

# Look Up! Explore Our Universe with the JWST Mission

May 25, 2021

**The webinar will begin at 1:00 p.m. (MT) and will be recorded.**

## **While you're waiting**

- 1) Find the toolbar – it will either be on the bottom or top of your Zoom window
- 2) Introduce yourself in the chat box (please select **“Share with Panelists and Attendees”** *not* **“Share with Panelists”**)
- 3) Click audio “Join by Computer” – you won’t have microphone access

Tip for viewing: You can resize and move the location of the video and slide screens by clicking and dragging them

# Facilitator Introduction

- Claire Ratcliffe Adams (Space Science Institute)
- Dr. Alexandra Lockwood (Space Telescope Science Institute)
- Yesenia Perez (NASA's Universe of Learning/STSI)

# Today's Agenda

- **Welcome/Intro**
- **Icebreaker**
- **NASA @ My Library Project Information**
- **James Webb Space Telescope**
- **Universe of Learning Resources**
- **Q&A**

# Icebreaker Poll Question

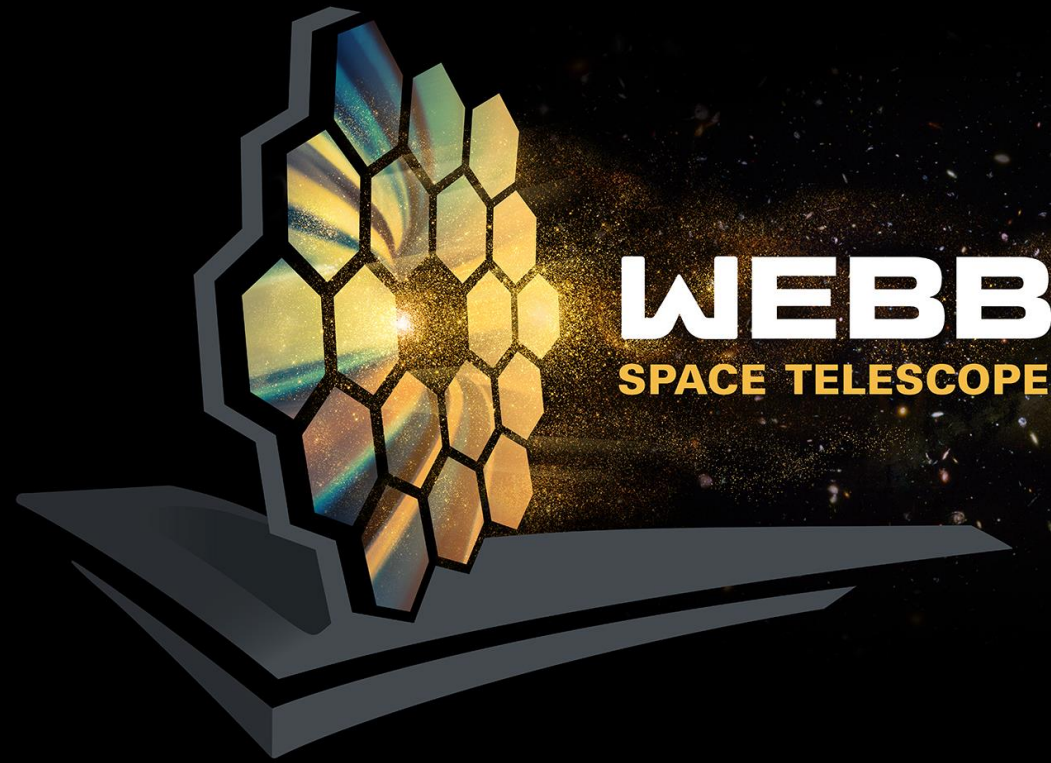
How many years back will the James Webb Space Telescope be able to see?

- a. 500
- b. 100k
- c. 10 million
- d. 13.5 billion



## Apply to be a member of NASA @ My Library

- 60 public and tribal libraries in the U.S. will receive:
  - Training and resources to implement NASA events and programming
  - Access to Subject Matter Experts
  - \$1600 programming stipend
- Application deadline: July 21



# Unfold the Universe with the Webb Space Telescope

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Dr. Alex Lockwood

May 4, 2021



# Outline

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Motivations for Webb

Infrared Light and Webb Science

About the Telescope

# Motivations for Webb

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- Formulation
- Implementation
- Primary Ops
- Extended Ops

+ SMEX/MO (2025),  
MIDEX/MO (2028), etc.

