



Exploring Strange New Worlds

What are the ways NASA explores the Solar System?

About the Activity

Your visitors become teams of scientists living on a planet orbiting a distant star. They are on the threshold of exploring their own planetary system for the first time. With planets you have created, teams explore the planets using the methods NASA scientists use to explore the Solar System.

Materials Needed

- Copies of the "Communication and Exploration" handout for your visitors
- One or more "planets" that you've made beforehand (See Preparation below)
- (Optional) Tweezers
- (Optional) Rules of the Game
- (Optional) "I Explored the Solar System" certificates for visitors who complete the activity



Topics Covered

- What methods do scientists use to explore our Solar System?
- Exploring by: Telescope, Fly-by, Orbiter, Probe, Lander / Rover, Sample Return, and Human Exploration
- What are examples of the different kinds of missions?
- What decisions do scientists need to make when planning missions?

Location and Timing

Use this activity with the general public before a star party, indoors or outdoors, in a classroom or with a youth group. The activity takes about 30–45 minutes.

Participants

This activity is appropriate for families, the general public, and school groups in ages 10 and up. Any number of visitors may participate. It is recommended that teams consist of 3 – 7 people.

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Preparation

Making your Strange New Worlds

Materials: Your choice. See below for suggestions.

Objective:

- Create a planet or set of planets to explore in the “Exploring Strange New Worlds” activity.

Making the Planet and Keeping it Hidden

For the activity, “Exploring Strange New Worlds,” you need to make a planet – or set of planets – ahead of time. Here is an opportunity for you and your fellow club members to get really creative.

If you are working regularly with a group, such as Scouts or a classroom, you can involve the group members in preparing planets to explore for the next time you meet.

Keep your completed planet(s) in a bag or covered with a towel to prevent your visitors from seeing them close up. Keeping the planets hidden until you start the activity is very important. You will be placing the planets quite some distance from your visitors so it will be difficult to discern detail from their home planet.

Displaying your Planets during the Activity

Remember to keep planets covered until the activity starts!

Here are a few options for displaying the planets:

- Set out chairs or small tables and place the planets on them.
- Insert a stick into each planet and:
 - pick a visitor to hold each one. This way, the visitors can rotate the planet.
 - OR push the other end of the stick into the ground (if the ground is soft enough)
 - OR push the other end into a lump of clay sitting on a table.



Suggestions for Constructing Planets

- **The planet should be** at least 5 inches in diameter and can be as large as 12” in diameter.
- **Include items of interest on the planet:** water, signs of life, sedimentary layers, signs of erosion. You might want to include a dinosaur, a building, or a coin.
- **Include an aroma:** Sprinkle with food flavoring such as mint, vanilla, or vinegar; imbed chunks of strong cheese; attach crushed bay leaves or other crushed, dried herb. Use sparing amounts of perfume or after-shave (some people have allergies to artificial scents).
- **Include areas where a sample** of the planet (either surface or atmosphere) could be pinched off – for sample return missions.

Ideas for the planet base:

- Use the 6-inch dylite ball included in the ToolKit as a base for your planet
- Use an inflatable beach ball
- Use a roundish fruit, like cantaloupe, pumpkin, or large grapefruit.
- Use multi-colored clay or Play-Doh®
- Wadded-up newspaper core covered with crumpled and shaped aluminum foil (make mountains and plains), covered partially or fully with cotton batting.
- Mud ball planet: Freeze it
- If it is cold enough where you are, use a snowball as a base
- Use cotton batting or different colored felt and pull it apart to make a thick atmosphere – can wrap around a solid core or just leave it fluffy to make a gas giant. Carry in plastic bag and re-fluff when needed for use (see photos below).



