño, construcción y prueba es un ciclo en el que es posible que después de cada prueba se requiera mejor diseño o construcción, antes de que la nave esté lista para la misión.

4 Use tools to detect the invisible	**4 Use herramientas para detectar lo invisible**
This part of the exhibit lets you try out some devices that are similar to the tools scientists use to study Earth, the Sun, the solar system, and the rest of the universe. Visible light—the only light that humans can perceive without special equipment—makes up a very small part of the full spectrum of light energy. We call the full range of light energy the electromagnetic spectrum, or the EMS. The EMS encompasses all light energy, from radio waves to gamma rays. Studying the universe using just visible light would be like hearing only every tenth note in a song. By using special tools to detect other forms of light, we're better able to understand the full symphony of the universe. On the table in front of you, slightly set back from its edge, is an array of tools and detectors for studying phenomena otherwise imperceptible to humans. Also on the table are several square wooden tiles, each about six inches across. Simple images decorate the	Esta parte de la exposición le permite experimentar con algunas herramientas similares a las que utilizan los científicos para estudiar la Tierra, el Sol, el sistema solar y el resto del universo. La luz visible —la única luz que los humanos pueden percibir sin usar un equipo especial—es una parte muy pequeña del espectro total de la energía de la luz. Llamamos espectro electromagnético o EMS (en inglés) al rango completo de la energía de la luz. El EMS abarca toda la energía de la luz, desde las ondas de radio hasta los rayos gamma. Estudiar el universo utilizando sólo la luz visible sería como escuchar sólo la décima nota de una canción. Al utilizar herramientas especiales para detectar otras formas de luz, podemos comprender mejor la sinfonía completa del universo. En la mesa de enfrente, ligeramente alejada del borde, hay una selección de herramientas y de detectores para estudiar fenómenos que de lo contrario serían imperceptibles a los humanos. En la mesa también hay varias placas cuadradas de madera, cada una de unas seis pulgadas de ancho. Unas imágenes sencillas decoran las superficies de las placas.

surfaces of the tiles. By placing the tiles under the tools, more hidden details emerge! These are the tools, from left to right: First is an infrared light detector. This tool uses an infrared video camera and a black and white monitor. When you place a tile beneath the camera, the monitor shows the infrared light reflecting off the tile. The camera reveals details on the tiles that are hidden by materials that block visible light but not infrared light. Next comes a magnifying lens. This tool relies on visible light, but it allows users to see details too small to easily make out with the naked eye. Hold a tile flat against the vertical surface behind the tool, and look through the protruding scope. The lens will reveal tiny lines of text. Most objects in the universe are so distant from Earth that we must use light-collecting and magnifying devices to study them. To the right of the magnifier is an ultraviolet light. Lay a tile on the platform below the tool and press the red button on the front of the tool to activate an ultraviolet light source (often called a “black light”). Human eyes can’t directly perceive ultraviolet light, but special pigments on the tiles glow, or fluoresce, under ultraviolet light, revealing hidden designs.	Al colocar las placas debajo de las herramientas, ¡emergerán más detalles escondidos! Éstas son las herramientas, de izquierda a derecha: La primera es un detector de luz infrarroja. Esta herramienta utiliza una cámara de video infrarroja y un monitor blanco y negro. Cuando uno coloca una placa bajo la cámara, el monitor muestra la luz infrarroja reflejándose desde la placa. La cámara revela detalles en las placas que están cubiertos por los materiales que bloquean la luz visible pero no la luz infrarroja. A continuación, hay una lupa. Esta herramienta depende de la luz visible, pero permite a quien la usa ver detalles muy pequeños que serían difíciles de distinguir a simple vista. Sostenga una placa contra la superficie vertical detrás de la herramienta y mire a través del lente de aumento en el extremo. Éste revelará líneas de texto muy pequeñas. La mayoría de los objetos en el universo están tan distantes de la Tierra que debemos utilizar dispositivos de aumento y de recolección de luz para estudiarlos. A la derecha del lente de aumento hay una luz ultravioleta. Coloque una placa en la plataforma debajo de la herramienta y presione el botón rojo enfrente de la herramienta para activar la fuente de luz ultravioleta (a menudo llamada “luz negra”). El ojo humano no puede percibir la luz ultravioleta directamente, pero los pigmentos especiales que hay en las placas resplandecen, o se ven fluorescentes bajo la luz ultravioleta, y revelan los diseños escondidos.

