1. OVERVIEW DESCRIPTION

Space STEM Live! is an exciting, interactive, and educational event where guests participate in a variety of Universe of Learning-inspired activities. Utilizing everyday supplies mixed with a few event-specific materials, educators and volunteers inspire participants for four hours leading up to a special speaker sharing their own scientific discoveries.

2. UNIVERSE OF LEARNING RESOURCES

   i. NASA Images used in UoL PowerPoints
   ii. Eyes on Exoplanets
   iii. Micro Observatory
   iv. NASA Resources Website for Teaching Materials
   v. AstroPix
   vi. World Wide Telescope
   vii. Visions of the Universe Poster Exhibit

3. PROGRAM DETAILS

   A. 300 participants from the local public community
   B. 50 underserved local young women and their families
   C. Schedule of Events

      i. 10:00am- Doors open, Learning Stations open on the Main Floor
      ii. 10:30am- Planetarium shows begin every half hour on the Mezzanine
      iii. 11:00pm- Lunch provided for staff and volunteers in the Conference Room
      iv. 12:00pm- Guest Speaker in the Auditorium
      v. 2:00pm- Event ends

4. PROGRAM MODEL

   Staffing

   • Event Coordinator to order supplies, plan the layout, organize and train volunteers, reach out to a local scientist, and coordinate activities the day of.
   • Volunteers/Educators to run the Learning Stations and aid in setup/teardown.

   Marketing
• Guests will need to be invited using convenient marketing methods such as flyers, social media, and announcements. Scheduling during Spring Break surely helped our attendance.

• Flyers will need to be printed and distributed to local libraries, rec centers, and elementary schools to reach the community.

• Guest Speaker will need to be invited ahead of time. Recommend a local university professor who has experience explaining their research to the public’s minds.

Facilitation guide

1 month prior- Contact volunteers and speaker
    Order materials and print posters
2 weeks prior- Send out flyers, begin social media advertising
1 week prior- Organize supplies by station, finalize floor plan
2 days prior- Order lunch for staff, volunteers, and speaker to be delivered
1 day prior- Setup tables
Day of-
2 hours prior- Setup learning stations and Planetarium
30 min prior- Train volunteers or staff on the learning stations
10:00am- Doors open, Learning Stations open
10:30am- Planetarium shows begin every half hour
11:00am- Lunch provided for staff, volunteers, and speaker
11:30am- Setup speaker’s PowerPoint if necessary
12:00pm- Guest Speaker
2:00pm- Event concludes

Activity Outlines

Learning Stations:
Activity – Hubble Deep Field

Description

Guests attempt to count the dots featured in NASA’s Hubble Deep Field image. Guests then hold a dime at arm’s length to illustrate that the entire image fits on a dime at arm’s length size of the night sky. Further illustrations on where the image was taken can be added.

Materials

- Hubble Deep Field Poster
- Dime
- Celestial Sphere/Star Map
- Additional Imagery and information on Hubble

Time – 5 minutes

Instructions

1. Look at the Hubble Deep Field Image
2. Try to count the dots that you see
3. Locate the area in our night sky that the image was taken from using a Star Map or Celestial Sphere

Background Information

- Notice there are no stars where this image was taken
- The astronomer who proposed the idea to stare the best telescope in the world at a black spot in the sky was laughed at
- It took ten consecutive days of observing in December 1995 to get this image
- It covers an area about 1/24 millionth of the sky (the size of a dime at arm’s length)
- Each dot in this image is a galaxy far beyond our own Milky Way Galaxy totaling over 3,000 galaxies
- Since then, the Hubble Deep Field South, Hubble Ultra-Deep Field, and the Hubble eXtreme Deep Field images have been taken

References

https://www.flightmuseum.com/stem-activities/
Activity – Distances in Space

Description

Guests learn about the size of our Universe by holding objects in their hands and thinking analogously.

Materials

- Marble
- Push pin
- Quarter
- DVD

Time – 5 minutes

Instructions

4. If the Earth is a marble, how big is the Moon?
   a. As big as the head of a push pin.
   b. The Moon is about ¼ the size of the Earth.

