Toolkit Name	Kit Description	Activity Details (Linked to this document)	Reference Material: Name (Linked to NSN site)	Description	Activity Key: Daytime Event	Activity Key: Nighttime Event	Activity Key: Outside Venue	Activity Key: Inside Venue	Target Audience: Child	Target Audience: Teen	Target Audience: Adult
Our Galaxy, Our Universe NSN Link	Amateur astronomers doing public outreach report that two of the most misunderstood concepts in astronomy are distance and scale. Related to those are the difference between the Solar System, the Galaxy, and the universe.The ToolKit consists of activities and resources that are designed to help your audiences:• Visualize the basic structure and organization of our Galaxy and the rest of the universe, and the place of our Solar System within it. Understand the vast distances to the stars, nebulae, and other galaxies viewed through the telescope.The variety of activities and materials are designed for use at the telescope, during star parties, and are appropriate for daytime and nighttime venues.	**Our Place In Our Galaxy** Link	Download ToolKit Manual **(PDF, 27.83 MB)**	Manual	X	X	X	X	X	X	X
			Activity Video: Our Place in Our Galaxy	Mentally construct a model of our place in the Milky Way Galaxy and the distribution of stars, with a quarter coin and some birdseed. This is a great introduction to the distances of objects your visitors will view in the telescopes and can be adapted to many venues.							
		A Universe of Galaxies Link	Activity Video: A Universe of Galaxies	Use this model of the Milky Way and other galaxies to indicate relative distances to other galaxies.							
		Telescopes as Time Machines Link	Activity Video: Telescopes as Time Machines	The "Passport Through Time" handout shows the difference between each of three different distance categories: within our Solar System, within the Milky Way, and within the rest of the universe.							
			Activity Video: What's a Light Year?	For many activities, you will need to establish with your audience what a light year is. Many people mistakenly use this term as a unit of time rather than a unit of distance.							
			Video:Solar System, Galaxy, Universe: What's the Difference?	Many people do not know the difference between the solar system, Galaxy, and Universe. It is important to establish this difference. Many people believe stars are sprinkled among the planets in the Solar System.							
			Playlist for all activity videos on Youtube	Video playlist							
Exploring The Solar System NSN Link	Exploring the Solar System ToolKit Manual: includes hands-on activities to show the structure of our Solar System, including models for sizes and distances, and to connect what is seen in the sky with where the planets are in relation to Earth. The many NASA missions that explore our Solar System serve as an inspiration to children and adults. This ToolKit provides activities that give an introduction to the many ways we can explore, learn, and discover: fly-bys, orbiters, landers, probes, sample returns. The second document is only the Exploring the Solar System Handout with the monthly star charts and how to find where the planets are. This can also be found within the full Manual (p. 104-117).	**Exploring Strange New Worlds** Link	Download ToolKit Manual: Exploring the Solar System **(PDF, 19.58 MB)**	Manual	X	X	X	X	X	X	X
		Solar System Models: Sizes & Distances Link	Download Handouts **(PDF, 6.9 MB)**	Exploring the Solar System handout							
		Exploring Our Solar System Link	Pocket Solar System Activity	How far apart is everything in our solar system? It can be hard to imagine, but this activity can help! Try out this simple Pocket Solar System activity that is sure to get an "Ah-ha!" moment from your visitors. Using a strip of paper (you can even grab some from a roll of toilet paper!), construct a quick scale model of the distances between the orbits of the planets, the Asteroid Belt, and Pluto as part of the Kuiper Belt.							
			Explorers' Guide to the Solar System (PowerPoint)	This presentation's focus is on NASA's exploration of the Solar System. Exploring other worlds in our Solar System stretches our minds and excites our imaginations like nothing else. It's the only way to answer some of our deepest questions.							
			Worlds of the Solar System - Make a Scale Model	Use a set of scaled balls and beads to show the relative sizes of the planets, the Moon, Ceres, and Pluto to each other and to the Sun. This permanent model can be used over and over again in many ways. Handout included.							
			Star Maps: Where are the Planets? Activity and Star Chart	Want to know what's up in our Solar System? Use a star map and mark the current locations of planets and the Moon along the ecliptic.							
Life In The Universe NSN Link	Aliens are a favorite topic for many visitors to public astronomy events. This toolkit is designed to take science fiction questions and direct them toward scientific facts and exciting new discoveries being made in the search for life outside Earth.	**Life In the Extreme** Link	Download Full ToolKit Manual **(PDF, 1.72 MB)**	Manual	X	X	X	X	X	X	X
		Earth Timeline Link	Life in the Extreme Activity	Find out about the extreme conditions that life can not only survive in, but thrive! This activity can lead to lively discussions about the latest NASA science on other worlds in our solar system, and if these watery worlds contain the conditions for life as we know it. Participants are each given one of 14 examples of extremophiles, organisms found in some of the toughest conditions on Earth. They sort themselves into groups according to the various preferences of their organisms. Finally, they discover that all known life on Earth requires liquid water to survive and grow.							
		Anyone Out There? Link	Anyone Out There? Activity and PPT	"Do aliens exist?" This might be the most popular question you get while doing outreach! You can help your questioning audiences explore the possibilities of life in the universe with this exploration of the Drake Equation. This presentation of the Drake Equation reviews each of the factors that contribute to the likelihood of intelligent life in our galaxy. The presentation can easily be made into a fun interactive outreach activity, with participants discussing 6 questions in groups. Starting with all of the stars in the Milky Way, the presenter methodically looks at many variables that together estimate the potential number of intelligent civilizations in the galaxy. Bonus! See how we can analyze exoplanet atmospheres using spectroscopy with the slides at the end of this presentation. We also have a related video, a webinar from the Galileo Teacher Training Program (GTTP) on more best practices on using this presentation. Find it on YouTube at https://www.youtube.com/watch?v=poKVH8KXgS8							
		How Do We Find Planets Around Distant Stars? Link	Earth Timeline and Banner	- When in Earth's history did life develop? - How long did it take for complex life to develop? - What can these answers tell us about the type of life we might find on other planets? Guess when various kinds of organisms first developed in the history of Earth. Then reveal actual timeline of life. The early development of simple life and the relatively late development of complex life changes many people's ideas of what alien life may look like. The back of this banner has an overview of the watery worlds of our Solar System. You can also download it separately below.							
		Keys to the Rainbow - Demonstrate Spectroscopy Link	Keys to the Rainbow Activity	Discover how we learn about stars and the atmospheres of exoplanets by examining the light in greater detail. Match up the spectra of stars and planets with their atmospheric ingredients. In particular, what ingredients are we looking for in planets that may harbor life?							