Other recipes:

http://www.quincypublicschools.com/schools/preschool/artrecipes_text.shtml

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

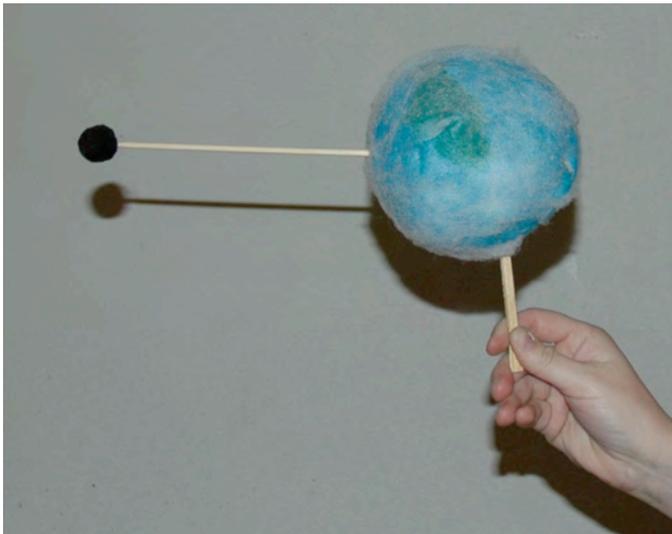
Ideas for decorating your planet:

- Use skewer sticks to attach “moons” to the planet.
- Make rings from Saturn’s rings (in the Activity “Solar System Models: Sizes & Distances”) printed on a transparency and laminated.
- Glue items to the surface: bark, moss, rocks, small plastic animals, sequins, marbles, seashells, anything small and interesting.
- Pull apart and attach cotton balls for clouds.
- Attach stickers and colored tape
- Attach or glue clay to it and imbed rubber bands (rivers), gravel, peppercorns, leaves.
- Paint it in a variety of colors.
- Spread glue on the surface and sprinkle on it sand, dirt, herbs, glitter, sawdust, or any other small grainy material.
- Carve canyons and river valleys.
- Drip colored candle wax on it – lakes or lava, depending on the color.
- Add an aroma (see above under “Suggested Rules”).



Examples of other Strange New Worlds

A wiffle ball covered with painted cotton batting.
Includes a moon.



Constructed as wadded newspaper covered with aluminum foil and painted. Pulled cotton balls for clouds.

Detailed Activity Description

Exploring Strange New Worlds

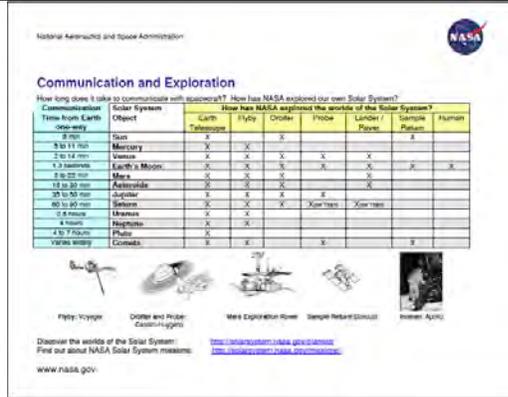
Leader's Role	Participants' Role (Anticipated)
Objective: <ul style="list-style-type: none">• This activity first introduces many of the ways to explore bodies in <u>our</u> Solar System.• Then your visitors become scientists who use these techniques to explore some Strange <u>New</u> Worlds.	
Set-Up: <p>To set this up, you'll want to place the planets (or the visitors holding the planets) at least 10 yards/meters away from the rest of your audience so the audience cannot easily see detail on the planets. If you have more than one world, you can create a planetary system and place them at different distances.</p> <p>If you have people holding the planets, rather than placing them on tables or chairs, for a little more reality, have each person slowly rotate their planet, say to a count of 20.</p> <p>Depending on the size of the group and how much time you have, you can form teams or allow each visitor to explore the worlds on their own. In this case, teams are formed.</p>	



Leader's Role

Participants' Role (Anticipated)

To Do:
Pass around the "Communication and Exploration" handout (shown at right) to your visitors and start by examining how we explore.



To Say:
Today you will become scientists exploring Strange New Worlds.
(Point to the planets in the field)
You will plan missions to explore these places. Take a look at this handout – what are some of the ways we can use spacecraft to explore our Solar System?

Fly-by!
Orbiter!

To Do:
Pick a visitor with a fuzzy hat or jacket and place the person about 10 feet from you and the audience.

To Say:
Let's quickly demonstrate each method. This will be your planetary scientist training session. Make yourself a viewer from your handout.

To Do:
Roll your handout into a tube.

To Say:
We'll use [visitor's name] and pretend she is a planet. First, we explore by viewing the planet from Earth through a telescope. Everyone view her. Then you send spacecraft to explore the planet.

Visitors roll up handouts.

Visitors look through viewers.

