Out of This World – Akela’s Workbook

# Prologue

Hello,

If you are reading this then you are about to embark on a wonderful exploration into space sciences with your cub scout den, patrol, or pack. I have put together this document to outline what you can cover, who you can reach out to, and how to make it fun. I hope your experience is a success and that the youth come out of this with a newfound love for space, the solar system, and the universe around us.

If you are new to the STEM/NOVA program with BSA, let me just cover some of the basics. STEM stands for Science, Technology, Engineering, and Mathematics. They are the core components in logic and deductive reasoning in our world today, a skill that has been lost by most. For generations the US was the leader in many of these fields, but we have begun to stray from this path and it only hurts us as a nation. Children, myself included, were raised to believe that science and math were hard and that they weren’t important and nothing could be further from the truth. The BSA has always incorporated STEM components in their merit badges and advancement criteria, and the NOVA awards utilize those existing awards as well as some additional steps. **Out of This World** focuses on the Science of space and encourages the youth to research new topics and share what they have learned. All NOVA awards follow these basic requirements:

1. Research for an hour. It doesn’t matter how (reading, video, movie etc), but it should be specific to the subject.
2. Perform a group activity. This could include earning one of the rank’s elective Adventure loops or pin related to the topic, or it could be group activities. Adventures earned for another award cannot not count towards this award.
3. Engage in a learning activity. This may have one or more facets, but is designed to involve the youth in research, critical reasoning, and presentation of their discoveries.
4. Visit somewhere where the subject in question is being used or performed.
5. Follow up with the NOVA counselor on what was learned.

I have incorporated a slideshow presentation and handouts for the youth that will cover every requirement of every question. For **Out of This World**, you will perform all of steps 1 and 2, select 2 of the options in step 3, and one of the options in step 4. The following pages will help you to talk about the different subjects, provide questions that you can ask to get the youth thinking, and help to answer questions that may be asked.

NOVA awards, on average, should be accomplished in about a month’s timeframe. This gives the youth a chance to do their research, create their presentations, and discuss what they are learning along the way. Engage the youth in whatever activities you would like to in an environment that works for them, but they will learn best by doing. Follow the Leading EDGE and Teaching EDGE philosophies. I wish you the best of luck in your adventure.

Corey Peoples

Pack 455, NSC, C250-17-1

# Slide 1 - Beginning

Introduce yourself and the excitement with the youth. Why did you choose to lead this award? What’s your passion for space science?

# Slide 2 - Agenda

Read verbatim or paraphrase:

The goal of this STEM course is to discover the wonders of space exploration, with a look at our solar system. We have a few requirements that we will do for this course. The first thing that we will do is some research. Select a book, movie, youtube video, or magazine, or a combination and learn about our solar system for an hour. There are thousands of topics to choose from that are fun to know about. I’ll give you some examples. Did you know that Jupiter, the largest planet in our solar system, has such a powerful magnetic field that we can hear it on our radios? It’s on the AM frequency between 15 and 40 Hz. (calculate ahead of time) If I were on the moon, I would weigh \_\_\_\_\_ lbs! Between the time Pluto was discovered and now it hasn’t even finished one full year! Every 75 years Haley’s comet shows up in our sky and makes a beautiful streak of gas and dust that we can see with our eyes.

Next, there is our adventure loop or pin. For this, we will be working on an elective adventure relating to space sciences.

Thirdly, we have our hands on learning projects. We have a lot to choose from, but I will have us work on 2 specific projects as a group.

Through all of this, we will also have a field trip outdoors. (describe the field trip or event planned).

And then, I want you to tell me what you learned and what excited you.

# Slide 3 - Requirement 1: Research for an hour

This activity can be done as individuals or as a group. If your meeting place is at a library, then this opens up access for the youth to get books or movies from the library. Here are some suggestions on things that can be done:

|  |  |
| --- | --- |
| **Reading Books for Cub Scouts** | Reading Magazines for Cub Scouts |
| TV Shows and Movies | Youtube channels |

Be sure to have the Reading/Learninghandouts from the youth worksheets package available.