		Where Are the Distant Worlds? Star Maps Link	Where Are the Distant Worlds? Star Maps	Where are the distant worlds in the night sky? Use these monthly star maps to find constellations and to identify stars with extrasolar planets. (Northern Hemisphere only, naked eye)							

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Shadows & Silhouettes NSN Link	Hands-on activities on Moon phases, lunar and solar eclipses, transits, and Venus phases. Features NASA's Kepler Mission and provides activities to explore searching for planets orbiting in the habitable zone around other stars.	**Shadows in Space: Phases and Eclipses** Link	Download ToolKit Manual **(PDF, 6.99 MB)**	Manual							
		Be the Local Transit Authority! Transits & the Kepler Mission Link	Video Tutorial: Standing in the Shadow of the Earth	Shadows in Space: Standing in the Shadow of the Earth							
		Trip Around the Triangle Link	Video Tutorial: Why Does the Moon Have Phases?	Got a toothpick and a styrofoam or clay ball? You can easily find out why the moon has phases in less than two minutes.							
			Video Tutorial: Why Do Eclipses Happen?	Shadows in Space: Why Do Eclipses Happen?							
			Video Tutorial: Spotting Craters	Spotting Craters Activity							
			Video Tutorial: What is a Transit?	Transits: What Is A Transit? Activity							
			Video Tutorial: How Will Kepler Detect Transits in Space?	Transits: How Will Kepler Detect Transits In Space?							
Space Rocks NSN Link	The Space Rocks ToolK it concentrates on asteroids and phenomena stemming from the dynamic nature of the Asteroid Belt, such as impacts and meteorites. Comets also play a part in the history of Earth impacts and are referenced in the handout and card game. Activities about comets, asteroids, and craters. Includes information about meteorites and meteor showers.	**Sorting the Solar System** Link	Download Space Rocks Outreach ToolKit Manual **(PDF, 11.48 MB)**	Manual	X	X	X	X	X	X	X
			Space Rocks: Impacts of Our Smallest Neighbors - Presentation (PowerPoint) Link	Use this PowerPoint in conjunction with the activities included on the Space Rocks ToolKit or on its own. Talk about our smallest neighbors, the properties of comets and asteroids, how we are searching for them, the potential hazards of Near-Earth Objects (NEOs) and what we might do to avoid future impacts.							
			Sorting the Solar System Cards	Start discussions of the characteristics of asteroids, comets, planets, and moons with these images of Solar System objects. Practice scientific thinking by sorting objects into categories according to their common qualities.							
		Meteorite or MeteorWrong Link	Meteorite or MeteorWrong?	Learn all about meteorites with this hands-on activity: where they come from, how they got here, and what they are made of. Compare the characteristics of meteorites and Earth rocks in this engaging activity.							
			Heads Up! It's a Meteor Shower Handout	November and December bring many beautiful meteor showers to light up our cold skies. This handout gives out some vital information about meteors and when to spot them, and is appropriate for all audiences.							
		Craters on the Earth and Moon Link	Craters on the Earth and Moon Scaling Activity	Make craters on models of the Moon and Earth in this fun outreach activity. Investigate the properties of Earth that hide past cratering events, such as movement of the crust, erosion, water, and a protective atmosphere.							
		Scaling the Asteroid Belt Link	Scaling the Asteroid Belt Activity	Explore the asteroid belt in this astronomy activity and learn some surprising truths about just how difficult it would actually be to navigate. It may not be as tightly packed as Hollywood would have you believe!							
		Asteroid Hunters Link	Asteroid Hunters Activity	Find asteroids in a star field and discover why astronomers are locating even more asteroids using powerful infrared telescopes in this outreach activity. Answer these questions and more and encourage the next generation of asteroid hunters! How are asteroids discovered? How fast do asteroids appear to move in the sky? How are infrared telescopes used to locate more asteroids? How does the WISE (now NEOWISE) Mission find asteroids using its infrared systems?							
Glass & Mirrors: An Inside Look At Telescopes NSN Link	Explore how glass and mirrors make telescopes work. Optical activities galore. Use these demonstrations to answer questions that the public (or new club members!) may have about how telescopes work. Show how both a reflector and a refractor work using a simple setup using just a couple of yardsticks, lenses, and mirrors.	**Glass & Mirrors: An Inside Look at Telescopes** Link	Download Glass & Mirrors ToolKit Manual **(PDF, 2.71 MB)**	Manual	X	X	X	X	X	X	X
			Download Handout: Compare your observations to Galileo''s **(PDF, 317 KB)**	Handout							
			See a trailer for the PBS documentary here	Official trailer of the PBS documentary "400 Years of the Telescope". Available for purchase from ShopPBS.org or Apple iTune. Stream on Netflix.com.							
Supernova! NSN Link	The SUPERNOVA! ToolKit tells the story of the lives of stars, cosmic radiation, and how Earth is protected from that radiation.	**Supernovae in the Lives of Stars** Link	Download SUPERNOVA! ToolKit Manual **(PDF, 14.79 MB)**	Manual	X	X	X	X	X	X	X
			Activity Video: Lives of Stars	Allow visitors to discover the life cycle of stars and when supernovae happen with this activity and handout. Many people think the different stages in the life of a star are actually different types of stars, rather than just stages in the life of a single star.							
		Protecting Earth from Cosmic Radiation Link	Activity Video: Let's Make a Supernova!	Participants imagine themselves inside a large star at the end of its life, just as it is about to go supernova. Learn what happens in the core of a star when it runs out of fuel. This is a very active, engaging activity that your audience will remember.							
		A Universe Without Supernovae Link	Activity Video: Supernova Star Maps	Which stars in the night sky will go supernova? Use star maps to find stars in the night sky that will eventually go supernova.							
			Activity Video: Nuclear Fusion in Stars	This simple and engaging activity explains nuclear fusion and how radiation is generated by stars, using marshmallows as a model. Don't eat the hydrogen!							
			Activity Video: Protecting Earth from Cosmic Radiation	This demonstrations shows how Earth's atmosphere protects us from high-energy radiation and particles.							
			Activity Video: Gamma-Ray Bursts and Supernovae	A demonstration illustrating how Gamma Ray Bursts are detected on Earth.							
			Supernova Activity Videos on YouTube	The SUPERNOVA! ToolKit tells the story of the lives of stars, cosmic radiation, and how Earth is protected from that radiation.The following videos help illustrate how to use the materials outlined in the Night Sky Network .resources found here: https://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=275							

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Telescopes: Eyes On The Universe NSN Link	Explore the ins and outs of telescope observing with your star party visitors, with answers (and explanations!) for common questions like "How much does the telescope magnify?" and "Can you see the flag on the moon?"	**Can You See the Flag on the Moon?** Link	**Download ToolKit Manual (PDF, 13.04 MB)**	Manual	X	X	X	X	X	X	X
			Can You See The Flag On the Moon? Magnification vs. Resolution (Telescope Activity)	Has anyone ever asked you (or have you ever wondered) if you could see the flag on the Moon with a telescope? Want to know what the 25X magnification on that telescope means? Find out why size matters with telescopes when it comes to light collecting							
			How Far Can You See? - Dr. Phil Plait (Article)	Just how far can we see into the universe?							
			How Telescopes Changed our Understanding of the Universe (PowerPoint Presentation)	This PowerPoint and suggested script is about major discoveries made with telescopes and their technologies that changed the way we understand our universe.							