Leader's Role	Participants' Role (Anticipated)
<p><u>To Do:</u> Approach the planet visitor with your viewer and execute a fly-by.</p> <p><u>To Say:</u> You can send fly-by missions, like the Voyager spacecraft—usually as part of a survey to fly by two or more planets to get a close, but quick look.</p> <p><u>To Do:</u> With viewer to your eye, orbit the planet visitor.</p> <p><u>To Say:</u> Orbiters like the Cassini mission at Saturn, get a more detailed, more thorough look at the planet – in some cases to determine where you might want to land your next mission.</p>	
<p><u>To Do:</u> Use a finger and slowly descend to the top of the planet visitor's head or shoulder.</p> <p><u>To Say:</u> Probes, like Huygens, which parachuted through the atmosphere of Saturn's moon, Titan, or Deep Impact which hit a comet, to analyze the material the object is made of.</p> <p><u>To Do:</u> With the viewer to your eye, use your fingers to crawl over the planet visitor's head or shoulder. Keep your viewer focused on your fingers.</p> <p><u>To Say:</u> Landers and Rovers, like those on Mars, explore a small area to collect and analyze surface material and get images from the surface. These can only explore a limited area of a planet so you must keep your landing site in your viewer at all times. This is the limit of your Rovers' range.</p>	
<p>And there are sample returns, like Stardust which collected material from a comet and returned it to Earth for analysis.</p> <p><u>To Do:</u> Pull a piece of fuzz off a fuzzy sweater or hat and carry it back to the audience.</p>	

Leader's Role	Participants' Role (Anticipated)
<p><u>To Say:</u> Now that you've been trained as planetary scientists, imagine we are scientists living on a planet orbiting a distant star. Like Earth's Sun, <u>our</u> parent star has other planets around it. But we haven't explored them yet.</p> <p><u>To Do:</u> Open your handout and point to each method.</p> <p><u>To Say:</u> Your job as scientists is to decide which of these methods you want to use to explore the planets in our system. You can have fly-bys, orbiters, probes, landers / rovers, and sample returns.</p> <p>You have a budget for three spacecraft missions, and your objective is to discover enough about these worlds to make a case for more missions. [or whatever objective you want to assign]</p> <p>Before we start the missions, use your telescopes and look out there from our home planet.</p> <p>Tell me what you notice about the planets. Can you tell how they are different?</p>	<p>Visitors view planets.</p> <p>Variety of comments regarding color, texture, moons</p>
<p><u>To Say:</u> When you send spacecraft, what will you find on the planet? Water? Signs of life? Is it just gas or does it have a surface? We'll form two teams.</p> <p><u>To Do:</u> Split the group into two or more teams.</p> <p><u>To Say:</u> When you're done with your missions, your team will want to give reasons why more exploration should be done.</p> <p>Let's take a look at the rules on the back of your sheet.</p>	

Leader's Role	Participants' Role (Anticipated)
<p><u>To Do:</u> Read the first rule, then choose different visitors to read each of the rest.</p> <p><u>Basic Rules for the Activity:</u></p> <p>(Feel free to add or modify! See page 11 for ideas.)</p> <ol style="list-style-type: none"> 1. Everyone on the team is a scientist, but one person at a time is assigned as a spacecraft. Scientists can take turns being the spacecraft. 2. Each team decides what type of missions to send and what they want their mission to accomplish. 3. Each team decides which planet or planets the spacecraft is to explore. More than one team can explore the same planet. 4. Your team's budget allows for three missions. 5. When the spacecraft's mission is done, you change to become a radio message that returns to Mission Control to tell the scientists what the spacecraft found. 6. The spacecraft must use its viewer during every mission as it approaches and as it examines the planet. 7. Only the spacecraft goes to the planet. The scientists remain at Mission Control. 	