5. If the Earth is a marble, how big is the Sun?
   a. The Sun would be 3 feet tall
   b. 1.3 million Earths could fit inside the Sun
   c. The largest star is 2,000 times larger than our Sun

6. If the Earth is a marble, how far away would the push pin Moon be?
   a. Push pin Moon would be 1 foot away from the marble Earth.
   b. The Moon is 240,000 miles from Earth, 3 days by rocket

7. If the Earth is a marble, how far away would the 3-foot Sun be?
   a. The 3-foot Sun would be one football field away
   b. The Sun is 93 million miles away, a distance we call 1 Astronomical Unit (AU)
   c. Light (the fastest thing in our Universe) takes 8 min to travel from the Sun to the Earth

8. If our solar system was shrunk down to fit on a quarter, how large would our galaxy be?
   a. Our galaxy would be the size of the United States.
   b. Human spacecraft have only just made it out of our solar system with Voyager 1

9. If our galaxy was shrunk down to fit on a DVD, how far away would our closest neighbor, the Andromeda galaxy, be?
   a. Andromeda would be 8 feet away
   b. Andromeda is 2.537 million light years away

References

https://www.flightmuseum.com/stem-activities/
Activity – Electromagnetic Spectrum

Description

Through spectroscopes, guests view the spectra of different elements in a halogen lamp. A graphic of the electromagnetic spectrum explains how we can view the world through different filters.

Materials

- Electromagnetic Spectrum poster
- Spectrographs Spectral Tube Power Supply and Mount
- Spectral Tubes
- Laptop (optional)

Time – 5 minutes

Instructions

1. Using spectroscopes, determine which tube contains which gas based on their spectra
   i. Hydrogen will have more purple bands
   ii. Helium will have a distinct gold band
2. Hold the spectroscopes up to the ceiling lights
3. How might this be useful when we study stars or our Sun?
4. Explore seeing outer space with different filters with a laptop set to public.nrao.edu/color/

Background Information

- Light (photons) travels at different wavelengths called the electromagnetic spectrum
- Humans can see light in the visual spectrum
- The electromagnetic spectrum can tell us a lot
  o Radio waves- show us gas clouds that aren’t visible
  o Infrared waves- shows us heat from a system and rotation or movement
  o Visible waves- shows us light emitting objects and chemical composition
  o Ultraviolet waves- shows us most energetic areas and star birth regions
  o X-ray waves- show us the locations of neutron stars and black holes
  o Gamma waves- deadly to humans, show us supernova explosions and antimatter
- Visible light can be broken into the rainbow and any missing colors can tell us what chemicals are in the gas

References

https://www.flightmuseum.com/stem-activities/
https://public.nrao.edu/color/
**Activity – Dark Matter with a Gravity Well**

**Description**

Using a gravity well, guests explore gravity with different sized and weighted marbles to explore gravity and discover dark matter on their own!

**Materials**

- Dark Matter Poster
- Gravity Well
- Marbles
- Tennis ball
- 2-inch Ball Bearing

**Time – 5 minutes**

**Instructions**

- The Gravity Well demonstrates how two objects with matter interact
  - Put a tennis ball in the center of the gravity well
  - Let a few marbles fall towards it
  - Replace the tennis ball with the ball bearing
  - Let a few marbles fall towards it
  - Did the marbles move faster or slower towards the heavier weight?
  - More matter means a stronger gravitational attraction
- What if there was something pulling objects towards it, but we couldn’t see what it was
  - Pull the gravity well cloth from the bottom down a few inches
  - Let a few marbles fall towards the center
  - If the marbles are falling towards it, then there has to be something pulling it
  - Since we can’t see what it is, we call it dark matter

**Background Information**

- Gravity is based on matter, the more matter the stronger the gravitational attraction
- Scientists added up all the matter from the stars and planets that they could see, and the number they got was a lot less than the amount of matter necessary to make the galaxy move the way it does
  - Conclusion: there is some matter we cannot see!
  - Dark matter got its name, and many scientists are studying this elusive substance.