			It's All Done with Mirrors (Astronomy Activity)	These simple demonstrations are a great way to illustrate the path of light as it reflects off of mirrors and how this is used in telescopes, especially if you have ever been asked why the Moon appears "flipped" or "upside down" in your eyepiece!							
			Making the Photon Connection by James Mullaney (Article)	This is an article about the importance of directly experiencing the night sky with your own eyes. From Sky & Telescope, June 1994							
		Ready to Observe? Link	**Ready to Observe? How to Enhance Your Visitors' Experience at the Telescope. (Link)**	Help the visitor at your telescope understand why they see what they see.							
			Telescopes: Eyes on the Universe Activity Manual and Training Video (Link)	The full manual for the ToolKit: Telescopes: Eyes on the Universe; provides hands-on activities to answer common questions at the telescope.							
			The Universe in a Different Light (Link)	There is more to the Universe than meets the eye. By looking in space using detectors for energy invisible to our eyes, we get a more complete story, and these downloadable cards and activity help to explain this.							
		What Power Is Your Telescope? Link	**What Power Is Your Telescope? (Astronomy Activity)**	You can show the basics of how telescopes collect light with these activities, by using just a few props.							
		Why doesn't it look like the photos? Link	**Why Doesn't It Look Like the Photos? (Link)**	This set of activities provides tools to help your visitors understand the two main reasons views through the telescope do not look like photographs: exposure time and different wavelengths.							
Our Magnetic Sun NSN Link	This ToolKit provides activities and demonstrations that explore the Sun and its powerful magnetic fields, how these fields generate the features we observe, and how the Sun's magnetic activity affects our way of life and technologies here on Earth.	**Protection from Ultraviolet** Link	**Download Our Magnetic Sun ToolKit Manual (PDF, 1.8 MB)**	Manual	X	X	X	X	X	X	X
			Download Background Informationextracted from the Manual (PDF, 602 KB)	Sun background information							
			Download Masters for Set of 15 Energy Cards (PDF, 4.67 MB)	Energy cards							
			Download Masters for Explore the Sun Cards (PDF, 2.88 MB)	Sun cards							
		The Sun In A Different Light Link	**Download Artwork for Sun in a Different Light Banner (PDF, 2.29 MB)**	Our Magnetic Sun banner							
		Explore the Sun Cards Link	**Download Masters for FULL Set of 30 Energy Cards (PDF, 3.54 MB)**	Full set of energy cards							
			Space Weather PowerPoint	Use this PowerPoint presentation to show how space weather directly effects our way of life on Earth. You can also download the movies below to include in your presentation. Topics: 1) Illustrates some of the effects that solar storms have on our technologies. 2) Explores how magnetic fields cause these solar storms. 3) Explain how we see the effects of magnetism on the Sun. 4) Show how viewing the Sun in different wavelengths shows different phenomena.							
		Magnetic Connection Link	**The Magnetic Connection Activity**	Introduce the connection between the Sun's magnetic activity and Earth's magnetic field with this activity for small groups. Use a group of compasses and a small magnetic boomerang to show how solar storms are generated from the Sun's magnetic activity and illustrate how solar storms interact with Earth's magnetic field to create aurora and potentially disrupt our modern electronic infrastructure.							
			Astronomy Activity: Magnetic Connection (Video)	Tips on how introduce the connection between the Sun's magnetic activity and Earth's magnetic field with this activity for small groups. This activity also shows how solar storms are generated from the Sun's magnetic activity and how solar storms interact with Earth's magnetic field to affect Earth's infrastructure.							
		Where Does the Energy Come From? Link	**Where Does the Energy Come From? Activity**	Discover that the Sun is the ultimate source of energy for almost everything that we do in our daily lives! Participants each use cards to build up an "energy chain" leading back to our Sun in a truly "hands-on" activity, perfect for almost any occasion.							
Black Hole Survival NSN Link	Explore black holes and gravity with these activities.	**Black Hole Explorer Board Game** Link	**Download Black Hole Survival ToolKit Manual (PDF, 5.84 MB)**	Manual	x	x	x	x	x	x	x
		Gravity and the Fabric of Space Link	**Activity: Gravity and Falling**	Using a bucket with stretchy fabric stretched over it, allow visitors to experiment with marbles and weights to discover some basics about gravity.							
		Where are the Black Holes? Link	**Activity: Black Hole Explorer _ Free Printable Game**	The download below contains the game board and cards for Black Hole Explorer Board Game, along with instructions on how to print, assemble, and play this free educational game.							
			Activity: Why Doesn't the Moon Fall to Earth?	Using a bucket with stretchy fabric stretched over it, allow visitors to experiment with marbles and weights to discover some basics about gravity and orbits.							
			Activity: Black Holes: No Escape	How space curves around black holes and why it is impossible to escape.							
			Activity: Gravity Assist	Trajectories to distant targets are planned to take advantage of the gravitational pull of other bodies along the way.							
			Activity: Star Maps: Where are the Black Holes?	Star maps for the locations of known Black Holes.							
Planetquest NSN Link	The PlanetQuest ToolKit's complete manual provides hands-on activities and observing using telescopes to learn about discovering planets orbiting other stars.	**How do we find planets around other stars?** Link	**Download ToolKit Manual (PDF, 5.6 MB)**	Manual	X	X	X	X	X	X	X
			Download National Science Standards mapped to PlanetQuest (PDF, 31 KB)	National Science Standards Mapped to PlanetQuest Activities							
			Download PlanetQuest Activity Bag Inserts (PDF, 292 KB)	PlanetQuest Activity Bag Inserts							
			How do we find planets around other stars? (PDF)	The Wobble Method actually uses Radial Velocity (or Doppler Shift). This involves measuring the redshift or blueshift of a star's spectral lines as it moves away from (redshift) and toward (blueshift) us along our line-of-sight ("radial" movement).							
		Telescope treasure hunt: how do stars and planets form? Link	**Telescope Treasure Hunt video**								
		Where are the distant worlds? Link	**Where are the Distant Worlds? video**								
			Why Do we Put Telescopes in Space? video								
Planetary Investigations Draft Kit											

Toolkit Name	Activities	Big Question:	Big Activity	Participants:	Activity Duration:	Topics Covered:	Venues:										
							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom K-4	Classroom 5-8	Classroom 9-12	Club meeting	General public presentation: Seated	General public presentation: Interactive
Our Galaxy, Our Universe	***Our Place In Our Galaxy*** *NSN Link*	Where are we in the Milky Way Galaxy? How far to the stars?	Presentation: Mentally construct a model of our place in the Milky Way Galaxy and the distribution of stars ... with a quarter and some birdseed.	Adults, teens, families with children 8 years and up	Presentation (with or without the PowerPoint): 10 – 20 minutes	Scale and structure of our galaxy including how many stars are in it: a scale model of the width, depth, and distribution of stars in the Milky Way.											