Leader's Role	Participants' Role (Anticipated)
<p><u>To Say:</u> OK – time to plan your first mission. Choose who on your team will become the first spacecraft. You have 30 minutes to complete all your missions. Your time starts now.</p> <p><u>To Do:</u> Continue with words of encouragement. When the time limit is reached, call a halt to the activity.</p> <p><u>To Say:</u> Time's up! Now it's time for each team to report what was discovered and what future missions would you like to send. What further information would you want the next mission to get?</p> <p><u>To Say:</u> Well, I think you all deserve funding for further exploration. Give yourselves a hand.</p>	<p>Teams plan and run their missions.</p> <p>Teams report.</p> <p>Visitors applaud.</p>
<p>Presentation Tip: You can hand out small prizes or certificates "I explored a Strange New World" at the end. A template for a certificate is included below. You may want to put your club information on the back.</p> <p>You can add variations to this activity, as suggested below. Depending on your audience and location, you may want to plan to keep the rules as simple as possible.</p>	

Variations and additional rules you may want to choose from:

- a. Assign a dollar value to each type of mission and give each team a dollar budget instead of a number-of-missions budget.
- b. Add a rule that teams are allowed to collaborate. Teams could belong to different countries.
- c. Place a time limit on completing their missions (e.g. “You have 20 years/months to complete your missions. But on our planet, a year/month is only 1 minute long.”)
- d. Each planet could be given an in-transit time – the more distant planets take more time to reach, so you might use up your time budget before you’ve completed even one mission.
- e. The spacecraft must walk at a certain rate, e.g. heel-to-toe to simulate the time to get to the planet. The radio message can travel much faster – the person can run back to Home Planet.
- f. If a number of your visitors have cell phones with cameras, the spacecraft could be allowed to take pictures of the planets and either send or bring them back to the science team for review.
- g. Have precedence rules, for example:
 - You can only send an orbiter after you’ve sent a fly-by to determine which of the planets warrants a more detailed mission.
 - You can only send a lander after you’ve send an orbiter to determine an appropriate landing site.
 - You can only send a sample return after you’ve run a mission to determine where to take the sample from.
- h. For sample returns: Use tweezers
- i. For probes: Allow visitors to use a skewer stick or pen to impact the surface of the planet.
- j. If the science team decides to send a lander or rover, the craft can only explore within a defined range around its landing site.
- k. Provide notepads to take notes and plan strategy.
- l. Other objectives for the teams:
 - Find signs of life and win the Nobel Prize
 - Provide evidence that a planet has water on it (or not)
 - Give a report of what your planet is made of – how is the planet different from other worlds in this system?
 - Provide evidence that we might be able to live there (or not!).

Helpful Hints

You may want to use the PowerPoint, “Explorers’ Guide to the Solar System” to introduce this activity. The PowerPoint and suggested script can be found on the Resource Download Site: <http://nightsky.jpl.nasa.gov/download-search.cfm>

- Be sure to make your planets ahead of time. You might want to consider how durable your planet is and how many times it will survive “exploration.”
- There are quite a number of ways you might run this activity. A basic set of rules and a list of variations are provided. You are likely to come up with others.
- This is particularly effective in a large field or park where you can have a number of planets spread out in different directions.
- If you are working with families, this can be quite a successful family activity. Assign each family as a team.
- If working with Scouts, assign each patrol or other group as a team.
- When doing this with young people, it is recommended that the children be at least 12 years old. Young people require a little more direction than families and older teens or adults.
- Use the “Communication and Exploration” handout to discuss how we have explored. Potential discussion questions:
 - How far have we sent humans?
 - Are there any worlds in our Solar System we haven’t explored, except by telescope?

Background Information

1. Ways we remotely explore the Solar System:

Method	Definition / Purpose	Examples of Missions / Facilities
Telescope	Either Earth or space-based telescopes Deep Space Network collects data from spacecraft exploring the Solar System	Keck Hubble Space Telescope Deep Space Network
Fly-by	Send a spacecraft to pass by one or more worlds of the Solar System for a brief survey and /or to gain speed through a gravity assist	Pioneers Voyagers New Horizons (Kuiper Belt)
Orbiter	Orbiting spacecraft that do detailed surveys of the world from space	Mars Reconnaissance Orbiter Lunar Reconnaissance Orbiter Cassini (Saturn) MESSENGER (Mercury) Dawn (Ceres and Vesta in the Asteroid Belt)
Probe	Impactor to blast material off the surface for analysis Instrument that floats down through the atmosphere to analyze composition	Deep Impact (Comet) Huygens Probe (delivered by Cassini to Saturn's moon, Titan)
Lander / Rover	Spacecraft that land on and explore worlds from their surface	Mars Exploration Rovers
Sample Return	Collects material from a body and returns it to Earth for analysis	Genesis (Solar wind atoms) Stardust (Comet)

2. For information on the missions listed above:

<http://solarsystem.nasa.gov/missions>

Deep Space Network: <http://deepspace.jpl.nasa.gov/dsn/>

Voyager and the Deep Space Network:

http://science.nasa.gov/headlines/y2006/21sep_voyager.htm?list227097

3. For a history of the Robotic Exploration of space:

<http://solarsystem.nasa.gov/history/index.cfm>. Select "History Timeline."

