



Bela Power

Lead Instructor

**STARBASE
Oklahoma**

**NASA OKSG
MTPE
Ambassador**

Mysteries of the Dark: 2.0



Learn how to build models of the universe and the observatories NASA uses to explore it. Students will learn what exactly makes up the universe and experience topics they might not have encountered before. Exploring the mysteries of dark energy and dark matter will get students excited about future discoveries!



James Webb Space Telescope



Alpha Magnetic Spectrometer

... and 3 models of the Universe!

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Our Presenters



Bela Power

NASA OKSG MTPE Class of 2019-2020 Ambassador

NASA OKSG STELLAR Mentor

Lead Instructor, STARBASE Oklahoma



Dorinda Risenhoover

Education Coordinator

NASA Oklahoma Space Grant Consortium/ NASA EPSCoR



Jessica Cortez

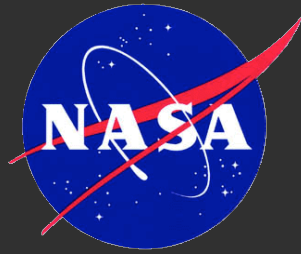
NASA OKSG STELLAR Class of 2021-2022 Participant

Early Childhood Education, Oklahoma State University



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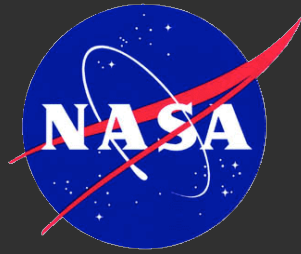





WHAT IS THE NASA SPACE GRANT CONSORTIUM?

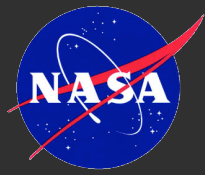


- Legislated by Congress in 1988; initiated by NASA in 1989
- National network of university-based Space Grant Consortia whose goal is to contribute to the nation's science enterprise by funding education, research, and public engagement projects.
- The Space Grant national network includes over 850 affiliates from universities, colleges, industry, museums, science centers, and state/local agencies.
- These affiliates belong to one of 52 NASA Space Grant Consortia, one in each of the 50 states, one in Puerto Rico, and one in DC.

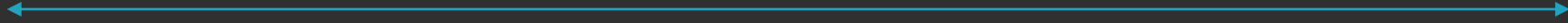


NASA SPACE GRANT CONSORTIUM OBJECTIVES

- 
- Establish and maintain a national network of universities.
 - Encourage cooperative programs among universities; aerospace industry; and Federal, state, and local governments
 - Encourage interdisciplinary education, research, and public service programs related to aerospace
 - Recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities
 - Promote a strong science, mathematics, and technology education base from elementary through secondary levels.



NASA OKSG AFFILIATES





At DoD STARBASE, students participate in challenging "hands-on, minds-on" activities in STEM.

- ✓ Students interact with military personnel to explore careers and observe STEM applications in the "real world."
- ✓ 25 hours of stimulating experiences at National Guard, Marine, Air Force Reserve, Army, and Air Force bases across the nation.
- ✓ Motivates fifth graders to explore STEM opportunities as they continue their education.
- ✓ Serves students that are historically underrepresented in STEM: in inner cities or rural locations, socio-economically disadvantaged, low in academic performance, or have a disability.



Special thank you to The Gerald A. Soffen Memorial Fund Travel Grant



Jerry Soffen, a biologist by training, led a distinguished career in NASA, including serving as the Project Scientist for Viking and as an architect for the NASA Astrobiology Institute.

The Travel Grant continues Jerry's dedication to educating and involving future generations in space science and engineering pursuits.

Next Gen Standards

HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

5-PS1-3. Make observations and measurements to identify materials based on their properties.

TEKS Standards

ASTR.14(D): Recognize the importance of space telescopes to the collection of astronomical data across the electromagnetic spectrum.

Math 3.1(E): Create and use representations to organize, record, and communicate mathematical ideas.

Math 3.4(D): Determine the total number of objects when equally-sized groups of objects are combined or arranged in arrays up to 10 by 10.

Science 5.3(A): In all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.

Building the James Webb Space Telescope

Objectives: Participants will build an origami paper model of the James Webb Space Telescope, while learning about the JWST and related NASA missions.

- Search for the first galaxies formed after the Big Bang
- Determine how galaxies evolved from their formation until now
- Measure the properties of planetary systems, including our own, and investigate the potential for life in those systems

Mission Overview
(from jwst.nasa.gov)

- Webb will be launched in 2021
- Mission duration: 5-10 years
- Primary mirror material: beryllium coated with gold



Materials

Please see the PDF "Mysteries of the Dark: 2.0" for full instructions and extra resources!



Jenny Chan at Origami Tree

Jenny Chan is an amazing origami artist. She is an arts & crafts teacher and paper crafts designer. Check out her incredible website and designs!