Finally, farthest to the right, is a magnetic field detector. This tool is shaped like a large wedge. To use the detector, place a tile on the lower part of the slanted surface and slide it up into the slot. The tile will then be obscured by a layer of special film that becomes darker in the presence of a magnetic field. Small magnets embedded inside the tiles create patterns on the film. A graphic panel behind these tools shows an image of NASA's Juno spacecraft with labels explaining how the tools it carries—similar to those on the table—help it in its mission to study Jupiter.	Finalmente, en el extremo derecho, hay un detector de campo magnético. Esta herramienta tiene la forma de una cuña grande. Para usar el detector, coloque una placa en la parte baja de la superficie inclinada y deslícela en la ranura. La placa entonces se oscurecerá gracias a una película especial que se vuelve más oscura en presencia de un campo magnético. Los pequeños imanes insertados en las placas crean diseños sobre la película. El panel gráfico detrás de estas herramientas muestra una imagen de la nave espacial Juno de la NASA con etiquetas que explican cómo las herramientas que carga —similares a las que hay en la mesa— le ayudan en la misión de estudiar a Júpiter.

5 We ask questions about Earth	**5 Hacemos preguntas sobre la Tierra**
Our planet is always changing. Some of the changes are natural, and some are the result of human activity. This part of the exhibit highlights some of the changes that have occurred on Earth in recent decades as well as the ways NASA has observed and tracked these changes from space. A large, highly detailed image of Earth shows our planet's green landscapes, blue ocean, and swirling white clouds. This is a real image of Earth, but it was not taken in a single shot;	Nuestro planeta siempre está cambiando. Algunos cambios son naturales y otros son resultado de la actividad humana. Esta parte de la exposición destaca algunos de los cambios que han ocurrido en la Tierra en décadas recientes, así como las formas en que la NASA ha observado y rastreado estos cambios desde el espacio. Una imagen grande y bastante detallada de la Tierra nos muestra los verdes paisajes de nuestro planeta, el océano azul y las nubes blancas dando vueltas. Esta es una imagen

NASA scientists and visualizers layered, assembled, and stitched together months' of satellite observations to create this seamless vision of the planet.	real de la Tierra, pero no en una sola toma; los científicos y visualizadores de la NASA estratificaron, ensamblaron y reunieron las observaciones realizadas por los satélites durante meses para crear esta visión unificada del planeta.
On the slanted rail below the image of Earth are four satellite photos on hinged flaps. Below each image is a second image of the same location, taken years later.	En el panel inclinado debajo de la imagen de la Tierra hay cuatro fotos de satélites en un soporte que permite mirarlas por ambos lados. Debajo de cada imagen hay una segunda foto del mismo lugar, tomada años después.
The first set of images shows the progress of construction of large, palm tree-shaped artificial islands in the Persian Gulf off the coast of Dubai between 2001 and 2012.	La primera serie de imágenes muestra los avances en la construcción entre los años 2001 y 2012, de unas grandes islas artificiales en el Golfo Pérsico, a lo largo de la costa de Dubái, en forma de palmeras.
The next set of images shows massive urban growth in Shanghai, China, between 1984 and 2016. The later photograph shows the city spilling far beyond its 1984 limits.	La siguiente serie de imágenes muestra un desarrollo urbano masivo en Shanghái, China, entre los años 1984 y 2016. La última foto muestra como la ciudad se ha extendido sobrepasando sus límites de 1984.
The third set of images shows summer sea-ice coverage in the arctic. Sea ice grows and shrinks with the seasons, but long-term climate change is causing the seasonal minimum to get smaller and smaller. The first photo, taken in 1984, shows extensive ice coverage. The second photo, taken in 2012, shows a distinctly shrunken area of coverage.	La tercera serie de imágenes muestra la cobertura de hielo marino en el ártico durante el verano. El hielo marino se agranda y se encoge durante las estaciones, pero el cambio climático a largo plazo está causando que el mínimo estacional se reduzca cada vez más. La primera foto, tomada en 1984, muestra la extensa cobertura de hielo. La segunda foto, tomada en el año 2012, muestra un área de cobertura ampliamente reducida.
The final set of images shows the growth in open pit coal mines in the Powder River Basin in Wyoming from 1984 to 2016. The 2016 image shows many massive new surface	La serie final de imágenes muestra el crecimiento de las minas de carbón a cielo abierto en la cuenca del río Powder en Wyoming, desde 1984 hasta 2016. La imagen