Spitzer  
8/25/2003

WFIRST  
Mid 2020s

Euclid (ESA)  
2022

SXG (RSA)  
7/13/2019

Webb  
2021

Ariel (ESA)  
2028

Chandra  
7/23/1999

XMM-Newton  
(ESA)  
12/10/1999

TESS  
4/18/2018

Swift  
11/20/2004

NuSTAR  
6/13/2012

Fermi  
6/11/2008

IXPE  
2021

XRISM (JAXA)  
2022

SPHEREx  
2023

ISS-NICER  
6/3/2017

GUSTO  
2021

Hubble  
4/24/1990

SOFIA  
Full Ops 5/2014

+ Athena (early 2030s),  
LISA (early 2030s)

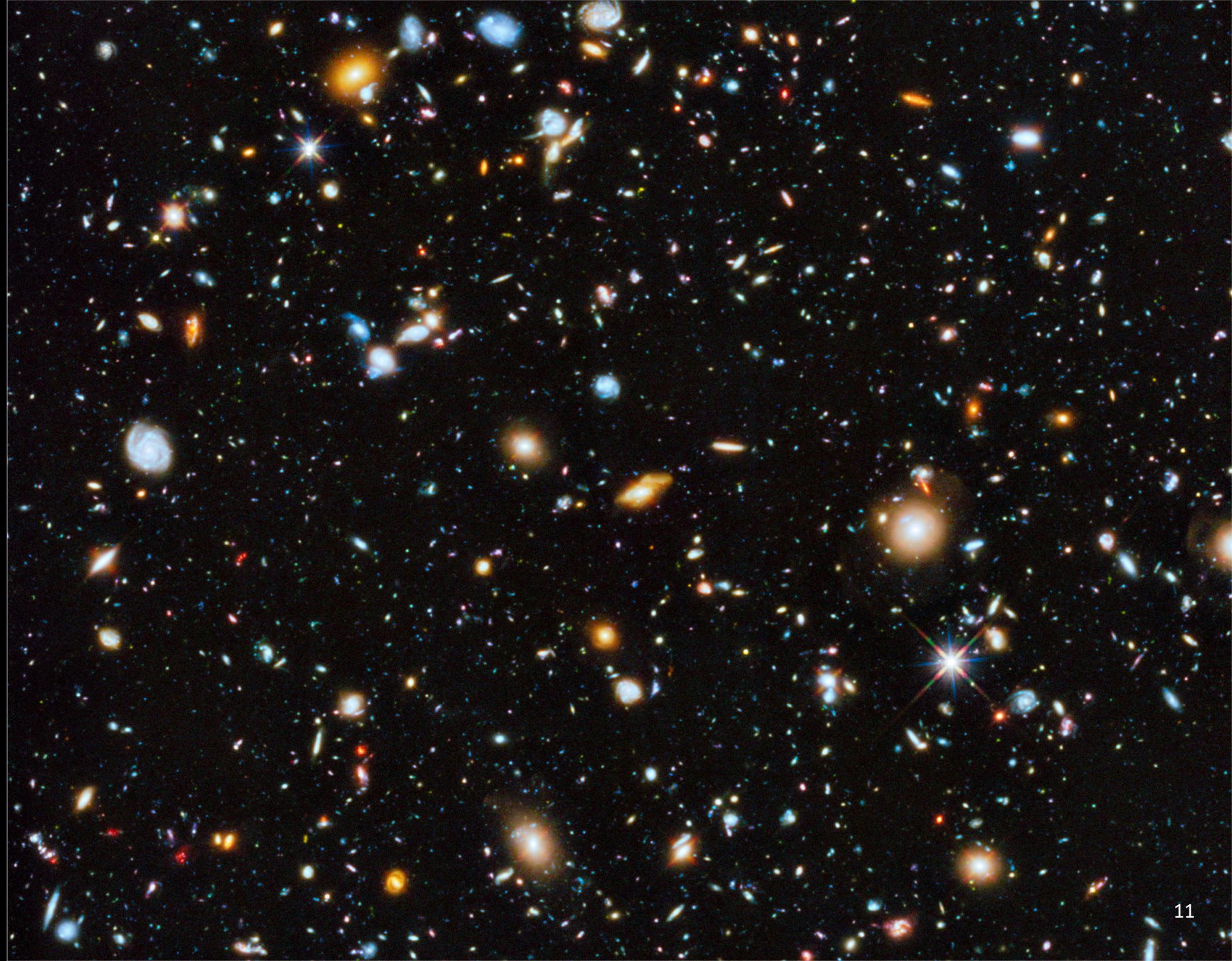
# The Hubble Space Telescope

30 years in space  
and a legacy of  
images and  
discoveries



*Image credit: NASA; NASA, ESA, and the Hubble SM4 ERO Team; NASA, ESA/Hubble and the Hubble Heritage Team; NASA, ESA, and the Hubble Heritage - ESA/Hubble Collaboration*