<http://www.origamitree.com/>



Finished JWST

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James Webb Space Telescope



❖ Needed Materials



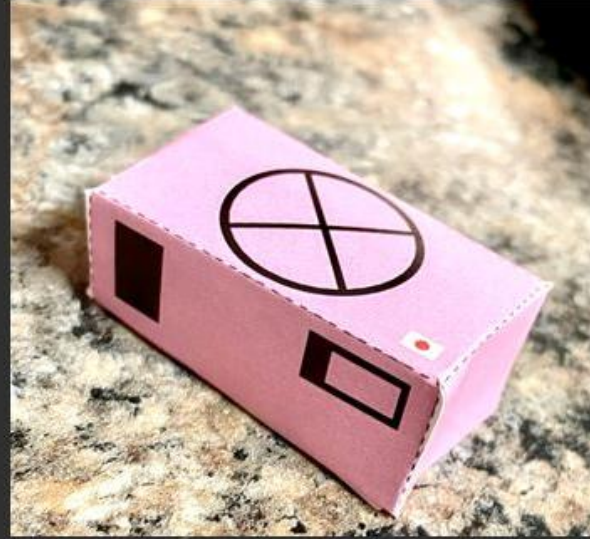
- ❖ Cut out all pieces
- ❖ Fold the "cold" side of Sunshield along dotted lines



James Webb Space Telescope



- ❖ Glue along the sections that have a red dot
- ❖ Glue “sun-facing” side of Sunshield to “cold” side



- ❖ Fold along the dotted lines of Spacecraft Bus
- ❖ Glue along the sections that have a red dot



- ❖ Glue the Antennae like this

James Webb Space Telescope



- ❖ Glue Antennae to Spacecraft Bus as shown



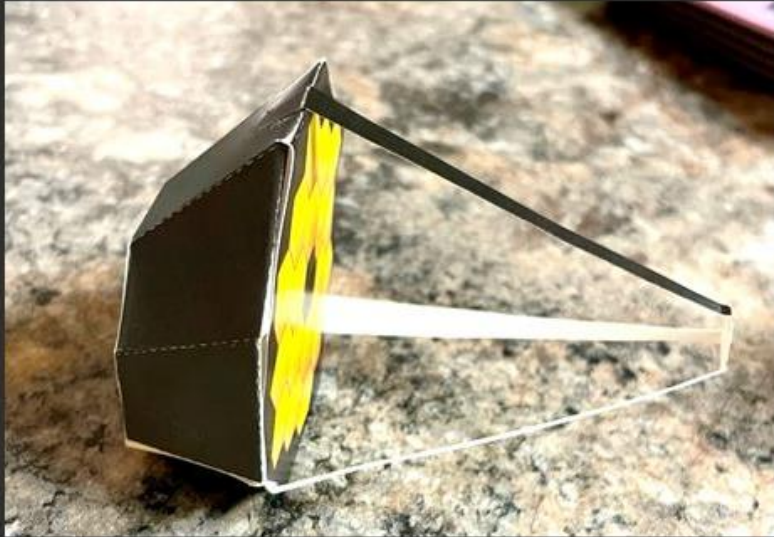
- ❖ Fold Primary Mirror and Scientific Instruments along dotted lines

- ❖ Glue along sections that have a red dot



- ❖ Fold Secondary Mirror as shown

James Webb Space Telescope



- ❖ Glue Secondary Mirror to Primary Mirror as shown



- ❖ Glue both mirrors to “cold” side of Sunshield
- ❖ Craft glue or a glue gun works better for this step!



- ❖ Glue Spacecraft Bus and Antennae to “sun-facing” side of Sunshield
- ❖ Craft glue or a glue gun works better for this step!

Building the Alpha Magnetic Spectrometer

Objectives: Students will learn about the Alpha Magnetic Spectrometer and related NASA missions. Students will review multiple resources concerning the Alpha Magnetic Spectrometer (AMS). SWBAT build their own model AMS using cardboard paper towel rolls and other materials.

Launch: 5/16/11
 Installation: 5/19/11
 Assembly Mission: ULF6
 Shuttle Mission: STS-134
 Vehicle: Space Shuttle
 Endeavour
 Crew on station: Expedition 27

Mission Overview



Materials



Finished AMS 1



Finished AMS 2

Watch this fun AMS video so students can learn a little bit about what they will be making:

https://www.youtube.com/watch?v=jcBTITScI_M

Display the AMS image where students can see.

Please see the PDF "Mysteries of the Dark: 2.0" for full instructions and extra resources!

"Mission Control" can now say:
 "Congratulations! Your experiment is now ready to explore the universe!"

My daughter showed some impressive creativity with this! She said, "This is my organized side with the rainbow. This is my fun, creative side that likes to mix things up and this is my religious side because it has a cross on it."