# Slide 4 - Requirement 2: Rank Adventure

If you should so choose, select an adventure to work on based on the rank of the youth. Please note that this adventure loop or pin should be unique to the STEM award and not used from any other award previously earned, unless that is not possible.

If you do not want to do a rank adventure because it was already earned for another award, or you have a mixed age range of youth, move n to steps slides 5 or 6 which include group activities. Of slides 4, 5, and 6, only one needs to be selected to do.

# Slide 5 - Requirement 2: Group Activity – Space

If slide 4 was not an option for your group, you can use either slide 5 or 6. Read this verbatim or paraphrase:

Let’s do some activities involving space! I have here a [Telescope/Binocular]. How it works is it bends light so that we can see from a far distance, but since everyone’s eyes and face are a little different, it has to be adjustable. Let’s take a look at this object and see if we can focus it.

With a telescope collecting light from far away and focusing it to our eyes, we can see the planets of our solar system. There are 8 of them, as well as several dwarf planets. Can you draw them out?

Lastly for this activity, let’s look at constellations. Constellations are groups of stars that we play “connect the dots” with. There are 88 officially registered constellations. Let’s look at slides 12 to 17 for more information.

# Slide 6 - Requirement 2: Group Activity – Air

If slide 4 was not an option for your group, you can use either slide 5 or 6. This activity will require a “runway” to measure distances, so set up a starting line and have a way to measure the distance. Read this verbatim or paraphrase:

A fun thing to do with paper is fold it to make paper airplanes. These gliders can fly far, or fall short, or twist and turn and smack you back in the face. The smallest fold makes these do some strange things. Let’s build a paper airplane following the instructions here. Now, let’s line up at the starting point and launch our airplanes. How far did they go? Did they go straight or curve? Let’s fly them 5 times and measure how far they flew.

Now, let’s change it up. What if we were to add extra folds, or make a different style? Can we fly the paper airplane further or does it not work as well?

The paper airplanes are gliders, meaning they only have as much power as we throw it with. That doesn’t hold true for things with an engine, like a car, where the engine makes the craft move by transferring power to it. We can build one with this car kit, a straw, and a balloon. (Build the kits like the image shows). Ok, now let’s race. As you can see, it travels a certain distance. What happens if we use a larger balloon? Or a smaller balloon? Let’s race and see!

# Slide 7 - Requirement 3: Perform 2 Learning Adventures

This slide is the home page for all of requirement 3. To jump to one of the legs of the requirement, simply click it and you will move to the introduction of that segment. Once that segment is finished, you can press the Return button on the bottom right corner of the last slide of that segment. When the 2 segments of the 3rd requirement are complete, press the Next button in the bottom right corner to move to requirement 4.

# Slide 8 - Requirement 3a: Have a star party

We’re going to have a star party! Be sure to print off at least 3 copies of the Constellations page from the youth worksheets attachment.

# Slide 9 - Requirement 3a: Have a Star Party: Segment Requirements

Read verbatim or paraphrase:

For this learning adventure segment, we are going to do the following: Find a night to view the stars. Our plan is for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at \_\_\_\_\_ o’clock, location and weather permitting. During that night, our plan is to look at the sky and find cool events and constellations, and then draw what we see.

# Slide 10 - Requirement 3a: Have a Star Party: Finding a clear night

Read verbatim or paraphrase:

Who knows what light pollution is? Light pollution is an effect that we have in our modern society caused by all of our street, home, and building lights illuminating the ground. This does provide safety for our citizens which is why we do it, but that light bounces back into the sky and makes astronomy hard. The more lights there are, the harder it is to see the stars in the sky. That means that if we want excellent viewing abilities, we need to move away from the light. That is one of the reasons why observatories are built on top of mountains far away from cities. This website can help us find clearer viewing locations.