# The Hubble Ultra Deep Field



*Image credit: NASA, ESA, H. Teplitz and M. Rafelski (IPAC/Caltech), A. Koekemoer (STScI), R. Windhorst (Arizona State University), and Z. Levay (STScI)*

**We can use  
deep fields to  
construct the  
history of  
galaxies over  
time**

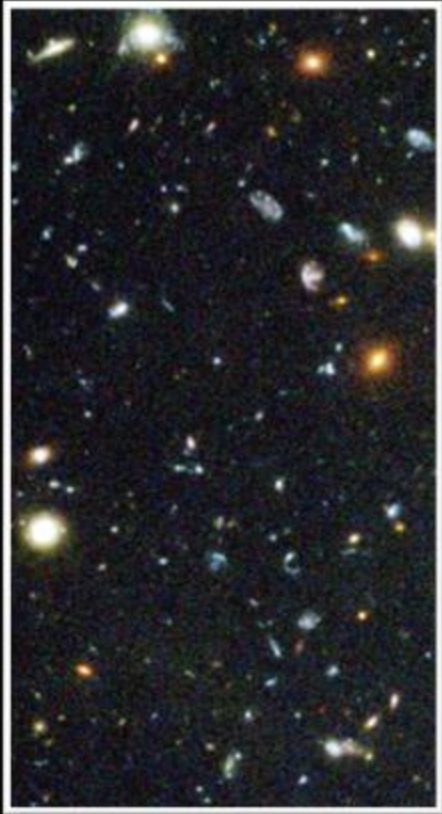
***But what about  
the first  
galaxies?***



*Image credit: Frank Summers, Alyssa Pagan, Leah Hustak, Greg Bacon, Zolt Levay, Lisa Frattare (STScI), Anton Koekemoer, Bahram Mobasher, and HUDF Team*

# Webb Science and The Infrared

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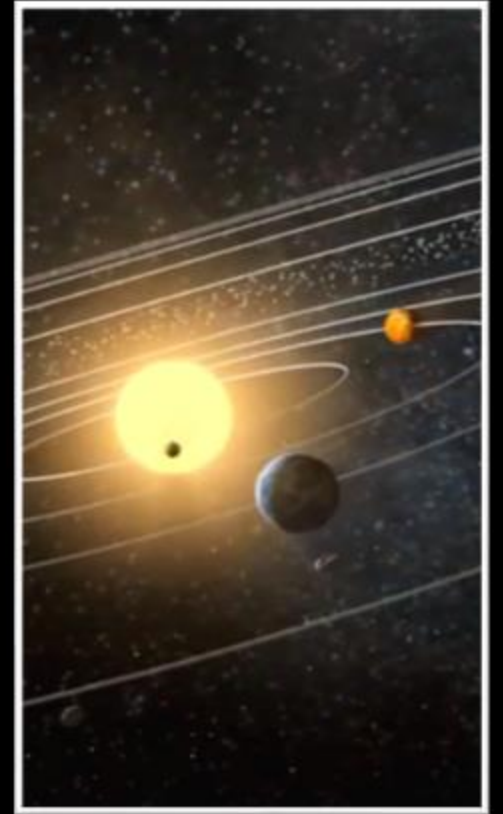
Early Universe