Alpha Magnetic Spectrometer



❖ Needed Materials



❖ Place paper towel tube in the center of a side that does not have a seam

❖ Check to make sure there is also not a seam on opposite side



❖ Trace a circle around the paper towel tube

❖ Flip over to opposite side of box and do the same on that side



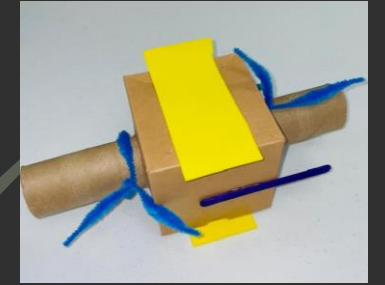
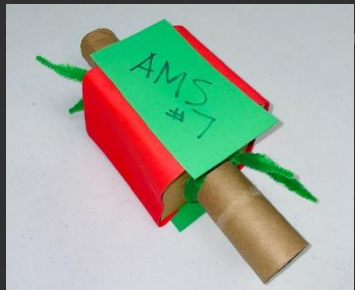
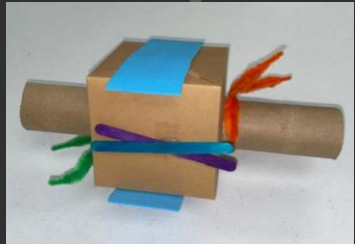
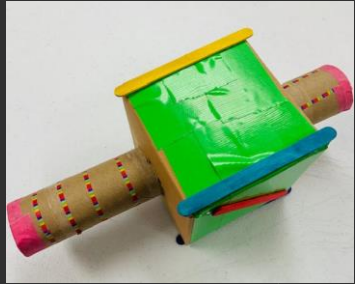
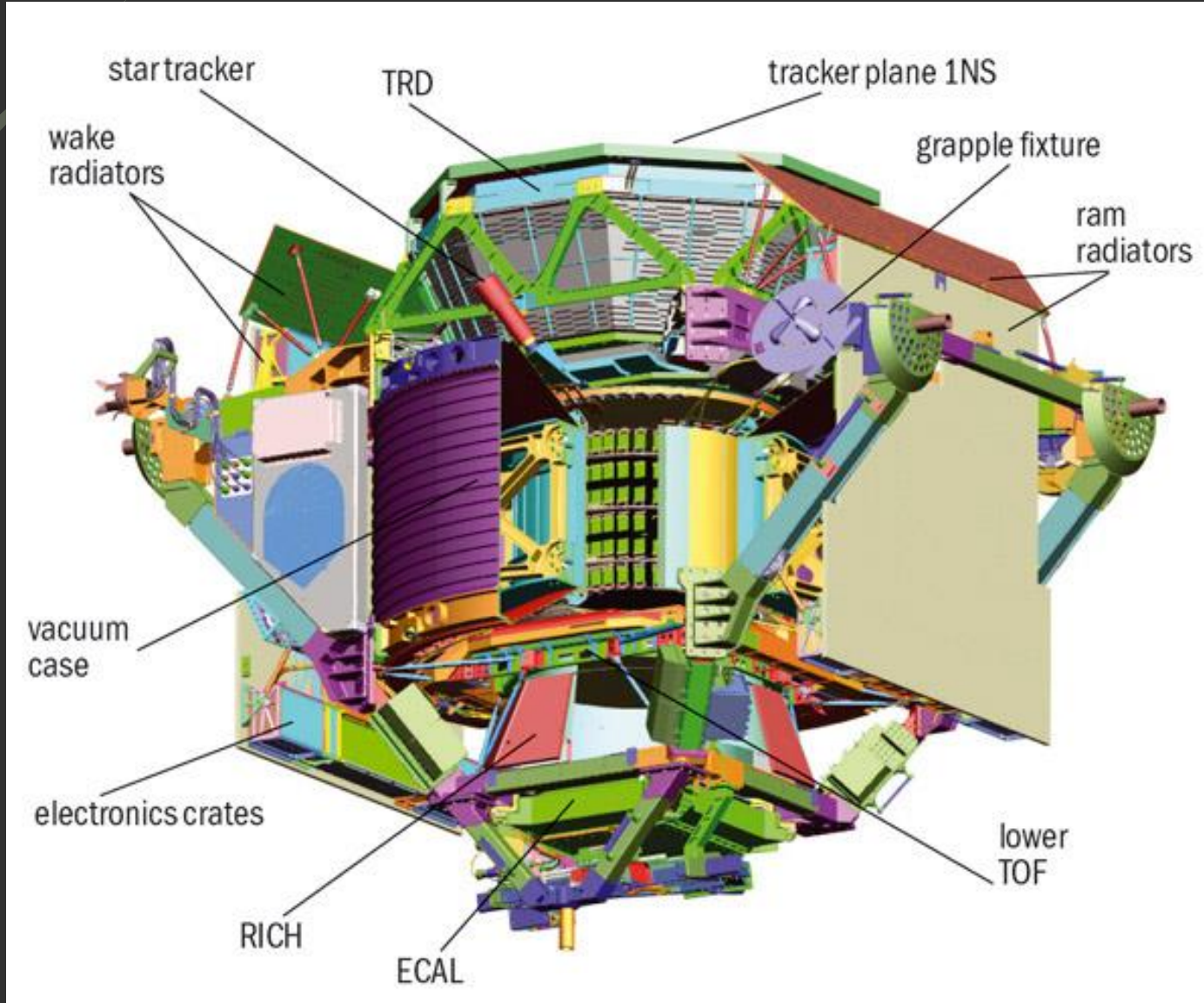
❖ Cut out both circles as shown

Alpha Magnetic Spectrometer



- ❖ Put the paper towel tube through the center of the box
- ❖ You may add glue to hold in place, but that usually isn't necessary
- ❖ Use the paper and other materials to decorate your artistic representation of the AMS!

AMS Magnet and Detectors



What Makes Up the Universe?