mines. These mines produced nearly a quarter of the United States' coal supply in 2014, but officials believe they will run out of recoverable coal by the 2030s.	del año 2016 muestra muchas minas masivas nuevas en la superficie. Estas minas produjeron cerca de una cuarta parte del suministro de carbón de los Estados Unidos en el 2014, pero los funcionarios creen que el carbón recuperable se terminará hacia los años 2030.

6 We ask questions about the Sun	**6 Hacemos preguntas sobre el Sol**
The Sun is a dynamic star, but much of its activity is invisible to human eyes. The large, vertical panel in front of you shows a vibrant orange image of the Sun, with fiery protrusions bursting from its surface and stretching thousands of kilometers into space. This is a phenomenon called a coronal mass ejection, or CME. We're able to study the CME in great detail here because this image was created by recording the extreme ultraviolet light coming from the Sun. Humans cannot perceive extreme ultraviolet light (or any light energy other than visible light) without special tools. CMEs and solar flares, another energetic solar event, are more common during solar storms, when the Sun's complicated magnetic field rearranges itself, releasing bursts of energy and particles. These events can affect life on Earth by disrupting our satellites, power grids, and communication	El Sol es una estrella dinámica, pero gran parte de su actividad es invisible al ojo humano. El gran panel vertical de enfrente nos muestra una vibrante imagen anaranjada del Sol, con protuberancias de fuego reventándose desde su superficie y expandiéndose miles de kilómetros en el espacio. Este es un fenómeno llamado eyección de la masa coronal o CME (en inglés). Aquí podemos estudiarlo en gran detalle porque esta imagen fue creada al registrar la luz ultravioleta extrema proveniente del Sol. Los humanos no podemos percibir la luz ultravioleta extrema (u otra energía de la luz, aparte de la luz visible) sin usar herramientas especiales. Las eyecciones de la masa coronal y las erupciones solares, otro evento solar energético, son más comunes durante las tormentas solares, cuando el complicado campo magnético del Sol se reorganiza a sí mismo, liberando explosiones de energía y de partículas. Estos eventos pueden afectar la

systems. This solar activity is cyclical, with solar storms increasing and decreasing in frequency and intensity over an 11-year period. The slanted rail below the large image of the Sun shows a series of paired images of the Sun taken in different light energies. Each image pair shows the Sun near the most active and least active periods of its 11-year cycle. The different light energies shown—infrared, visible, ultraviolet, and X-ray—each allow us to study different aspects of the Sun. On the right side of this rail is an image explaining the electromagnetic spectrum. This is the spectrum of light energy that includes radio waves; microwaves; infrared, visible, and ultraviolet light; X-rays; and gamma rays. Of these light energies, humans can only perceive visible light without the aid of tools.	vida en la Tierra, perturbando nuestros satélites, las redes eléctricas y los sistemas de comunicación. Esta actividad solar es cíclica, con las tormentas solares aumentando y disminuyendo en frecuencia e intensidad durante un período de más de 11 años. El panel inclinado debajo de la imagen grande del Sol muestra una serie de pares de imágenes del Sol tomadas en diferentes energías de la luz. Cada par de imágenes muestra el Sol cerca de los períodos más y menos activos de su ciclo de 11 años. Cada una de las diferentes energías de la luz que se muestran —infrarroja, visible, ultravioleta y rayos X—nos permite estudiar diferentes aspectos del Sol. Del lado derecho de este panel hay una imagen para explicar el espectro electromagnético. Este es el espectro de la energía de la luz que incluye ondas de radio; microondas; luz infrarroja, luz visible y luz ultravioleta; rayos X; y rayos gamma. De estas energías de la luz, los humanos sólo pueden percibir la luz visible sin el uso de herramientas.