# Slide 11 - Requirement 3a: Have a Star Party: Find Something Worth Viewing

Read verbatim or paraphrase:

Space is so big that we wouldn’t be able to look at everything up there if we spent our entire lives at it. Even in our own solar system, whether it is our eyes or our telescopes, there are thousands of things to see and they change constantly. This website helps us to know what is visible to us at different times of the years. Planets are bright and visible with our eyes but look pretty cool in our telescopes. The moon is always there and fun to learn about. Every once in a while we are lucky enough to see comets in our night sky, a ball of ice and gas flying in from Pluto and beyond which gets too close to the sun and starts to evaporate leaving a long colorful tail behind it. The Sun’s energy gets caught in our planet’s magnetic field which creates the most stunning light show in the northern sky, an aurora borealis. Earth collides with small asteroids all the time creating stunning meteor showers. These are just some of the fun things that we can see from here on earth.

# Slide 12 - Requirement 3a: Have a Star Party: Constellations

Read verbatim or paraphrase:

With our star party, we are going to look at constellations. Does anyone know what constellations are? How many people have played Connect the Dots? We Humans have done this for as long as we can remember. Stars are so far away that they don’t ever appear to move for us in the sky. By putting pictures in the sky that don’t change, we could use the sky in the past to tell us when the seasons were changing long before a calendar was invented and what direction we were travelling before a compass was invented. The images that we drew were usually based on the brightest stars and told stories from our past. Officially we recognize 88 constellations today, but there have been thousands through time. Let’s look at a few.

# Slide 13 - Requirement 3a: Have a Star Party: The Big Dipper

Read verbatim or paraphrase:

The big dipper is an easy one to spot, as we can see it all year long. It looks like a stove pot or large ladle for scooping. Although we call it the big dipper, it actually isn’t a recognized constellation because it is a part of a bigger one, the Ursa Major constellation or The Big Bear. The star grouping always appears in our northern sky, and has 2 stars on one end that point directly to a star we call Polaris, or The North Star. Polaris doesn’t move in the night because our planet’s tilt is pointed directly at it. In ancient Greek mythology, the civilization who gave us the Ursa Major name we use today, the goddess Hera turned the creature named Callisto into the She-Bear because of jealousy. In ancient Hungarian mythology they saw a wagon in the stars, and the doctor Taltos pulled the Great Wagon from village to village with medicine that could cure any disease. Flip it upside down and yeah, I could see a wagon with a place for horses or oxen.

# Slide 14 - Requirement 3a: Have a Star Party: The Pleiades

Read verbatim or paraphrase:

The Pleiades is a cluster of 7 bright visible stars, born about 200 million years ago. Their position in the sky puts them highest around the end of October. In fact, it was once believed that they were trapped souls and when they reached their peak on October 31st that evil spirits would be released to cause problems on earth and this is the earliest known backstory behind Halloween. An interesting story about the Pleiades comes from the Greek mythology, again the origin of the name. The ancient king Plieone had 7 beautiful daughters. One day, the hunter Orion saw them and went mad because of their beauty. He began to chase them and they ran all over the world. After 7 years of running, the daughters finally prayed to Zeus, the king of the Greek Gods, and Zeus turned them into birds so they could escape and fly into the stars. Even in the sky today, though, the constellation of Orion still chases them. Another great origin story is that of the Kiowa tribe of native Americans. They believed that one night 7 young girls decided to break away from the campsite to dance under the stars. While they were dancing, a bear started to attack. They ran from the bears and found a large rock. Once on top of the rock, they asked it to save them. The rock grew out of the ground and reached to the sky. The bears kept clawing at the rock, but they could not reach the women. Once at the sky, they were turned into the stars we see today, and the rock is known to us as “Devil’s Tower” in Wyoming.

# Slide 15 - Requirement 3a: Have a Star Party: Orion The Hunter

Read verbatim or paraphrase:

Orion is the last constellation we will talk about as a group. Orion was a great hunter in Greek Mythology and his stories earned him a place among the stars because he was attacked by Hera and Zeus put him in the sky out of spite. The constellation is most notably known for the 3 stars along Orion’s Belt which are almost in a straight line. There are also some really cool things about Orion, such as a gas nebula in his leg and the fact that several of the stars are supergiants, several hundred times the size of our Sun. These are large and bright and close to the end of their lives. In a few hundred million years, they will shed their gasses which can form new stars. Some will do this quietly, others will explode in one of the largest explosions known to the universe, a Supernova. Another example of a cultural myth of the same stars is the Egyptians believed that the 3 stars that made up the belt were the got Sah, a pharaoh who had died and ascended to the heavens. In fact, the 3 great pyramids at Giza are said to be aligned with the stars on Orion’s belt, but we may never know if that was the intent.