Objectives: Participants will build 3 models to understand the different “pieces of the puzzle” that make up our universe, while learning about dark matter, dark energy, and related NASA missions. Participants will be able to name the three “pieces of the puzzle that make up the universe”:
dark energy, dark matter, and familiar atomic matter (modify whatever you call this for young students).



Materials



Finished Pom Pom Universe

Ask students: “How can we see the universe? We aren’t out there in space, so we will have to make our own model of what the AMS sees!”

Please see the PDF “Mysteries of the Dark: 2.0” for full instructions and extra resources!



Materials



Finished Perler Bead Universe

An awesome video here showing Astronaut Chris Hadfield talking about the importance of the AMS!

<https://www.youtube.com/watch?v=PiI26tZkug>



Ball Universe

Make sure to use the Jellybean Universe PDF and share Pieces of the Universe Puzzle!

Pom Pom Universe



❖ Needed Materials



- ❖ Count out 73 pom poms of one color
- ❖ This is a great time to draw some arrays (circles) to place the pom poms in to practice counting by 10s or beginning stages of addition



- ❖ Count out 22 pom poms of another color
- ❖ The pom poms have been grouped into 10s for the two colors on this slide, but you can skip count however you choose

Pom Pom Universe



❖ Count out 5 pom poms of the last color



❖ Put all the counted pom poms in the pie pan



❖ Mix them all around
❖ This model of the Universe is complete!

Perler Bead Universe



❖ Needed Materials



- ❖ Count out the Perler beads:
73 of one color
22 of a second color
5 of a third color
- ❖ These beads have been grouped into 10s to make counting easier
- ❖ Place in paper cup for organization if desired



- ❖ Place all beads onto board in random order as shown
- ❖ It doesn't have to be a circle, but the beads all need to touch so they will fuse together

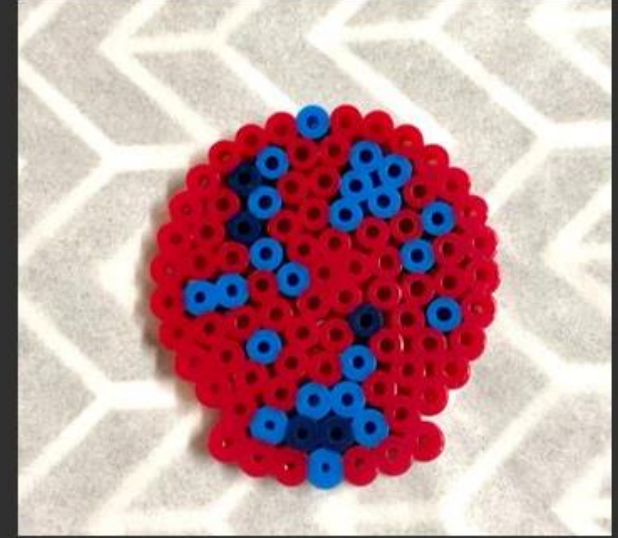
Perler Bead Universe



- ❖ Place board on ironing surface and cover with ironing paper



- ❖ Iron according to directions. This usually should be done by the teacher. Recommended heat is medium setting, running iron over design in a circular motion for 10 seconds.



- ❖ This model of the Universe is complete!

Plastic Ball Universe



❖ Needed Materials

In this presentation, I changed our total to 110 balls to fill up this pool as much as possible.

To keep the percentages correct, I have changed them to the following:

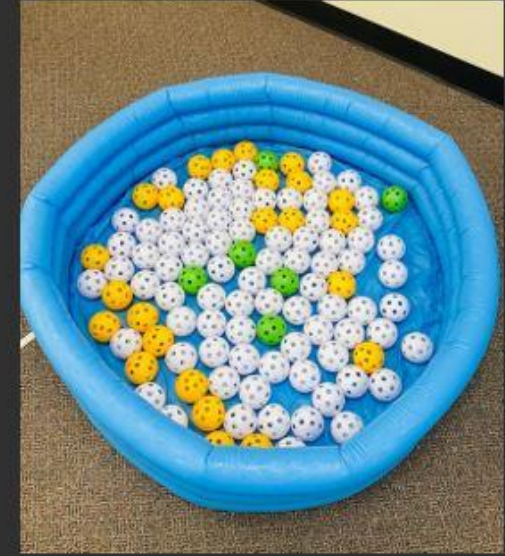
- 80 of one color
- 24 of a second color
- 6 of a third color



❖ Count out:

- 73 balls of one color
- 22 balls of a second color
- 5 balls of a third color

❖ Divide them all randomly into paper bags, depending on the number of students (Each student should have one bag.)



❖ Give each student a paper bag

- ❖ Place the swimming pool in a central area
- ❖ Have students all together throw the balls into the swimming pool
- ❖ This model of the Universe is complete!

What *Do* We Know About Dark Matter and Dark Energy?