**References**

https://www.flightmuseum.com/stem-activities/

https://www.youtube.com/watch?v=Ze4IlpaODyM
Activity – Eyes on Exoplanets

Description
After exploring an image of all the exoplanets currently known, guests can use NASA's Eyes on Exoplanets website to explore these exoplanets further.

Materials
- Model of our solar system
- Exoplanets Poster
- Laptop
- Additional teaching material

Time – 5 minutes

Instructions
1. Using the Eyes on Exoplanets application, explore the known exoplanets throughout our galaxy
2. Please note, these are 3D renderings based on scientific data and are not actual images

Background Information
- The Kepler space mission uses the transit method to discover planets
  - Kepler has discovered 2,242 confirmed exoplanets
  - Of those, 30 are Earth-sized in the habitable zones of their host stars
- Spitzer Space Telescope uses Direct Imaging to identify exoplanets
  - In February 2017, Spitzer identified 7 Earth-like exoplanets around Trappist 1 star- a great possibility for hosting life

References
https://www.flightmuseum.com/stem-activities/
https://eyes.nasa.gov/eyes-on-exoplanets.html
Activity – MicroObservatory

Description
Using a laptop set to NASA’s Micro Observatory, guests schedule a telescope to capture an image of an object of their choice and send it to their email. Once they select an object, guests are given a copy of a NASA quality photo of their object to take home.

Materials
- Laptop
- Desktop Photo Printer
- Printer Ink and Paper

Time – 5 minutes

Instructions
3. Using the website, choose a target to image and when the image is taken (within 48 hours) it will be emailed to you
4. Take home a NASA quality image of your target in the meantime, printed before your eyes!

Background Information
- Micro Observatory is a network of automated telescopes that can be controlled over the Internet.
- The telescopes are located in Cambridge, MA and Amado, AZ
- The network is composed of several 3-foot-tall reflecting telescopes using a 6-inch mirror to capture the light from distant objects

References
https://www.flightmuseum.com/stem-activities/
http://mww.cfa.harvard.edu/MicroObservatory/
**Activity – Comets**

**Description**

With simple household supplies, guests make a comet to play with, explore, and take home. A bowl with dry ice and ammonia can be added to set the scene for comets.

**Materials**

- Foil
- Skewers
- Ribbon
- Dry Ice
- Ammonia

**Time – 10 minutes**

**Instructions**

5. Build your own comet on a stick and wave it around to show the tail
   a. Start with a skewer
   b. Begin to fold a sheet of foil around the end
   c. Before you completely crumple the foil, stick a few strands of ribbon into the foil
   d. Crumple the foil up completely
6. Wave your comet around to show off the tail

**Background Information**

- Our solar system is composed of a star (the Sun), planets, asteroids, comets and more
- Explore what a comet is made of but DON’T TOUCH
  - Comets are dirt clods covered in ice
  - As they travel through our solar system, the Sun’s heat melts the ice creating a tail
  - A comet’s tail will always point away from the Sun even if it is also moving away from the Sun

**References**

https://www.flightmuseum.com/stem-activities/

https://spaceplace.nasa.gov/comet-stick/en/
Activity – Galaxy Slime

Description
Guests mix the ingredients, choose the color of slime and glitter, then slide their slime into a bag to take home all while learning about the multiple objects and elements that make up our own galaxy!