Galaxies  
over Time



Star Lifecycle



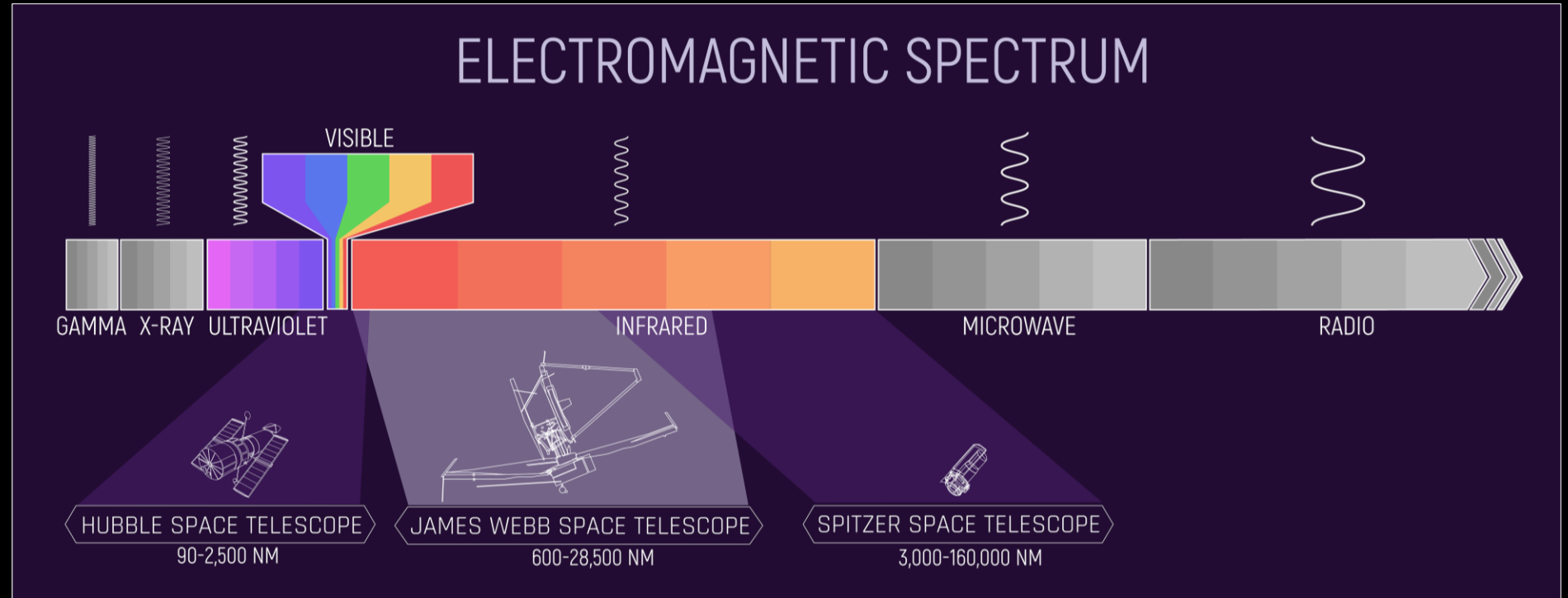
Other Worlds

# Everything is glowing

*What we perceive as heat is infrared radiation*



# Webb is tuned to infrared light



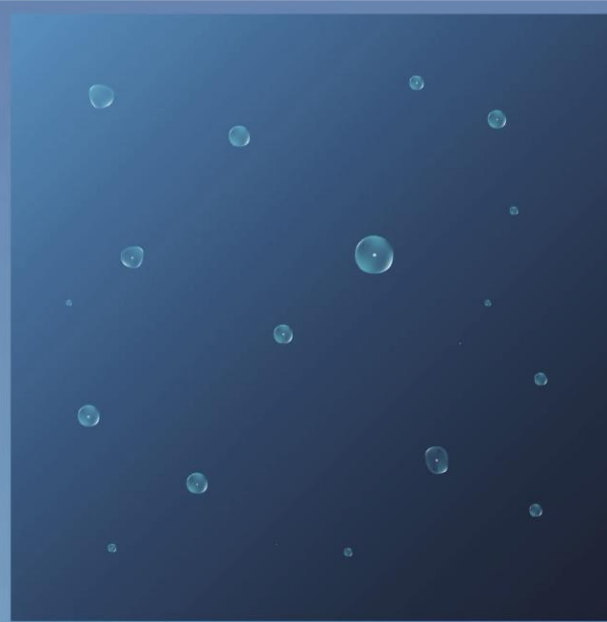


# Early Universe and the first Galaxies

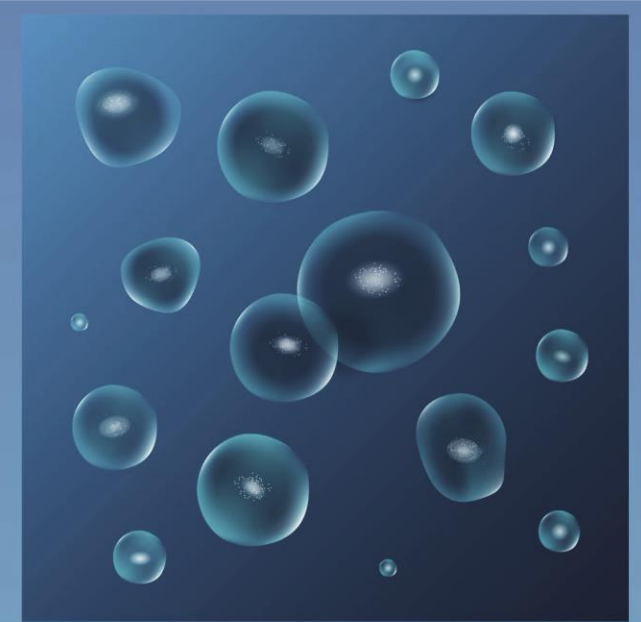