95% - Dark Energy and Dark Matter
5% - Energy and Matter We Know

73% - Dark Energy
22% - Dark Matter
5% - Familiar Matter



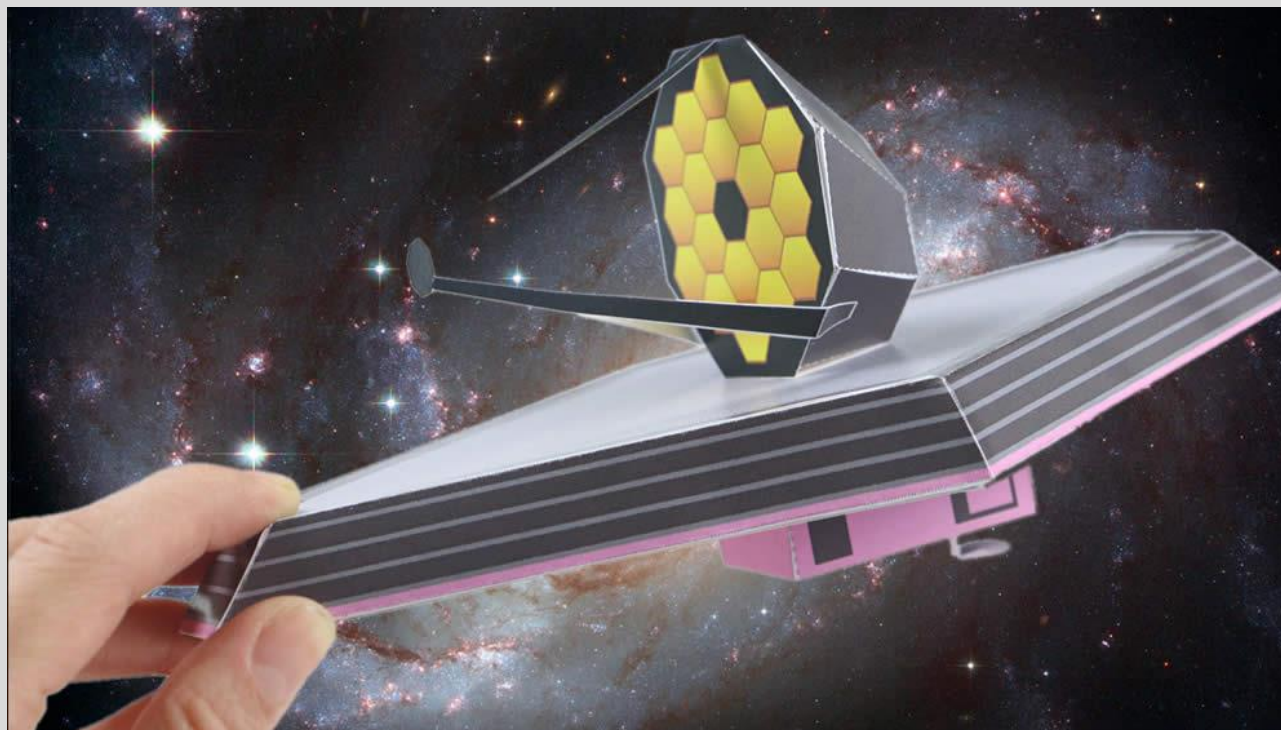
- After the universe was created, the expansion of it should have begun to slow after a period of time.
- Scientists have discovered the universe is expanding. Not only that, but the speed is increasing!
- Some kind of unknown energy is causing this. We call this dark energy.

- Dark matter is not something we can see, but like all matter - it has gravity.
- We can “see” dark matter due to gravitational lensing. (Thank you, Einstein!)
- Einstein theorized that heavy objects distort spacetime and if light passes near to those objects, then it would bend. This phenomenon is known as bending of light due to gravity.
- We can’t see dark matter, but we can see it bending the light!