		What is "The Milky Way" we see in the sky?	At the Telescope: Use the scale model to allow visitors to better understand distances to objects they view in your telescope.	If a school/youth group, 5th grade and higher From one person to an auditorium of participants	At the telescope: 1 – 5 minutes	What the Milky Way is and what it looks like in the night sky All the stars we can see naked eye in the night sky are in the Milky Way Galaxy Establish a standard to understand distances to objects we see in the telescope within our Galaxy	X	X			X				X		
	A Universe of Galaxies *NSN Link*	How is the universe structured?	Use the Milky Way Galaxy CD and the set of other galaxies to indicate relative distances to other galaxies.	General public	Activity/Presentation: 15 minutes	Our location in the Milky Way											
		How far away are the other galaxies? How far to the limit of the observable universe? Where are we located with respect to other galaxies we see in the telescope?		Schools 5 th grade and up	At the telescope: 1 or 2 minutes	Relative distances to other galaxies and limit of the observable universe. **In order to do the activity of building the universe, you will need a large area, e.g. parking lot, playground, park, football field**		X	X				X	X			
	Telescopes as Time Machines *NSN Link*	How long has the light we see now from different objects in the universe been traveling to reach us tonight?	A journey through time to view in the telescopes at least one object from each of three different distance categories: within our Solar System, within the Milky Way, within the rest of the universe. The guide is a "Passport through Time." Visitors can view multiple objects within each category and keep a record of what objects they saw.	From the club: A minimum of one person with a telescope up to all telescope providers at a public star party. Visitors: Appropriate for families, the general public, and school groups in grades 4 and up.	The "Passport Through Time" can be used for the duration of the star party, typically one or two hours.	How long did it take the light we are seeing tonight from distant objects to reach us? How is looking farther away looking back in time?		X	X	X							X
Exploring The Solar System	***Exploring Strange New Worlds*** *NSN Link*	What are the ways NASA explores the Solar System?	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.	From the club: One to three members. Visitors: This activity is appropriate for families, the general public, and school groups in grade 5 and up. Any number of visitors may participate. It is recommended that teams consist of 3 – 7 people.	30 – 45 minutes.	What methods do scientists use to explore our Solar System? Exploring by: • Telescope • Fly-by • Orbiter • Probe • Lander / Rover • Sample Return • Human Exploration What are examples of the different kinds of missions? What decisions do scientists need to make when planning missions?			X	X	X	X	X	X			X
	Solar System Models: Sizes & Distances *Links under "Big Activity"*	How big are the planets and what is the distance between them?	"Pocket Solar System": Using a strip of paper, construct a quick scale model of the distances between the orbits of the planets, the Asteroid Belt, and Pluto as part of the Kuiper Belt. NSN Link	**From the club:** A minimum of one person.	A few minutes, up to a half hour, depending on the number of topics covered.	Scaled distances of orbits in the Solar System		X	X	X	X	X	X	X	X	X	X
		What are the main realms of the Solar System?	"Worlds of the Solar System": Use a set of scaled balls and beads to show the relative sizes of the planets, the Moon, Ceres, and Pluto to each other and to the Sun. NSN Link	**Visitors:** Most activities are appropriate for families, the general public, and school groups in grade 2 and up. Any number of visitors may participate.		Scaled sizes of the worlds of the Solar System		X	X	X	X	X	X	X	X	X	X
			"Solar System to Scale" Handout NSN Link			The realms of the Solar System: • The Sun at the center • The four rocky inner planets • The four gas giant planets • The Asteroid Belt that divides the rocky planets from the gas giants • The Kuiper Belt of small icy bodies that surrounds it all.		X	X	X	X		X	X	X	X	
	Exploring Our Solar System *NSN Link*	What planets can we see in the night sky?	Using a banner with accurately scaled orbits of all the naked eye planets, explain a variety of concepts regarding the planets we see (and don't see) in the sky, what missions are exploring the Solar System, and how long it takes to communicate with spacecraft.	**From the club:** A minimum of one person.	A few minutes, up to a half hour, depending on the number of topics covered.	Where are the planets right now in relation to Earth?		X	X	X	X	X	X	X	X	X	X
		Why can't we see all the planets? Where has NASA explored in the Solar System? Where are the spacecraft now?	Use star maps to connect the positions of the planets on the banner to where the planets can be observed in the sky.	**Visitors:** Most activities are appropriate for families, the general public, and school groups in grade 5 and up. Up to 10 visitors at a time may comfortably participate in the banner activities. Any number of visitors can participate using the star maps.		Which planets can be seen in the morning and evening sky? Where do I look in the sky to find the planets? Where will the planets be in a month or a year? Which planets will be visible then? Where are NASA's Solar System missions right now? How long does it take to send messages between Earth and the spacecraft?		X		X				X			

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							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom K-4	Classroom 5-8	Classroom 9-12	Club meeting	General public presentation Stated	General public presentation Interactive
Life In The Universe	***Life In the Extreme*** *NSN Link*	What characteristics are common to all life on Earth? What are we looking for when we search for evidence of life on other worlds?	Participants are each given one of 14 examples of extremophiles – organisms found in some of the toughest conditions on Earth. They sort themselves into groups according to the various preferences of their organisms. Finally, they discover that all known life on Earth requires liquid water to survive and grow.	From the club: A minimum of one person Visitors: This activity works best with a group of at least 10 participants so that each person gets a card. With more participants, they can form "colonies." With fewer participants, this activity can be a simple sorting game spread out on a table. Ages 7 to adult will enjoy this activity at different levels.	5 to 15 minutes	All life that we have found on Earth needs liquid water to survive. Life is found in a variety of extreme environments on Earth. Science is using these facts to explore the possibility of life beyond Earth.			X	X	X	X	X	X	X		X
	Earth Timeline *NSN Link*	When in Earth's history did life develop? How long did it take for complex life to develop? What can these answers tell us about the type of life we might find on other planets?	Participants guess when various kinds of organisms first developed in the history of Earth. Then the actual timeline of life is revealed, usually to great surprise. The early development of simple life and the relatively late development of complex life changes many people's ideas of what alien life may look like.	From the club: A minimum of one person. Visitors: The Earth Timeline is appropriate for families, the general public, and school groups ages 10 and up. One to 30 visitors at a time may comfortably participate.	10 to 15 minutes	Life on Earth developed soon after oceans formed. Complex life developed recently (in the last ½ billion years) in the Earth's history. Scientists expect most life in the Universe to be simple. If any life is found in our Solar System beyond Earth, it is likely to be simple.			X	X	X		X	X	X		X