# Slide 16 - Requirement 3a: Have a Star Party: It Makes You Wonder

Read verbatim or paraphrase:

There are 88 constellations in the night sky, and many cultures have their names and stories based off of creatures and people from their culture. Can you imagine what the constellations would be like based on the stories we have from today?

# Slide 17 - Requirement 3a: Have a Star Party: Find 5 Constellations

Read verbatim or paraphrase:

When we have our star party, we are going to look for 5 constellations. We can only see a small portion of the constellations in the sky, but we can use tools like Google SkyMap or Star Chart to find the constellations. Be respectful if you are pulling out a tablet or phone, though, as that device will also create light pollution for everyone at the star party too. Once you have found 5 constellations in the sky, draw them out and share them. If you want to have some fun, find a constellation of your own, of anything you would like.

Press the return arrow to return to Slide 5, the question 3 page.

# Slide 18 - Requirement 3b: Rotation and Revolution

We’re going to talk about the universal Rs. Be sure to print a copy of the Planet Info grid and rotation & revolution fill in areas for each youth.

# Slide 19 - Requirement 3b: Rotation and Revolution

Read verbatim or paraphrase:

There are 3 things we are going to focus on for this section. The first is to learn all about rotation and revolution and how they affect us. The next is to do some research on rotation and revolution on different planets or plutoids in our solar system and measurements that could affect them. The last is to share what we have learned.

# Slide 20 - Requirement 3b: Rotation and Revolution

Read verbatim or paraphrase:

Rotation is the act of an object spinning on an axis, an imaginary line through the planet or star. For example, the Earth rotates once every 24 hours. The moon is much slower, though, at one rotation every 28 days!

Revolution is the act of two bodies orbiting around each other. It takes us 365 days to complete one revolution, or what we call a year. The moon revolves around the Earth once every 28 days.

# Slide 21 - Requirement 3b: Rotation and Revolution

Read verbatim or paraphrase:

Most of the time rotation is shown as one object, like the Earth orbiting around another, like the sun. In reality, the earth pulls on the sun just like the sun pulls on the earth, so there is a center point of gravity between the two that is slightly off of the center of the sun. The center point is always closer to the bigger object. For the Earth and moon orbit, the center point is close to the center of the Earth. If the objects orbiting each other are closer in size, though the center point might be between the two objects. That’s the case with Pluto and Charon (pronounced Sharron). Because the moon Charon is half the size of Pluto, it tugs quite a bit on the orbit. As a result, they seem to dance with each other in space like two figure skaters holding hands and spinning.

# Slide 22 - Requirement 3b: Rotation and Revolution

Officially for this one, scouts would now do their own research on this subject but you can play with this activity. Maybe have all of the numbers printed out on cards and the scouts have to arrange them how they think they should be and explain why. For the specified activity, though, read verbatim or paraphrase:

Now it’s time to do some research. I want everyone to pick 3 planets or dwarf planets in our solar system and compare them to the Earth. Tell me what the rotation and revolutionary periods are, and you can choose 2 or more of any of the topics on the left with a star to answer as well. The only ones you can’t choose are the Earth and the sun.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Rotational Period** | **Revolutionary Period** | **Average Temperature** | **Diameter** | **Distance from Sun** | **# of Moons** |
| Mercury | 59 days | 88 Days | -297 F (-183 C) to 800 F (427 C) | 3,031 Miles | 36,000,000 Miles | 0 |
| Venus | 243 days | 224 Days | 896 F  (480 C) | 7,521 Miles | 67,000,000 Miles | 0 |
| Earth | 23 Hours 56 Minutes | 365.25 Days | 57 F  (14 C) | 7,926 Miles | 93,000,000 Miles | 1 |
| Mars | 24 Hours, 37 Minutes | 687 Days | -81 F  (-63 C) | 4,222 Miles | 141,700,000 Miles | 2 |
| Jupiter | 9 Hours, 55 Minutes | 11.86 Years | -202 F  (-130 C) | 88,864 Miles | 483,500,000 Miles | 66 |
| Saturn | 10 Hours, 39 Minutes | 29 Years | -202 F  (-130 C) | 74,900 Miles | 888,750,000 Miles | 62 |
| Uranus | 17 Hours, 14 Minutes | 84 Years | -328 F  (-200 C) | 31,763 Miles | 1,783,744,300 Miles | 27 |
| Neptune | 16 Hours, 7 Minutes | 164.8 Years | -328 F  (-200 C) | 30,779 Miles | 2,797,770,000 Miles | 14 |
| Eris | 8 Hours | 557 Years | -386 F  (-232 C) | 1,445 Miles | 3.5 to 9 Billion Miles | 1 |
| Pluto | 6 days 9 Hours | 248 Years | -378 F  (-228 C) | 1,473 Miles | 2.8 to 4.5 Billion Miles | 5 |
| Ceres | 9 Hours 5 Minutes | 4 Years 220 Days | -159 F  (-106 C) | 590  Miles | 257,031,000 Miles | 0 |
| Haumea | 4 Hours | 285 Years | -400 F  (-240 C) | 1,218 Miles | 3.2 to 4.8 Billion Miles | 2 |
| MakeMake | 7 Hours 46 Minutes | 309 Years | -405 F  (-243 C) | 994  Miles | 3.5 to 4.9 Billion Miles | 1 |

# Slide 23 - Requirement 3b: Rotation and Revolution

Read verbatim or paraphrase:

All bodies in the universe rotate. Some are slow, some are fast. The fastest that we know of is a type of star known as a pulsar. It’s about as big as New York City but it rotates 716 times a second! Can you imagine how dizzy you would get spinning that fast?

If moons revolve around planets, and planets revolve around stars, what do stars revolve around? We call the region of space where stars are clumped together and orbiting a central point a galaxy. Our galaxy is the Milky Way. It contains over 100 billion stars from big and bright to small and dim, but since it is 587,000,000,000,000,000 (587 quadrillion miles) wide, there’s plenty of room for them.

We’re so used to moving around at 1,000 miles per hour that we don’t even notice it. The earth has nearly 24,000 miles of equator to spin on. What would happen if we slowed down? What would that do to our oceans, our days, and our balance?

Akela, feel free to return to the menu when completed by pressing the return arrow in the bottom right corner.

# Slide 24 - Requirement 3c: Build a Mars Rover

Akela, this section will require you to bring craft supplies. This can include paper plates and cups, construction paper, pipe cleaners, stickers, coloring supplies, glue, scissors, and any other paper/crafting supplies you might need. Be sure to have them ready. If you are choosing to draw instead of build, print the first Mars Rover page from the youth worksheets attachment. For both drawing and building, print the 2nd Mars Rover page to describe the rover. For the slide, read verbatim or paraphrase:

For this session, we are going to build a Mars rover to explore another planet, and think about all of the tasks that it will need to do.

# Slide 25 - Requirement 3c: Build a Mars Rover

Read verbatim or paraphrase:

Our task is going to be to create a rover out of the construction materials I have brought today. Once built, I will ask you to explain how it will perform different tasks.

# Slide 26 - Requirement 3c: Build a Mars Rover

Read verbatim or paraphrase:

Before we start, though, let’s think about what we need to consider while building. Our first consideration is that Mars doesn’t have roads. It might be flat from the surface, but there are rocks and hills all over. Would just any wheel work? Or do we need to consider alternate methods of movement?

How does the rover get power? There aren’t any gas stations on Mars to fill up on but there are a few renewable sources of power like Sun or Wind. How will your rover take advantage of those?

If you pop a tire on your bike, you can use a patch kit to fix it or just replace the tire altogether. A Mars rover doesn’t have the luxury. If it breaks, what does that mean for you? How can you make sure it won’t easily break?

The purpose of a Mars rover is to explore, but that won’t do us any good here on Earth if it can’t share what it finds back to us. There isn’t any internet, so how can we get pictures and data from Mars back here to Earth?