<https://spaceplace.nasa.gov/dark-matter/en/>

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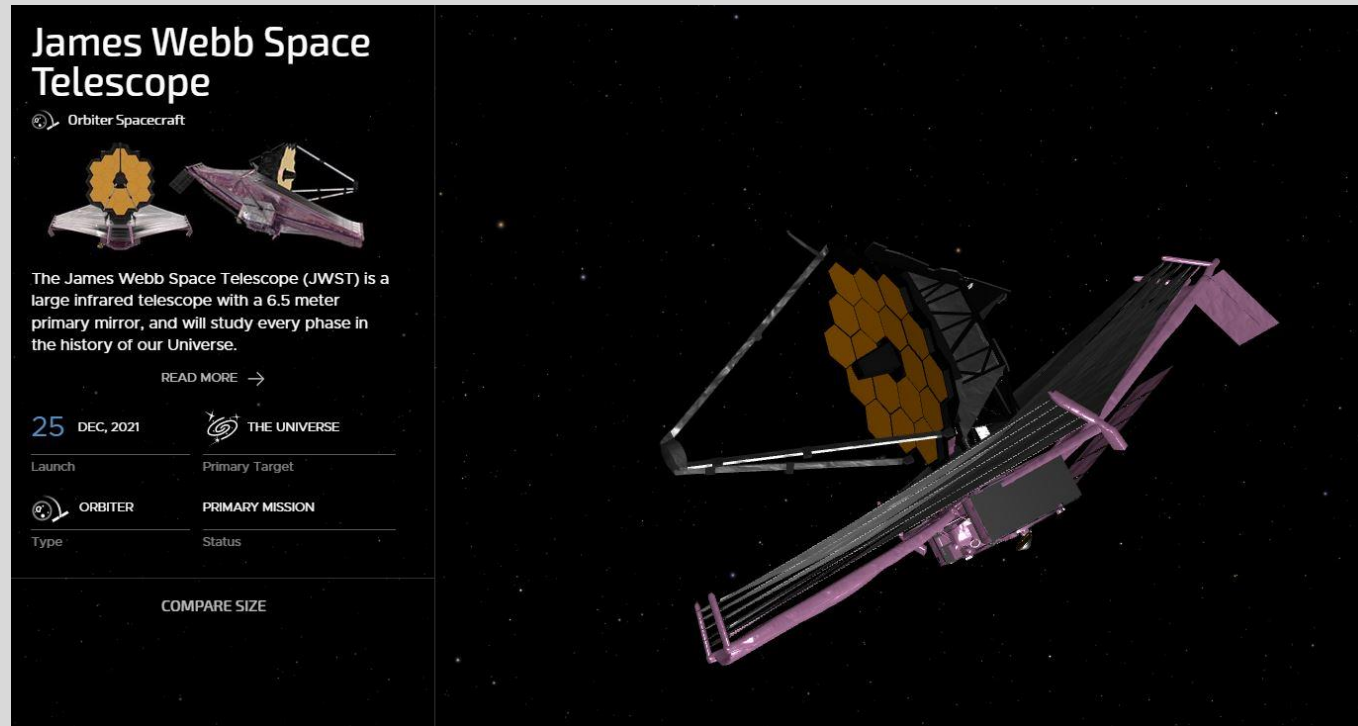


Origami James Webb Space Telescope

Origami paper models for James Webb Space Telescope
by Jenny Chan at Origami Tree

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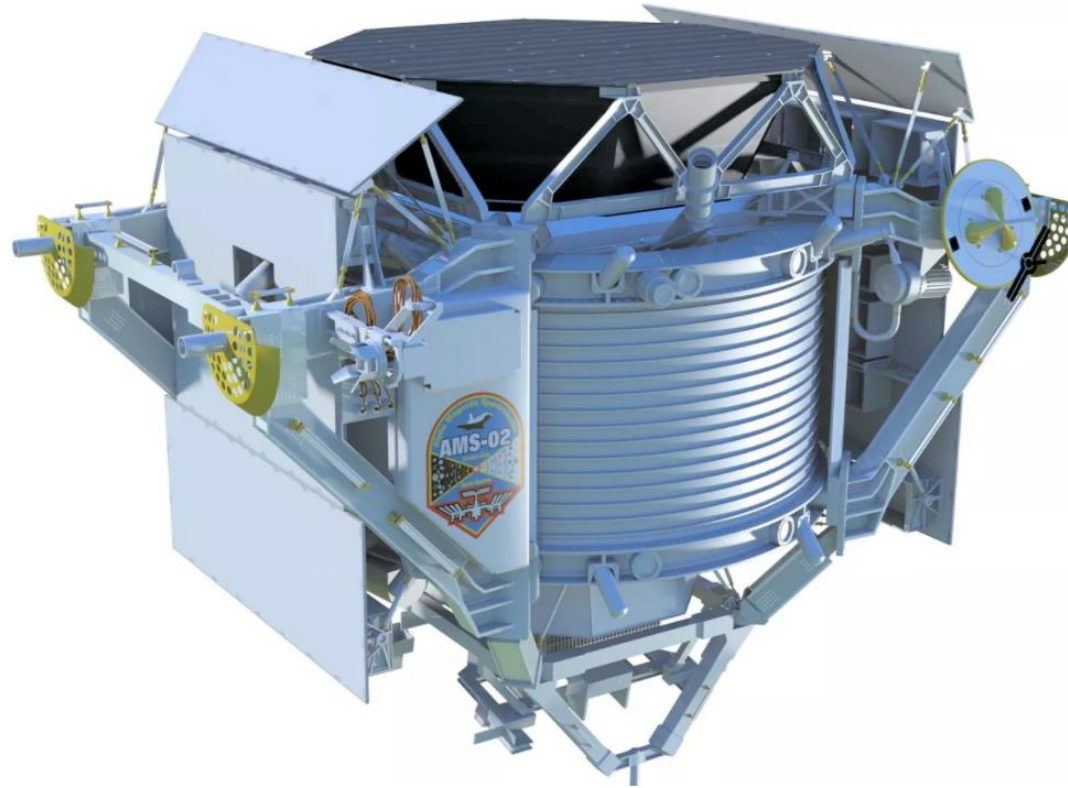
James Webb Space Telescope - NASA's Eyes

Provides a realistic simulated view of the James Webb Space Telescope

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The Alpha Magnetic Spectrometer (AMS)