	Anyone Out There? *NSN Link*	What are the chances that there are other intelligent civilizations in our Milky Way Galaxy? What are the factors to consider when we think about finding other intelligent civilizations?	Participants form groups around 6 questions about the likelihood of life in the Universe. Starting with all of the stars in the Milky Way, the presenter uses the participants' answers to come up with an estimate of the potential number of intelligent civilizations in the galaxy.	From the club: A minimum of one person. With large groups, it is good to have at least two presenters. Visitors: 25 or more visitors at a time may actively participate. It is best to have at least a dozen participants so that discussions emerge. "Anyone Out There?" is best used with ages 12 through adult, as the discussions can be elaborate.	20 minutes to an hour, depending on the discussions and extensions.	How scientists are searching for intelligent life on our galaxy Planets being discovered around other stars Why water is important for life When life developed on Earth How life evolved on Earth The fraction of Earth's life that humans have been here Humans' ability to communicate across interstellar distances			X	X			X	X	X	X	X
	How Do We Find Planets Around Distant Stars? *NSN Link*	How do we find planets around other stars?	Spin "stars" to simulate star wobble (astrometry and radial velocity). Briefly explain transit method and direct imaging of planets	From the club: A minimum of one person. Visitors:One to six participants (per set of materials)	5 to 10 minutes	Two ways we are detecting planets around a star: the transit method and the wobble method		X	X	X	X	X	X	X	X	X	X
	Keys to the Rainbow - Demonstrate Spectroscopy *NSN Link*	How do we get information out of light? How are we looking for life around distant stars? How do we detect the composition of the atmospheres of planets around different stars?	Match up the spectra of stars and planets with their atmospheric Ingredients.	From the club: A minimum of one person. Visitors: Up to 6 visitors at a time may comfortably participate.	5 to 15 minutes	How we spread light out to glean more information about its source What's in stellar atmospheres What kinds of ingredients we are looking for in the atmospheres of potentially habitable planets			X	X		X	X	X	X		
	Where Are the Distant Worlds? Star Maps *NSN Link*	Where are the distant worlds in the night sky?	Use a star map to find constellations and to identify stars with extrasolar planets. (Northern Hemisphere only, naked eye)	Adults, teens, families with children 8 years and up If a school/youth group, 10 years and older 1 to 4 participants per map	Timing depends only on how long you want to observe.	How to find Constellations Where we have found planets around other stars		X									
Shadows & Silhouettes	***Shadows in Space: Phases and Eclipses*** *Links under "Topics Covered"*	Where are the shadows in space and how do shadows make phases and eclipses?	Using the Sun, Moon, and simple props, address questions regarding Moon phases, eclipses, and shadows in space.	From the club: A minimum of one person (it is helpful to have one presenter for every 10 visitors for the Moon phases and eclipses activities). Visitors: Most activities are appropriate for families, the general public, and school groups in grades 2 and up.	A few minutes, up to a half hour, depending on the number of topics covered.	Standing in the shadow of Earth: Night doesn't fall – night rises		X		X	X		X	X	X		X
						Why does the Moon have phases?				X	X		X	X	X		X
						Why do eclipses happen? (Yardstick)				X	X		X	X	X		X
						Why don't eclipses happen every month?		X	X	X	X		X	X	X		X
						If I lived on the Moon would the Earth have phases?		X	X	X	X	X	X	X	X	X	X
						Does the Moon rotate?		X	X	X	X	X	X	X	X	X	X
						Spotting Craters: Why is full Moon a poor time to observe the Moon?		X	X	X	X	X	X	X	X	X	X
						Observing the Moon: What can you see on the Moon?		X	X	X	X	X	X	X	X	X	X
						Venus phases – Why does Venus look like the Moon?		X	X	X	X	X	X	X	X	X	X
	Be the Local Transit Authority! Transits & the Kepler Mission *Links under "Topics Covered"*	The Kepler Mission's objective is to: Detect transits ... • What are transits? Can I see one? of Earth-size plants ... • Why are Earth-size planets important? • How can we detect transits of planets orbiting distant stars? How will Kepler detect transits? in the Habitable Zone ... • Why is there abundant life on Earth and not on Venus or Mars? • What's the "Habitable Zone"? of Sun-like stars. • Are all the stars we see like our Sun? • What's a Sun-like star?	Learn about the Kepler Mission: NASA's first mission dedicated to finding Earth-size planets Watch Mercury transit the Sun! Try to detect an Earth-size planet transiting a distant star. Find the habitable zone around the Sun and around other stars. Discover what kinds of stars we see in the constellations.	Appropriate for families, the general public, and school groups in grades 3 and up. See "Helpful Hints" for more details.	5 minutes to 1 hour, depending on the number of topics covered.	What is the Kepler Mission about?			X		X		X	X	X	X	
						Transits Part 1: What is a transit? Mercury & Venus transits	X	X	X	X	X	X	X	X	X		X
						Transits Part 2: Other stars with transiting planets Transits Part 3: How will Kepler detect transiting planets?	X	X	X	X	X		X	X	X		X
						What's the "Habitable Zone"? Why is there abundant life on Earth and		X	X	X	X	X	X	X	X		X
						Are all the stars we see like our Sun? (What's a Sun-like star?)	X	X	X	X	X		X	X	X	X	X
	Trip Around the Triangle *NSN Link*	Where in the sky did Kepler look? What else can be seen in the Summer Triangle?	Trip Around the Triangle: Visitors to a star party use a printed handout to take a trip through the telescopes to view the area of the sky where the Kepler Mission monitored stars, and to view the variety of naked-eye and telescopic treats that occupy this very popular area of the night sky: the Summer Triangle. You hand out a printed guide to your visitors for their "Trip Around the Triangle" where they can keep a record of what objects they saw.	From the club: A minimum of one person with a telescope up to all telescope providers at a public star party. Visitors: Appropriate for families, the general public, and school groups in grades 2 and up.	The "Trip Around the Triangle" can be used for the duration of the star party, typically one or two hours.	What can be seen with and without a telescope in and around the Summer Triangle asterism The location of the Kepler Mission's target field of view and its primary mission	X										

Toolkit Name	Activities	Big Question:	Big Activity	Participants:	Activity Duration:	Topics Covered:	Venues:										
							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom K-4	Classroom 5-8	Classroom 9-12	Club meeting	General public presentation Stated	General public presentation Interactive
Space Rocks	***Sorting the Solar System*** *NSN Link*	What types of objects are in our Solar System?	Using images of Solar System objects, start discussions of the characteristics of asteroids, comets, planets, and moons.	From the club: A minimum of one person. With larger groups, up to four presenters can participate.	Ten minutes, up to a half hour, depending on the depth of questions and conversation.	Review of the diversity of objects in our Solar System											
		Why do the definitions of the objects change?	Practice scientific thinking by sorting objects into categories according to their common qualities.	Visitors: This activity is appropriate for families, the general public, and school groups ages 10 and up. With small groups, one set of cards can be used. Four sets are included for use in classrooms or larger groups. *Also, a large set of objects is included in this manual. You may print them yourself, but it is recommended that you do this at a print shop. Printing them requires a lot of ink.*		How scientists use common characteristics to classify the world around us			X	X	X		X	X	X	X	X