Akela, go ahead and start building. Help the youth with their projects and offer suggestions. Make sure the youth are considering how the rover will work.

# Slide 27 - Requirement 3c: Build a Mars Rover: It makes you Wonder

Read verbatim or paraphrase:

Mars is a rocky planet like Earth so we can explore it easily enough. How would we explore other types of planets like a moon made of water or a gas giant? What would we need to consider for those types of rovers?

Many of our planetary exploration vehicles have been satellites that can take measurements from space. Why would we want to do this? What sort of things would you want to know about from above a planet? (hint, How often do you use Google Maps?)

We explore space and other planets for a lot of reasons. Maybe we will want to set up colonies, or mine for resources. One of the biggest things we are looking for is signs of life that are or were on other planets. We only know of life here on Earth. What do you think it would mean if we found life on another planet? What would that life look like?

Akela, this concludes this section of the hands on learning activity. Press the Return button in the lower right corner to return to the options screen.

# Slide 28 - Requirement 3d: Design a Colony

Akela, this section will require you to bring drawing supplies. This can include construction paper, stickers, coloring supplies, glue, scissors, and any other paper/crafting supplies you might need. Be sure to have them ready. It might be fun to have a drawing that you’ve done ahead of time to show things off. You can print the first My Mars/Moon Colony page from the youth worksheets handout for the drawing, or use another method for a less restrictive drawing frame. Please also print off the 2nd My Mars/Moon Colony page to describe the colony. For the slide, read verbatim or paraphrase:

For this segment we are going to design a habitat for humans to live in on another planet or moon.

# Slide 29 - Requirement 3d: Design a Colony

Read verbatim or paraphrase:

This is going to be fun. In front of you I have supplies for you to draw the ultimate offworld base. It’s time to get creative. We will draw out the base and then talk about what we drew and why we drew it.

# Slide 30 - Requirement 3d: Design a Colony

Read verbatim or paraphrase:

Before we begin, let’s talk about what we need to consider. What are you doing right now without realizing it? Everyone take a deep breath. Ok, now try to take a deep breath without any air. We can’t do that, can we? That’s because air is everywhere here and humans need air. When we look at exploring other planets and staying on them, we need to have air to breath, and we need to be able to clean it. We breathe in oxygen and exhale carbon dioxide. We will get sick if we keep breathing in the carbon dioxide, but that’s what plants breathe in and they give us oxygen back, so maybe we want some plants for clean air.

What are we going to do to keep the base from breaking? If a hole pops into the wall here on earth, we can just go to the store to get materials to fix it. How would you handle that off world?

The most important thing to consider in a closed environment like a moon base is that we have limited resources. If you use a heavy plate for eating food, you can wash it to reuse that plate. Paper plates will take up storage space when they are thrown away and then you will need more plates when you run out. What else can we reuse? Can we keep the rinse water clean so we can reuse that too?

If we go to set up a base on the moon or another planet, why are we there? Surely we are there for more than “because we can be.” What tasks would you want to do on the planet or moon? What would we need in our base for this?

Akela, at this point we can begin the project. Guide the youth in their endeavors and encourage them. Offer suggestions for those youth who are stuck. When finished, share either as a group or 1 on 1.

# Slide 31 - Requirement 3d: Design a Colony

Read verbatim or paraphrase:

Think about this, kids. If we did send some people to another planet, how long could they stay there? What would they need to stay there longer?

Think of a colony like a city. All of the people work together in a localized area. Here on Earth, cities grow and people move to different cities. What happens on another planet? Can the colony expand? Can people start up a new colony in a different location. When would it go from “being an Earthling on Mars” to “being a Martian Human?”

When are we going to need to have colonies on other planets, moons, or ships? What sort of disasters would be bad for humans on Earth?

Akela, at this point the segment is finished. Press the back arrow in the lower right corner to return to the Learning Activities.

# Slide 32 - Requirement 3e: Become an Asteroid Mapper

This project can be fun for older youth, but does require parental involvement. Before selecting this as your segment for group activities, you should discuss it with the parents. To do this as a group, you will also need to have computers at the ready. There is also a handout on Mapping Asteroids in the attached youth worksheets document.