7 We ask questions about the solar system	**7 Hacemos preguntas sobre el sistema solar**
Much of the information NASA collects on the objects in our universe is either imperceptible to human senses, or it is too subtle for us to easily understand. To highlight this information, scientists often add color to images to represent data. This is called representational color.	Gran parte de la información que la NASA recolecta sobre los objetos de nuestro universo es imperceptible a los sentidos humanos, o es muy sutil para comprenderla fácilmente. Para destacar esta información, los científicos con frecuencia añaden color a las imágenes para representar la

The large image in front of you is a representational color photograph of the planet Saturn. It shows Saturn's gassy surface and familiar rings, but the color is unusual; the rings are deep blue, the sunlit side of the planet is leafy green, and the shadowed side is smoldering red. In this image, scientists used blue to represent reflected sunlight, red to show heat radiating from the planet's interior, and green to indicate a mix of sunlight and interior heat. On the left side of the rail below the large image of Saturn is a flip book with several images that use representational color to highlight conditions on other planets and moons; they show the mineral composition of the surface of the Moon, variations in the pull of gravity across Mars, and the hazy upper atmosphere of Neptune. To the right of the flip book (and occupying most of the rail) is a tray filled with long, narrow colored blocks. Behind this tray stands a shallow vertical alcove with an image of the surface of Venus on its recessed wall. A numbered grid covers the image of Venus. The numbers range from one to five. Each number on the grid is associated with a particular color. By placing colored blocks in front of each of the gridded squares, the photographic image of Venus is replaced with a representational color image of Venus's surface elevation; for example, bright orange blocks show high peaks, while purple blocks show low plains and valleys. Representational	información. Esto se llama color representativo. Esta imagen grande, frente a usted, es una fotografía de colores representativos del planeta Saturno. Muestra la superficie gaseosa de Saturno y sus conocidos anillos, pero el color es inusual; los anillos son de un azul profundo, el lado del planeta iluminado por el Sol es verde como las hojas, y el lado en la sombra es rojo humeante. En esta imagen, los científicos usaron el azul para representar el reflejo de la luz del sol, el rojo para mostrar el calor que se irradia desde el interior del planeta, y el verde para indicar una mezcla de la luz del sol y del calor interno. En la parte izquierda del panel que hay debajo de la imagen grande de Saturno, hay varias imágenes en un soporte que usan colores representativos para resaltar las condiciones en otros planetas y lunas. Éstos reflejan la composición mineral de la superficie de la Luna, las variaciones en la fuerza de la gravedad a través de Marte y la brumosa atmósfera superior de Neptuno. A la derecha de las imágenes que penden del soporte de metal (y ocupando la mayor parte del panel) hay una bandeja con bloques de colores largos y angostos. Detrás de la bandeja hay un nicho vertical, no muy profundo, empotrado en la pared con una imagen de la superficie de Venus. Una cuadrícula numerada cubre la imagen de Venus. Los números van del uno al cinco. Cada número en la cuadrícula está relacionado con un color particular. Al colocar los bloques de colores frente a cada uno de los cuadros de la cuadrícula, la imagen fotográfica de Venus es reemplazada

color helps the elevation measurements stand out at a glance.	por una imagen de color representativo de la elevación de la superficie de Venus; por ejemplo, los bloques de color anaranjado brillante muestran los picos altos, mientras que los bloques morados muestran las llanuras bajas y los valles. Los colores representativos ayudan a que las medidas de elevación resalten a la vista.