	Scaling the Asteroid Belt *NSN Link*	Explore the Asteroid Belt and learn some surprising truths about just how difficult it would be to navigate.	Compare a scale model of the Earth and Moon with a model of the Asteroid Belt. See how empty the Asteroid Belt actually is.	From the club: One presenter	The whole demonstration takes about 15 – 20 minutes. Pieces can be used in shorter explanations.	Amount of material in the Asteroid Belt											
		Is it hard to navigate a ship through all of the debris in the Asteroid Belt?		Visitors: Appropriate for families, the general public, and school groups ages 10 and up. 5 to 15 visitors at a time may comfortably participate.		Average distances between asteroids in the Asteroid Belt			X	X	X	X	X	X	X	X	X
		How dense is the Asteroid Belt?				Names of the first asteroids discovered											
		How did the Asteroid Belt form?				Size and distance scale of the Earth and Moon Size of impactor that caused the Chicxulub crater and the downfall of the Dinosaurs											
	Craters on the Earth and Moon *NSN Link*	Why do the Moon and the Earth look so Different?	Make craters on models of the Moon and Earth. Investigate the properties of Earth that hide past cratering events – movement of the crust, erosion, water, and a protective atmosphere.	From the club: A minimum of one person. With large groups, it is good to have at least two presenters.	10 to 20 minutes	How craters are formed											
		What processes on Earth erase the evidence of past impacts?		Visitors: Cratering is appropriate for families, the general public, and school groups ages 8 and up. Up to 10 visitors at a time may comfortably participate.		How atmosphere protects Earth from small impacts		X	X	X	X		X	X	X		X
		How old are the craters on the Moon?				Why natural processes erase the evidence of impact craters on Earth											
						When most of the Moon craters were created											
	Meteorite or MeteorWrong *NSN Link*	What are the physical characteristics of Meteorites?	Use various tests to pick meteorites from among a group of Earth rocks.	From the club: One presenter	About 15 minutes. Additional time can be used for discussion and extensions.	Where meteorites originate and how they end up on Earth											
		How can they be distinguished among a group of Earth rocks?		Visitors: Appropriate for families, the general public, and school groups in grade 5 and up. Up to 5 visitors at a time may comfortably participate.		Types of meteorites and what they are made of Characteristics of meteorites			X	X	X		X	X	X		X
	Asteroid Hunters *NSN Link*	How are asteroids discovered?	Find asteroids in a starfield and discover why astronomers are locating even more asteroids using infrared detectors.	From the club: One or two presenters can lead this activity.	10 – 15 minutes	How scientists search for asteroids i n starfields											
		How fast do asteroids appear to move in the sky?		Visitors: Appropriate for families, the general public, and school groups ages 10 and up. Up to 3 visitors at a time may comfortably share a set of starfields. For larger groups, there are 4 copies of each starfield included.		How an infrared camera sees temperature			X	X	X	X	X	X	X	X	X
Glass & Mirrors: An Inside Look At Telescopes	***Glass & Mirrors: An Inside Look at Telescopes*** *Links under "Topics Covered"*	How do telescopes actually work?	Using a simple setup with lenses and mirrors, demonstrate how a telescope collectslight, focuses it, then magnifies the image.	From the club: A minimum of one person.	About 15 minutes.	Glass & Mirrors: Introduction (Page 10)											
		Why are bigger telescopes better?		Visitors: Up to 10 people at a time is appropriate.		Glass & Mirrors: Light Gathering Power (Page 11)											
		What's the difference between telescopes made with lenses (refractors) and telescopes made with a mirror (reflectors)?				Glass & Mirrors: Magnifying the Image (Page 15)	X	X	X	X	X		X	X	X		X
		How are the telescopes of Galileo and Newton similar to telescope designs today?				Glass & Mirrors: Mirrors for Gathering Light (Page 17)											
						Glass & Mirrors: Handout "400 Years of the Telescope" (Page 20)											
Supernova!	***Supernovae in the Lives of Stars*** *NSN Link*	What is a supernova?	The Lives of Stars: Overview of the lifecycle of stars and which ones will go Supernova.	From the club: A minimum of one person.	The Lives of Stars: 5 – 10 minutes	The lifecycle of stars like our Sun compared to massive stars		X	X	X	X		X	X	X	X	X
		Where does it fit in the lives of stars?	Let's Make A Supernova! Using balls, an activity that illustrates what happens when a star explodes.	Visitors: Activities are appropriate for families with children over the age of 9, the general public, and school groups in grades 5 and up. Any number of visitors may participate.	Let's Make A Supernova: 2 – 5 minutes	Stages in the lives of stars		X	X	X	X		X	X	X		X
		Will the Sun go supernova?	Supernova Star Maps: Find stars in the night sky likely to go supernova!		Star Maps: Which Stars will go Supernova: A few minutes, up to 20 minutes, depending on the length of the discussion about the questions on the Supernova Information Sheet.	The fate of our Sun Why supernovae happen Observation of stars that will one day go supernova	X	X	X	X							X
	Protecting Earth from Cosmic Radiation *NSN Link*	What is cosmic radiation and where does it come from?	Nuclear Fusion, Supernovae, and Cosmic Radiation: A simple activity with marshmallows that explains nuclear fusion and how radiation is generated by stars and from supernova explosions.	From the club: A minimum of one person.	Nuclear Fusion, Supernovae, and Cosmic Radiation: 5 – 8 minutes.	How stars make the elements in the universe	X	X	X	X	X		X	X	X	X	X
		How are the elements in the universe generated?	Protecting Earth from Cosmic Radiation: An activity where visitors use models to try make gamma-rays, x-rays, atomic particles, and visible light reach Earth's surface.	Visitors: Activities are appropriate for families, the general public, and school groups in grades 5 and up. Any number of visitors may participate.	Protecting Earth from Cosmic Radiation: 5 – 10 minutes	Sources of high-energy cosmic radiation	X	X	X	X	X		X	X	X		X
		How are supernovae involved?	Air as a Radiation Shield: A quick demonstration of how our atmosphere protects Earth from x-rays and gamma-rays.		Air as a Radiation Shield: 3 – 5 minutes	Why supernovae are dangerous if you are too close to them	X	X	X	X	X		X	X	X		X
		How dangerous is this cosmic radiation and how is Earth protected?	Gamma-Ray Bursts and Supernovae: Demonstrating the power of radiation concentrated into beams.		Gamma-Ray Bursts and Supernovae: 3 – 5 minutes.	How Earth's atmosphere and magnetic field protect life from high-energy cosmic radiation.	X	X	X	X	X		X	X	X		X
		How does NASA study this radiation?				Some types of supernovae may generate gamma-ray bursts (GRBs).											
	A Universe Without Supernovae *NSN Link*	Supernovae seem dangerous, but what would the universe be like if supernovae never happen?	Active game that illustrates the value of supernovae in the universe.	From the club: A minimum of one person.	10 – 15 minutes.	The supernova explosion releases a lot of the elements that were created in the star during its lifetime and also generates new elements during the explosion, all in the matter of a few seconds.											
				Visitors: This activity is appropriate for families with older children, the general public, and school		If these stars didn't explode, all those elements would remain locked up inside the star.	X	X	X	X	X	X	X	X	X	X	X

Toolkit Name	Activities	Big Question:	Big Activity	Participants:	Activity Duration:	Topics Covered:	Venues:										
							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom			Club meeting	General public presentation	
												K-4	5-8	9-12		Seated	Interactive
	NSN Emix			groups in grades 5 and up. Plan on a minimum of 10 visitors, but you can easily involve up to about 40 people.		Almost all the elements except hydrogen were originally generated inside stars and without supernovae to disperse those elements, almost everything we see around us, including us, would not exist.											