Materials
- Bowls
- Clear Elmer’s Glue
- Water
- Measuring Cups
- Measuring Spoons
- Borax
- Glitter
- Food Coloring
- Baggies

Time – 15 minutes

Instructions
1. In one bowl, mix 1/4 cup of glue with 1/4 cup of water
2. Add food coloring to mixture
3. In another bowl, mix 1/2 teaspoon of borax with 1/2 cup of lukewarm water
4. Stir until borax is dissolved (takes some time)
5. Add the glue mixture to the borax water and stir slowly
6. Use your hands to mix the slime around and pull it from the bowl
7. Fold in some glitter and spread it around your slime
8. Put your slime in a bag and take it home

Background Information
Our Galaxy (the Milky Way) is made of gas, dust, stars, nebulas, planets, black holes, quasars, supernova remnants, dark matter, antimatter, and more

References
https://www.flightmuseum.com/stem-activities/
https://spaceplace.nasa.gov/universe-slime/en/
Poster Exhibit – Visions of the Universe

Description

12 posters about the wonderful objects in our solar system and beyond. These beautifully descriptive images invoke wonder to every aged guest.

Materials

- Printed Posters

Time – 20 minutes

Instructions

10. Print the posters on foam core from your local print shop
11. Display on easels or wall space

Background Information

In turning his telescope to the heavens in 1609, Galileo embarked upon a journey that would revolutionize science and culture, profoundly altering our view of our place in the universe. Our changing views of the universe are portrayed in the images and text of the exhibit, "Visions of the Universe: Four Centuries of Discovery."

In celebration of the International Year of Astronomy, the exhibit includes twelve panels that feature key astronomical discoveries from the past 400 years. The exhibit also highlights the technological advancements that made these discoveries possible. Exhibit topics range from celestial objects within our own “cosmic backyard” - the Sun, the Moon, Mars, and Saturn - to those beyond the realm of our solar system - including comets, stars, nebulae, and galaxies.

The poster PDF is a large-file-size, high-resolution file intended from professional print-center output. The poster measures 19 inches wide by 34 inches tall.

References

https://amazing-space.stsci.edu/visions/panel_visions_intro.php
Additional Events:

1. *Planetarium Show* utilizing AstroPix’s high resolution images to further explore NASA’s three big questions (*How did we get here, How does the Universe work, Are we alone*).

2. *Guest speaker* ties the event up with a bow as future scientists and science enthusiasts hear about the real research happening in their own city from a local scientist.
Materials

1. Hubble Deep Field
   a. Hubble Deep Field Poster
   b. Dime

2. Distances in Space
   a. Quarter with tiny solar system image taped on
   b. DVD with tiny Milky Way image taped on
   c. Size of the Universe Poster

3. Electromagnetic Spectrum
   a. Electromagnetic Spectrum poster
   b. Solar Spectroscopy Poster
   c. Spectrographs
   d. Spectral Tube Power Supply and Mount
   e. Spectral Tubes

4. Dark Matter- Gravity Well
   a. Dark Matter Poster
   b. Gravity Well
   c. Marbles
   d. 2-inch Ball Bearing

5. Exoplanet Detection
   a. Laptop
   b. Lamp
   c. Globes of various sizes

6. Eyes on Exoplanets
   a. Laptop
   b. Model of our solar system

7. Micro Observatory
   a. Laptop
   b. Desktop photo printer
   c. Printer Ink and Paper

8. Comets
a. Foil
b. Skewers
c. Ribbon
d. Dry Ice
e. Ammonia

9. Galaxy Slime
   a. Clear Elmer's Glue
   b. Borax
   c. Food Coloring
   d. Glitter
   e. Baggies

10. Visions of the Universe
    a. Printed Posters

11. Planetarium Show
    a. Full day of Planetarium Shows

12. Guest Speaker
Layout

1. Hubble Deep Field
2. Distance in Space
3. Electromagnetic Spectrum
4. Gravity Well
5. Exoplanet Detection
6. Eyes on Exoplanets
7. Micro Observatory
8. Comets
9. Galaxy Slime

Flow of traffic

Volunteers/Educators
Tips and Advice

1. We had originally planned to include 4 STEM professionals to speak to the guests about their work to help answers NASA’s questions but quickly realized that each of the professionals wanted to speak for a long time. Choosing one professional to host a talk worked better logistically allowing the public to really get a sense of her research.

References

Space STEM Live website: https://www.flightmuseum.com/spring-break/
Space STEM Live video compilation: https://youtu.be/8NIZPSpLPA4