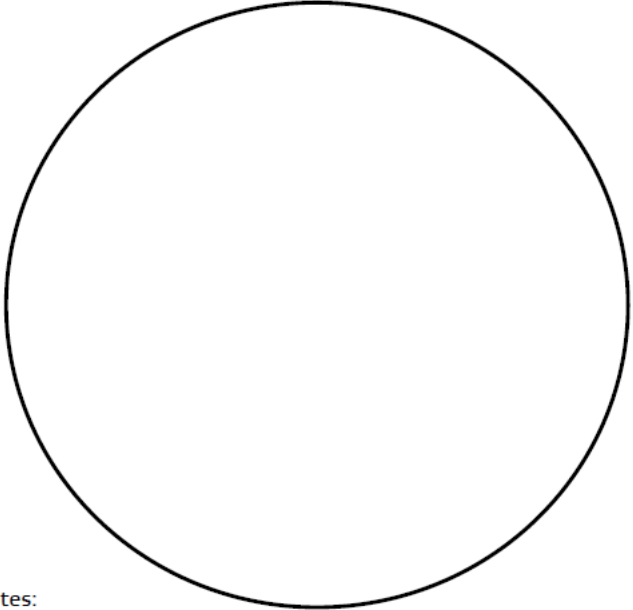
[Dark matter, WIMPS, and NASA's Alpha Magnetic Spectrometer data \(newatlas.com\)](https://newatlas.com/dark-matter-wimps-nasas-alpha-magnetic-spectrometer-data/)

This is an article from newatlas.com that talks about the AMS and its search for dark matter. I used the picture of AMS in this article as a visual for my students.



Name of scientist: _____

Date of observation: _____



Notes:

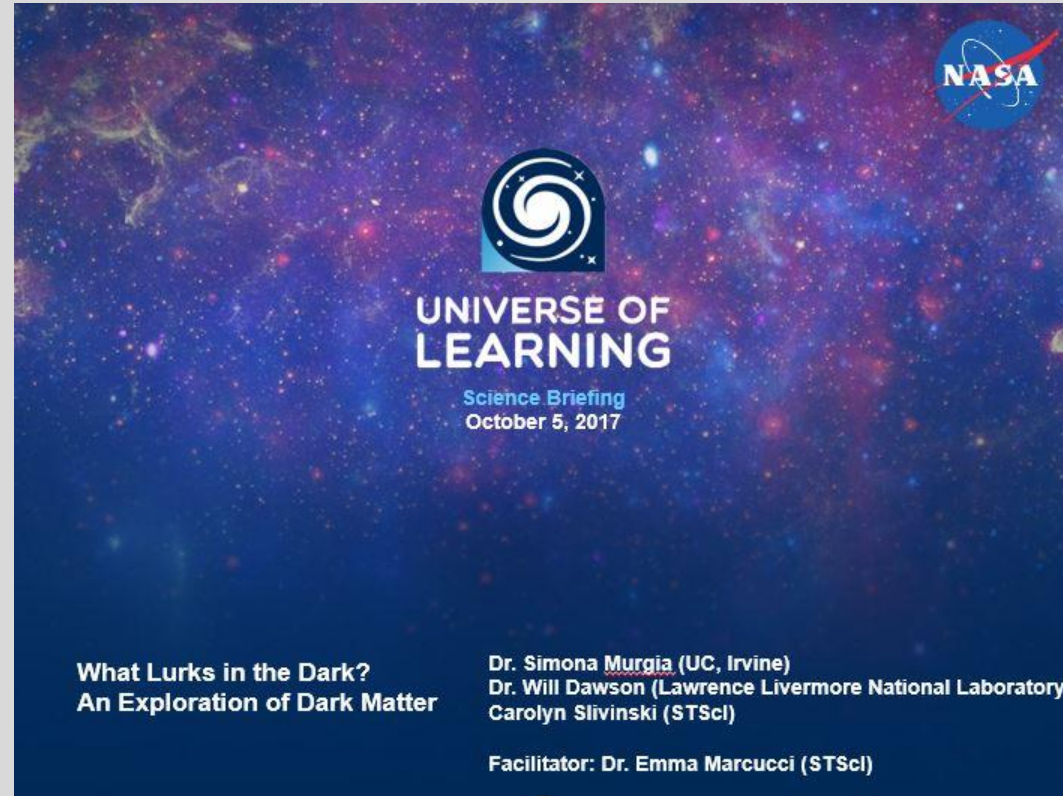
This is a PDF I created for students to draw and write about observations during the What Makes Up the Universe? Activities.



Link to the NASA SpacePlace webpage referenced earlier in this PowerPoint:

<https://spaceplace.nasa.gov/dark-matter/en/>

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Incredible PowerPoint over the topic of Dark Matter:

[What Lurks in the Dark?](#)

Scroll to the bottom of webpage for resources

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Abell 2744: Pandora's Cluster Revealed

One of the most complicated and dramatic collisions between galaxy clusters ever seen is captured in this new composite image of Abell 2744. The blue shows a map of the total mass concentration (mostly dark matter).