Read verbatim or paraphrase:

For part of our exploration, we are going to register with Nasa to map a large asteroid, Vesta! Can anyone tell me what Asteroids are? (Rocks in space). How big are they? (Some are as small as grains of sand while others are miles wide). Can anyone guess why we would want to map them?

# Slide 33 - Requirement 3e: Become an Asteroid Mapper

Read verbatim or paraphrase:

What we are going to do is register with Nasa’s Jet Propulsion Laboratory (JPL) and begin the process of mapping, like google maps but for space rocks. After we have mapped some, then we can discuss what we have learned.

# Slide 34 - Requirement 3e: Become an Asteroid Mapper

Read verbatim or paraphrase:

This is the link that we can use to register. Let’s go ahead and pull up this link and click on the link that says Asteroid Mappers: Vesta Edition. Follow the steps and download the application. Let’s go ahead and launch it. From this application, we can start pouring through thousands of pictures and look for cool things on the surface. Where are the craters, where are the cracks? Can we see anything that looks like Ice on it?

Akela, do this for a while and then circle back to talk about what has been learned.

# Slide 35 - Requirement 3e: Become an Asteroid Mapper

Read verbatim or paraphrase:

The asteroid that we looked at had a lot of craters on it, didn’t it? Can anyone guess why there are so many craters?

This asteroid is in orbit around the sun. How old do you think it is?

Asteroids can be huge, and if they hit a planet they can cause a lot of damage, but are asteroids something we need to be afraid of every day? No! Most asteroids burn up in our atmosphere as a beautiful meteor shower. It’s very rare that the big ones hit a planet.

# Slide 36 - Requirement 3f: Eclipses

Akela, this section requires objects like a basketball and baseball, and a flashlight. There is also an Eclipses page in the attached Youth Worksheets document so the youth can show what they have learned. Read verbatim or paraphrase:

Today we are going to talk about all kinds of eclipses.

# Slide 37 - Requirement 3f: Eclipses

Read verbatim or paraphrase:

For this session we are going to talk about Solar and Lunar eclipses and what they are. We are also going to demonstrate what those eclipses look like. Then we will all discuss what we have learned. Sound fun?

# Slide 38 - Requirement 3f: Eclipses

Read verbatim or paraphrase:

Let’s begin with Solar Eclipses. The sun is big and bright, but it is far away. The moon is smaller than the sun, but because it is closer it appears to be the same size as the sun. Just like you, the moon makes a shadow, and when that shadow blocks the sun from hitting the earth then we have a solar eclipse! The part that is completely blocked out is called a total eclipse, whereas the parts that are just partially blocked are a partial eclipse. We had a partial eclipse in August 2017, do you remember that? It will be a few years before we get another one that we can see. Let’s demonstrate a solar eclipse using this flashlight as the sun, this tennis ball as the moon, and this basketball as the Earth. (Turn lights off or down for maximum effect).

# Slide 39 - Requirement 3f: Eclipses

Read verbatim or paraphrase:

The other common eclipse type is called a Lunar eclipse. In this type, the sun is big but far away. The Earth is bigger than the moon, and so when the moon is hidden behind the Earth then it can’t get any sunlight either. Behind the Earth, though, the shadow is a lot larger than the moon, so it will stay in eclipse for a while. Let’s show what this looks like with the same objects.

# Slide 40 - Requirement 3f: Eclipses

Read verbatim or paraphrase:

So if you remember, the moon revolves around the earth once every 28 days. That means that the moon should be between the Earth and the sun at least once a month meaning we should see a lot of eclipses, right? Even though the moon would be directly in front of the Earth once every 28 days and behind once every 28 days, the moon actually orbits at a slight tilt to the Earth in comparison to the sun. As a result, the shadow that it makes might be above or below the Earth. We would be able to see it from a spaceship in orbit or another planet, but not from anywhere on the Earth itself.