8 We ask questions about the universe	8 Hacemos preguntas sobre el universo
Are we alone in the universe? While we have not yet encountered life beyond Earth, the more we learn about the sheer scale of the universe and the conditions on distant planets and moons, the more likely it seems that life must be out there somewhere. The image in front of you at first appears to be a vast field of bright stars against a black sky. Closer inspection, however, reveals the image to be much more than that. Most of the objects that look like stars are actually entire galaxies—about ten thousand of them—each one containing millions to billions of stars. Captured by the Hubble Space Telescope, this image is called the "Hubble Ultra Deep Field," and it represents only a tiny fraction of the night sky. Two objects stand out from the rail below the large Hubble Ultra Deep Field image. To the left is a metal scope mounted on a rod. The scope is forty-six centimeters long—about a foot and a half—and the opening on the far end is only the size of a pinhole (a little more than 1 millimeter, or one-thirty second of an inch, wide). The tiny dot of light that the small opening reveals when you look through the scope represents the size of the area of sky that the entire Hubble Ultra Deep Field image comes from—only zero point zero zero zero zero zero zero zero eight three percent of the sky.	¿Estamos solos en el universo? Aun cuando todavía no hemos descubierto vida más allá de la Tierra, entre más aprendemos sobre la escala real del universo y las condiciones en los planetas y lunas distantes, la probabilidad de que haya vida en alguna parte allá afuera es mayor. La imagen de enfrente, a primera vista, parece ser un campo extenso de estrellas brillantes contra un cielo negro. Una inspección más cercana, sin embargo, revela que la imagen es mucho más que eso. La mayoría de los objetos que se ven como estrellas son, en realidad, galaxias enteras —cerca de diez mil de ellas— cada una con millones y hasta miles de millones de estrellas. Esta imagen, captada por el Telescopio Espacial Hubble, se llama el "Campo súper profundo de Hubble" y representa sólo una minúscula fracción del cielo nocturno. Dos objetos sobresalen del panel debajo de la gran imagen del campo súper profundo de Hubble. Hacia la izquierda hay un tubo de metal montado sobe una varilla. Este tubo tiene cuarenta y seis centímetros de largo —casi un pie y medio— y la abertura en el extremo derecho sólo tiene el tamaño de un pequeñísimo agujero (un poco más de 1 milímetro, o 1/32 de pulgada de ancho). El pequeño punto de luz que la abertura revela cuando uno mira a través del tubo, representa el tamaño del área de cielo de donde proviene la imagen del Campo súper profundo de Hubble, sólo el cero punto cero cero cero cero cero cero cero ocho tres por ciento del cielo.

To the right of the scope is a clear plastic cylinder, mounted horizontally on the rail. Inside the cylinder are eight thousand yellow beads, almost two thousand blue beads, and a single red bead. These beads represent the ten thousand or so stars visible from Earth without the aid of a telescope. Scientists believe that about two thousand of these stars have planets with the potential to host life (they are probably the right size and temperature to support life as we know it). The blue beads represent these stars. The single red bead represents the only star that we know for certain has a life-bearing planet: the Sun. By spinning the cylinder, one can search for the single, certain location of life among the stars, and also see the great many possible places for life to exist near our planet.	A la derecha del tubo hay un cilindro de plástico transparente, colocado horizontalmente en el panel. Dentro del cilindro hay ocho mil cuentas amarillas, casi dos mil cuentas azules, y una sola cuenta roja. Estas cuentas representan las diez mil y más estrellas visibles desde la Tierra sin la ayuda de un telescopio. Los científicos creen que cerca de dos mil de estas estrellas tienen planetas con el potencial de albergar vida (probablemente tienen el tamaño y la temperatura adecuados para sustentar la vida como nosotros la conocemos). Las cuentas azules representan estas estrellas. La sola cuenta roja representa la única estrella de la cual tenemos la certeza que tiene un planeta que sustenta la vida: el Sol. Al girar el cilindro, uno puede buscar la única y cierta ubicación de vida entre las estrellas, y también ver la gran cantidad de lugares posibles donde puede existir vida cerca de nuestro planeta.