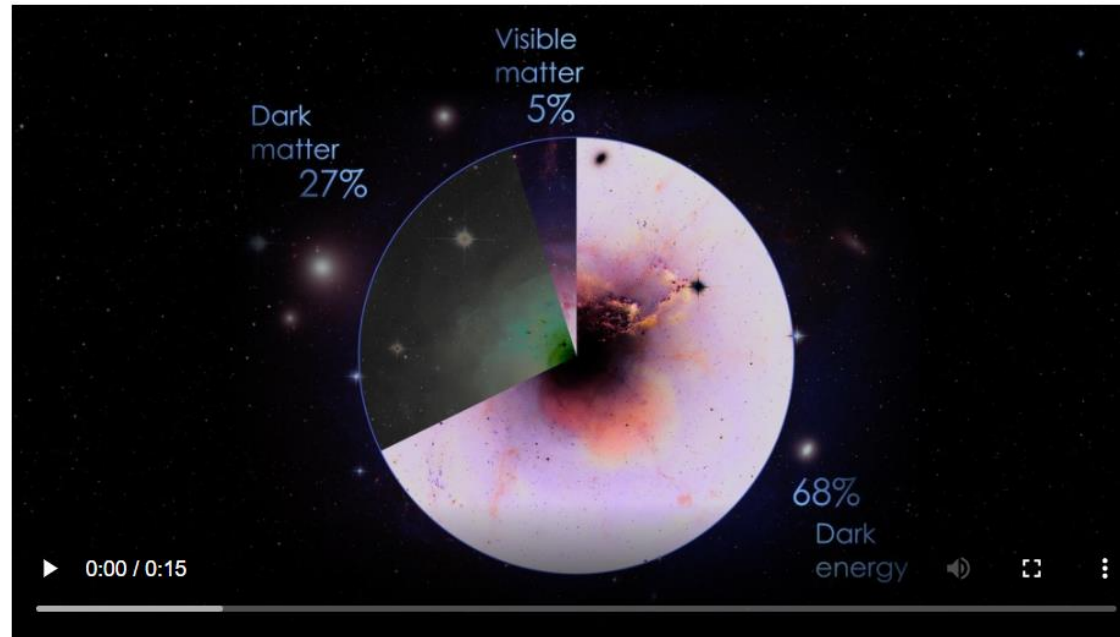
Additional information about dark matter and dark energy:

[Dark Energy, Dark Matter - NASA SCIENCE](#)

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Content of the Universe Pie Chart

Released on September 20, 2016



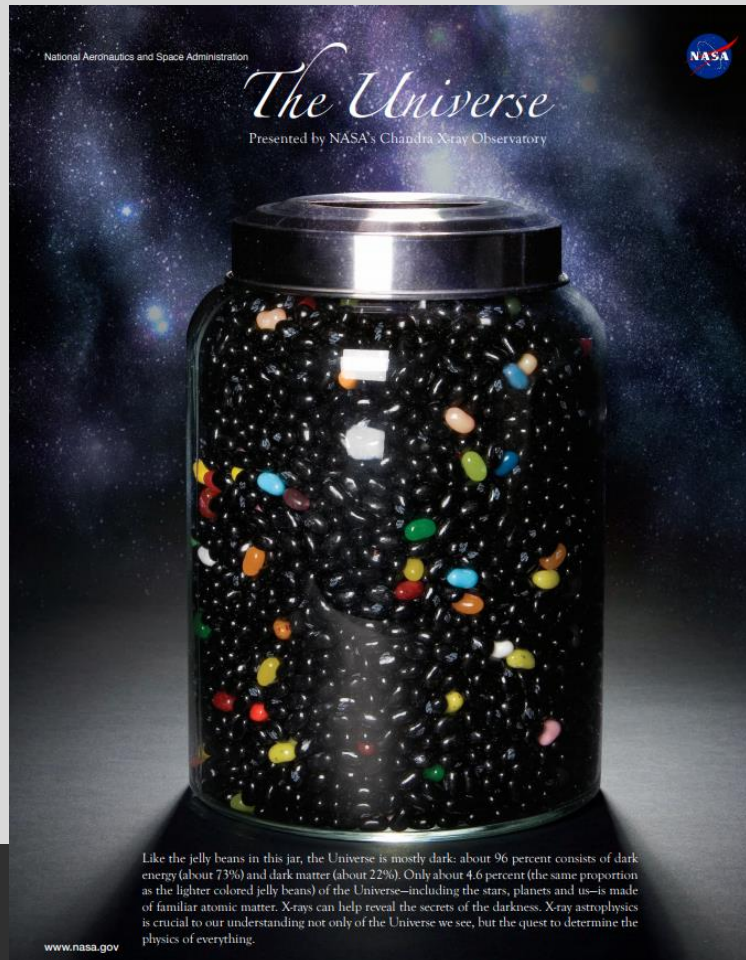
Animated pie chart showing rounded values for the three known components of the universe: normal matter, dark matter, and dark energy.

Download ▾

[GMS: Content of the Universe Pie Chart \(nasa.gov\)](#)

From: NASA's Goddard Space Flight Center. I used this pie chart to make a hands-on puzzle for students to see what makes up the universe.

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[The Universe Presented by NASA's Chandra X-ray Observatory \(harvard.edu\)](http://harvard.edu)

A fantastic visual representation from the Chandra X-Ray Observatory using jellybeans to show energy distribution in the universe. (Very large file)

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<https://www.youtube.com/watch?v=PiI26tZkug>

An awesome video here showing
Astronaut Chris Hadfield talking about the importance of the
AMS!

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Thank You for Attending

Thank you so much for coming to my session.



bmpower@starbaseok.org

If you have any questions,
please feel free to email me!

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