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							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom			Club meeting	General public presentation		
												K-4	5-8	9-12		Stated	Interactive	
Telescopes: Eyes On The Universe	***Ready to Observe?*** *NSN Link*	How can we prepare our visitors to understand and enhance their experience at the telescope?	Using a variety of simple props, help the visitor at the scope understand why they see what they see.	Adults, teens, families with children 5 years and up	Setup: 1 minute	This set of activities helps answer common questions we get at the telescope and provides tools to help your visitors understand what to expect and how to enhance their experience:												
				If a school/youth group, 2nd grade and higher	Presentations:	Why don't I see any color?		X	X		X	X	X	X	X			
				From one person to fifteen participants	Why don't I see any color? 30 seconds	How to explain "averted vision"												
					Averted Vision 1 – 3 minutes	Where are you looking?		X	X	X					X			
					Field of View Card: 1 – 10 minutes	How much of the sky are we seeing in the scope?		X	X	X	X	X	X	X	X			X
					Why is the image upside down? 1 – 3 minutes	Why is the image upside down?		X	X	X	X	X	X	X	X			X
	What Power Is Your Telescope? *NSN Link*	How is the power of telescopes determined?	Using a few simple props, show the basics of how telescopes work.	Adults, teens, families with children 5 years and up	Setup: 1 - 5 minutes													
				If a school/youth group, 2nd grade and higher	Presentation:	What power is your telescope?		X	X	X	X	X	X	X	X	X	X	X
				From one person to twenty participants	• Introduction: Light spreads out with distance: 2 minutes													
					• How do telescopes work: 3 – 10 minutes	How does a telescope work?		X	X	X	X	X	X	X	X	X	X	X
					• Aperture: How big are telescopes NASA uses?: 10 – 15 minutes	How is your telescope different from Hubble, Chandra, or Keck?			X	X	X	X	X	X	X			X
	Why doesn't it look like the photos? *NSN Link*	Why doesn't the view through the telescope look like the photos?	Using posters, demos, and a simple game, help visitors learn about exposure time and energy our eyes can't see.	Adults, teens, families with children 8 years and up	Setup: 2 to 5 minutes	This set of activities provides tools to help your visitors understand the two main reasons views through the telescope do not look like photographs:												
				If a school/youth group, 4th grade and higher	Presentation:				X	X	X	X	X	X	X			X
				From one person to fifteen participants	i. Exposure time: Galaxy stencil activity: 3 minutes	• Exposure time: why photographs have so much more detail than the view through the telescope.			X	X	X	X	X	X	X	X	X	X
					ii. "Representational" color: 1. Rusty, the Infrared Dog and USA images: 5 – 10 minutes 2. Universe in a Different Light card-sorting game: 10 - 15 minutes	• So me photographs are showing representational color: Different energies of light and why NASA needs so many different kinds of telescopes to detect that energy.			X	X	X		X	X	X			X
	Can You See the Flag on the Moon? *NSN Link*	Answering questions from your visitors regarding how much detail the telescope can resolve, such as "Can you see the flag on the Moon?"	Using simple props, help the visitor understand resolution – how much detail telescopes can reveal.	Adults, teens, families with children 5 years and up	• Can you see the flag on the Moon? (2 Presentation Options): 3 – 5 minutes	How much detail can we see with our eyes?												
				If a school/youth group, 2nd grade and higher	• Magnification vs. Resolution – Moon Images: 5 minutes	How much detail with backyard scopes?		X		X	X	X	X	X	X	X		
				From one person to fifteen participants		How much detail with Hubble or Keck?												
						Understand that the difference between magnification and resolution		X	X	X	X		X	X	X	X		
						Basics to consider when purchasing a telescope												
Our Magnetic Sun	***The Sun In A Different Light*** *Link*	1) Prepare the visitors for the experience of looking at the Sun 2) Show how different wavelengths of light reveal the variety of features caused by the Sun's magnetic field 3) Introduce solar storms 4) Allow visitors to envision the Sun as a sphere 5) Explore how the Sun's internal structure contributes to generating the Sun's magnetic field	Using cards, Sun banner, and 3D model explain the features that visitors are about to see through the telescope.	From the club: A minimum of one person. Visitors: This activity is appropriate for families with older children, the general public, and school groups in grades 5 and up. Any number of visitors can participate	A few minutes, up to a half hour, depending on the number of topics covered	Banner with 4 Sun images on the front and magnets on the back Bag with a few pipe cleaners: red "prominences" and silver "coronal loops" 3D Sun Model attached to banner (optional) One small compass (optional) Explore the Sun card: "How is the Sun like a Boiling Pot of Spaghetti?" (optional) QR code from "Our Magnetic Sun" banner	X	X	X	X	X	X	X	X	X	X	X
	Magnetic Connection *Link*	Use a group of compasses and a small magnetic boomerang to show how solar storms are generated from the Sun's magnetic activity and illustrate how solar storms interact with Earth's magnetic field to create aurora and potentially disrupt our modern electronic infrastructure.	Explaining the Sun's magnetic field and how it affects the Earth.	Presenters: A minimum of one person. Visitors: Appropriate for families with older children, the general public, and school groups in fifth grade and up. Up to about 5 visitors at a time can participate comfortably.	From 10 minutes to a half hour, depending on the number of topics covered	1) Introduce the connection between the Sun's magnetic activity and Earth's magnetic field 2) How solar storms are generated from the Sun's magnetic activity 3) How solar storms interact with Earth's magnetic field to affect Earth's infrastructure.	X	X	X	X	X	X	X	X	X	X	X
	Explore the Sun Cards *Link*	These 11 cards can be used at a solar telescope, for visitors waiting in line, or as a stand-alone station. These cards provide visitors with ways to understand more about the Sun and its magnetic fields, and also give presenters illustrations to help answer visitors' questions about the Sun.	Provide visitors with ways to understand more about the Sun and its magnetic fields Provide presenters with illustrations to help answer visitors' questions about the Sun	Presenters: Cards can be used with or without a club facilitator. Visitors: Cards are appropriate for families with older children, the general public, and school groups in fifth grade and up. Any number of visitors can participate.	A few minutes, up to a half hour, depending on the number of topics covered.	Can you see UV light Why do Sunspots Look Dark? Why are We Looking at the Sun?"		X	X	X	X	X	X	X	X	X	X	X
	Protection from Ultraviolet *Link*	Try out this fun, easy, and very practical astronomy demo that can be done with just a couple of UV beads! Explore ultraviolet (UV) light and how it can be blocked by different materials in this open-ended activity, great for even the youngest visitors.The very hands on nature of this activity helps demonstrate ways we can protect ourselves from the Sun's harmful rays.	Explore ultraviolet (UV) light and how it can be blocked by different materials Explore different kinds of energy: heat, visible light and invisible light from UV rays Understand that Earth's atmosphere protects us from most of the harmful UV rays Understand ways we can protect ourselves from the Sun's harmful rays	Presenters: A minimum of one person. Visitors: UV beads are appropriate for families with children, the general public, and school groups in third grade and up. Any number of visitors can participate.	A few minutes, up to a half hour, depending on the number of topics covered.	Ultraviolet light		X	X	X	X	X	X	X	X	X	X	X
		Discover that the Sun is the ultimate source of	Lead participants to discover that the Sun is the	Presenters: A minimum of one person.	Duration: Between fifteen	Where ultimatly do we get the energy we use on Earth?												