4. Exploring Strange New Worlds is an adaptation of the classroom activity called Strange New Planet:

http://solarsystem.nasa.gov/educ/docs/Strange_New_Planet.pdf

Another game for exploring the topic of mission design and exploration can be found here: <http://marsbound.asu.edu/>

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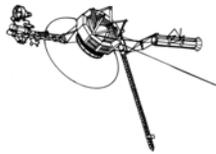
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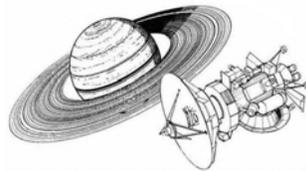
Communication and Exploration

How long does it take to communicate with spacecraft? How has NASA explored our own Solar System?

Communication Time from Earth one-way	Solar System Object	How has NASA explored the worlds of the Solar System?						
		Earth Telescope	Flyby	Orbiter	Probe	Lander / Rover	Sample Return	Human
8 min	Sun	X		X			X	
5 to 11 min	Mercury	X	X					
2 to 14 min	Venus	X	X	X	X	X		
1.3 seconds	Earth's Moon	X	X	X	X	X	X	X
3 to 22 min	Mars	X	X	X		X		
15 to 30 min	Asteroids	X	X	X		X		
35 to 50 min	Jupiter	X	X	X	X			
60 to 90 min	Saturn	X	X	X	X(on Titan)	X(on Titan)		
2.5 hours	Uranus	X	X					
4 hours	Neptune	X	X					
4 to 7 hours	Pluto	X						
Varies widely	Comets	X	X		X		X	



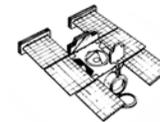
Flyby: Voyager



Orbiter and Probe: Cassini-Huygens



Mars Exploration Rover



Sample Return: Stardust



Human: Apollo

Discover the worlds of the Solar System:
Find out about NASA Solar System missions:

<http://solarsystem.nasa.gov/planets/>
<http://solarsystem.nasa.gov/missions/>

Exploring Strange New Worlds

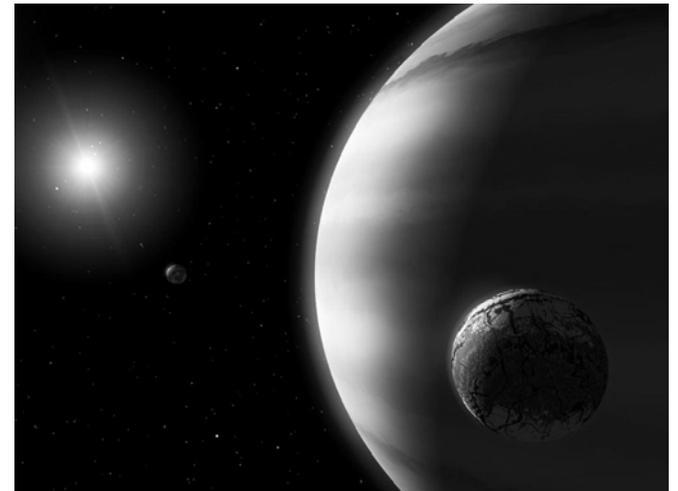
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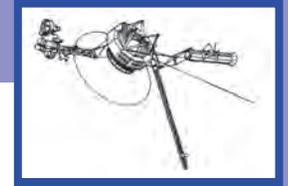
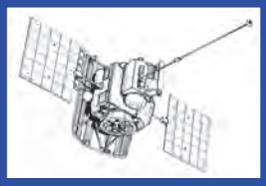
Discover the worlds of the Solar System:

<http://solarsystem.nasa.gov/planets/>

Find out about NASA Solar System missions: <http://solarsystem.nasa.gov/missions/>

www.nasa.gov





I explored Strange New Worlds



*This club is a member of the
NASA Night Sky Network
<http://nightsky.jpl.nasa.gov/>*