# Slide 41 - Requirement 3f: Eclipses

Read verbatim or paraphrase:

On earth we only have the one moon to give us an eclipse. Imagine the view from a planet like Saturn with over 60 moons. What do you think that would be like? <discussion points: more frequent, larger surface to move around on>

A transit eclipse is the act of watching one object pass in front of our sun, like the International Space Station or Venus. What do you think we can learn from these? <discussion points: speed of object, atmosphere of planet, size of the planet, distance from sun>

From Earth, our 2 most common types of eclipses are Solar and Lunar, but an eclipse is simply one object blocking the light for another. If we point our telescopes at other stars, do you think we can see eclipses far away? What does that tell us? <discussion points: transit eclipses to see other planets (Kepler space observatory), gravity of objects like stars and black holes>

Akela, this is the end of this segment. To return to the menu for question 3, press the Return button. Since this is the last slide of requirement 3, if you wish to move on to 4 press Next.**.**

# Slide 42 - Requirement 4: Visit or Explore

Choose an option, either visit somewhere where science is being done (this can tie in nicely with segment 3A should it be needed), or explore a career in space sciences. Advise the youth on which option you have selected.

There is a page in the attached youth worksheets document titled Visit where Space Science is Being Done for the youth to describe where they went, what they learned, and who they talked to.

For visiting somewhere, the next 3 slides have places within or near the Metro area that can be utilized with free outreach programs or visitations. Slide 44 has some career options and what must be done to effectively explore these careers.

# Slide 43 - Requirement 4: Visit or Explore: Visit MN Astro Society

Read verbatim or paraphrase:

The Minnesota Astronomical Society has a lot of great options for us to learn. We can either go to their observatory in Young America, Minnesota, or we can have a volunteer come to us. I have already arranged to (Fill in your option here). When we meet with someone at the event, come up with some questions to ask the scientist. Here are some examples you could use, or you can come up with more.

# Slide 44 - Requirement 4: Visit or Explore: Visit U of M Astro Department

Read verbatim or paraphrase:

The University of Minnesota gives back to the state by offering free outreach programs at request, within 30 miles of the U of M (If the distance is more, they may be willing to participate with payment). The attendee will be a grad student in the astrophysics program. They are also constructing a brand new planetarium in St. Paul, but that will open in 2019. When we meet with the visitor from the U of M, come up with some questions to ask. Here are some examples you can use, or feel free to come up with more.

# Slide 45 - Requirement 4: Visit or Explore: Como Planetarium

Read verbatim or paraphrase:

Part of the St. Paul Schools outreach program, there is a great planetarium that works for both clear and cloudy days because they can have us go inside to view a star show if we can’t see the stars outside. We will be going as a group on (*Fill in the date*). When we get there, be sure to ask the Planetarium Curator some questions about the solar system. Here are some examples, or feel free to come up with your own.

# Slide 46 - Requirement 4: Visit or Explore: Explore a Career

There is a page in the attached youth worksheets document titled Explore a career in Space Science for the youth to describe the career they chose, what they learned, and what they would need to learn to get to that career. Read verbatim or paraphrase:

Pick a space career. It could be anything from someone who goes out into space down to someone who uses math to explain how the universe works. Here are some examples of the common careers. For the career that you have selected, please find out and tell me the following: What education do you need for that career? Are there any physical needs for the job? I’ll give you a hint on this one, the astronaut goes through a lot of physical testing. How about what they do, is their work important to humanity? And how does it benefit us? Finally, when learning something about science careers, you’ll always hear about peer review which is where other scientists read your research to see if the experiment was done correctly and the data is valid. Why is peer review important? What does having someone else look at your work help you to do?

# Slide 47 - Requirement 5: Discuss what you have learned

Read verbatim or paraphrase:

As we wrap up, I want to know what you’ve learned in this session. What is your favorite part about space exploration? What fun fact did you learn about either from me, from our visit, or from the books you read? Are you excited for the future of space exploration? What questions about Space Exploration or Space Science careers do you still have?

# Final Thoughts

Akela,

Thank you so much for running this. I hope that you have had as much fun as the youth. Be sure to turn in whatever documentation is required to your advancement chair so that the youth earn both their NOVA award and their adventure rank.