Toolkit Name	Activities	Big Question:	Big Activity	Participants:	Activity Duration:	Topics Covered:	Venues:										
							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom			Club meeting	General public presentation	
												K-4	5-8	9-12		Seated	Interactive
	Where Does the Energy Come From? ***Link***	energy for almost everything that we do in our daily lives! Participants each use cards to build up an "energy chain" leading back to our Sun in a truly "hands-on" activity, perfect for almost any occasion.	ultimate source of energy for almost everything that we do in our daily lives.	Visitors: Most activities are appropriate for families with older children, the general public, and school groups in as young as kindergarten. Between 10 and 30 visitors may participate.	minutes and a half hour, depending on the number of topics covered.			X	X	X	X	X	X	X	X	X	X

Toolkit Name	Activities	Big Question:	Big Activity	Participants:	Activity Duration:	Topics Covered:	Venues:										
							At the telescope	Star Party	Pre-Star Party Indoors	Pre-Star Party Outdoors	Scout troop	Classroom			Club meeting	General public presentation	
												K-4	5-8	9-12		Seated	Interactive
Black Hole Survival	***Black Hole Explorer Board Game*** *Link*	Plan and carry out a mission to a Black Hole.	"Black Hole Explorer" is a board game where the players fly a spaceship to orbit around a black hole and launch scientific probes to study it. The object is to return to Earth with your results and collect the Nobel Prize!	Adults, teens, families with children 8 years and up If a school/youth group, 4th grade and higher Four participants or teams.	The game typically takes an hour or more.	Has your picture of what a black hole is changed because of this game? In what way?			X		X		X	X	X		
						How do you think events in the game would differ from a real mission to a black hole?											
						If you had to play the game again (or plan a real mission), what would you do differently, in the design phase, and in the mission phase?											
	Gravity and the Fabric of Space *Links to the left"*	How does gravity work?	Using a bucket with stretchy fabric stretched over it, allow visitors to experiment with marbles and weights to discover some basics about gravity.	Adults, teens, families with children 7 years and up If a school/youth group, 4th grade and higher From 1 to 15 participant.	3 minutes to 45 minutes, depending on how much you want to cover.	This set of activities explains the basics of Einstein's general theory of relativity especially regarding curved space – without using the jargon associated with it. There is no attempt to go into the details of relativity. The objective is to cover how mass affects the space around it – producing gravitational force. And how black holes fit into the picture – including what scientists are trying to discover about them. There are several parts to this presentation, introducing different ideas. You might want to present just one or two, or all of them, starting with the Introduction.					X	X	X	X	X	X	X
		Why can't we escape from a Black Hole?	Activity Name	What do we do?	Key Message	Introduction: Mass curves space (Page 59)											
			Falling In	Drop 2 same-size marbles from the edge of each bucket; Drop 2 different sized marbles from edge of one bucket	More mass, more gravitational force, objects fall faster; All objects regardless of mass will fall at the same rate into thesame massive object	Part 1: Falling Down / Falling In (Page 60)											
			Why Doesn't Moon Fall to Earth	Push marbles across empty space; Push marbles into orbit around weights	Paths of the orbits objects take in space is due to curved space	Part 2: Why Doesn't Moon Fall to Earth? (Page 64)											
			Martian year twice as long as Earth's year	Push marbles in orbit near weight and out toward edge of bucket	Farther from center of mass, space curves less: less gravitational force, so orbital rate is slower	Part 3: Why is a Martian year almost twice as long as an Earth year? (Page 68)											
			Are you a rocket scientist?	Using straws try to launch the pee-wee marble "rocket" off the Moon and off Earth; then from a black hole	Harder to reach orbit from a larger mass – higher initial speed is needed	Part 4: Are you a Rocket Scientist? (Page 74)											
			Sun as a Black Hole	Orbit marbles around softball and medium weight	At a distance, the same amount of mass will curve space thesame amount	Part 5: The Sun as a black hole (Page 77)											
			Why we can't escape from a black hole	Discuss an Earth-mass black hole and "center of mass"; orbit marbles around black hole	Space is curved completely around black holes – we cannot escape	Part 6: Why we can't escape from the region of a black hole. (Page 79)											
	Where are the Black Holes? *Links under "Topics Covered"*	How we know black holes are there?	Demonstration: Using magnets and magnetic marbles, demonstrate the effect black holes have on nearby stars.	Adults, teens, families with children 6 years and up If a school/youth group, 3rd grade and higher	Demonstration: From one person to fifteen participants	How we know black holes are there: How scientists are finding them. (Link)	X	X	X	X	X	X	X	X	X	X	X
		Where are they?	Observing Activity: make black holes real in the night sky by showing your visitors the locations of known black holes.		Observing Activity: Any number of participants	Making it real in the night sky: pointing out the locations of known black holes (Black Hole Star Maps)											
Planetquest	***How do we find planets around other stars?*** *Link*	How do we find planets around other stars?	Spin "stars" to simulate star wobble (astrometry and radial velocity). Briefly explain transit method and direct imaging of planets.	One to six participants (per set of materials)	5 - 30 minutes	Four ways we are (or will be) detecting planets around a star											
						Reasons why we need many ways to detect planets (Optional Activity)			X	X	X		X	X	X	X	X
						Upcoming NASA missions to find Earth-like planets											
	Telescope treasure hunt: how do stars and planets form? *Link*	How do stars and planets form?	Participants tour the telescopes to hunt for different objects that contribute to stellar and planetary formation, using a set of stickers and a Treasure List. Participants place one of their stickers next to each type of object they view. Alternatively, if no stickers are available, the participants can mark each item with a pen or pencil. When all the items on the Treasure List are found, one of the astronomers signs off on it.	Adults, teens, families with children 5 years and up. If a school/youth group, 5th grade and higher No minimum or maximum number of participants Minimum of 3 presenters	30 to 90 minutes	An overview of how stars and their planets form	X										
	Where are the distant worlds? *Link*	Where are the distant worlds in the night sky?	Use a star map to find constellations and to identify stars with extrasolar planets.	Adults, teens, families with children 8 years and up If a school/youth group, 5th grade and higher 1 to 4 participants per map	Varies (however long you choose to observe constellations)	How to find Constellations											
			1. At a star party, pass out to your visitors a monthly star map marked with stars with extrasolar planets - Northern Hemisphere only, and naked eye only.			Where we have found planets around other stars	X	X		X							
			2. Discuss information included on the Planetary PostCards about the star and its planetary system.														
			3. Discuss upcoming NASA missions to discover more about these and other planetary systems.														
Planetary Investigations Draft Kit																	