Ultra-deep field will detect the first galaxies (redshift  $\sim 15$ ).

Spectra of quasars, galaxies, and gamma-ray bursts will show how the galaxies reionized the hydrogen gas that fills the Universe.

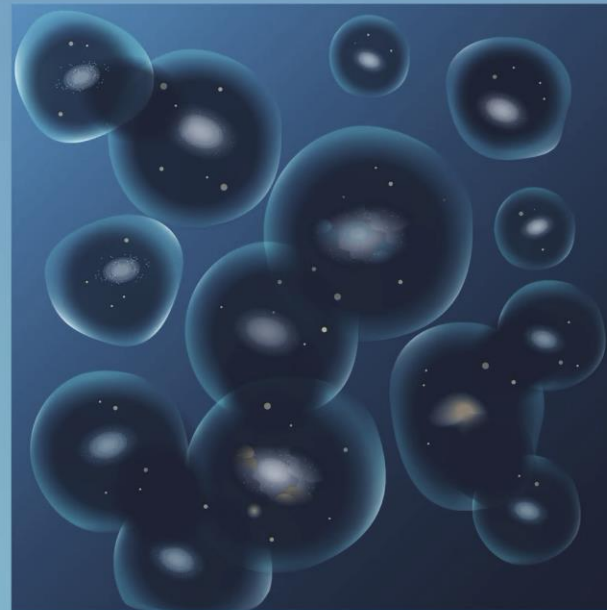
*Image credit: NASA, ESA, and L. Hustak (STScI)*



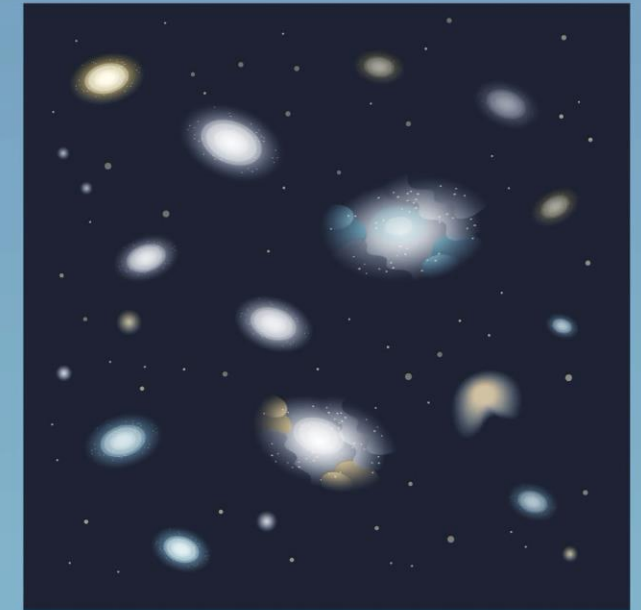
Stars begin forming, heating gas



Stars assemble into galaxies



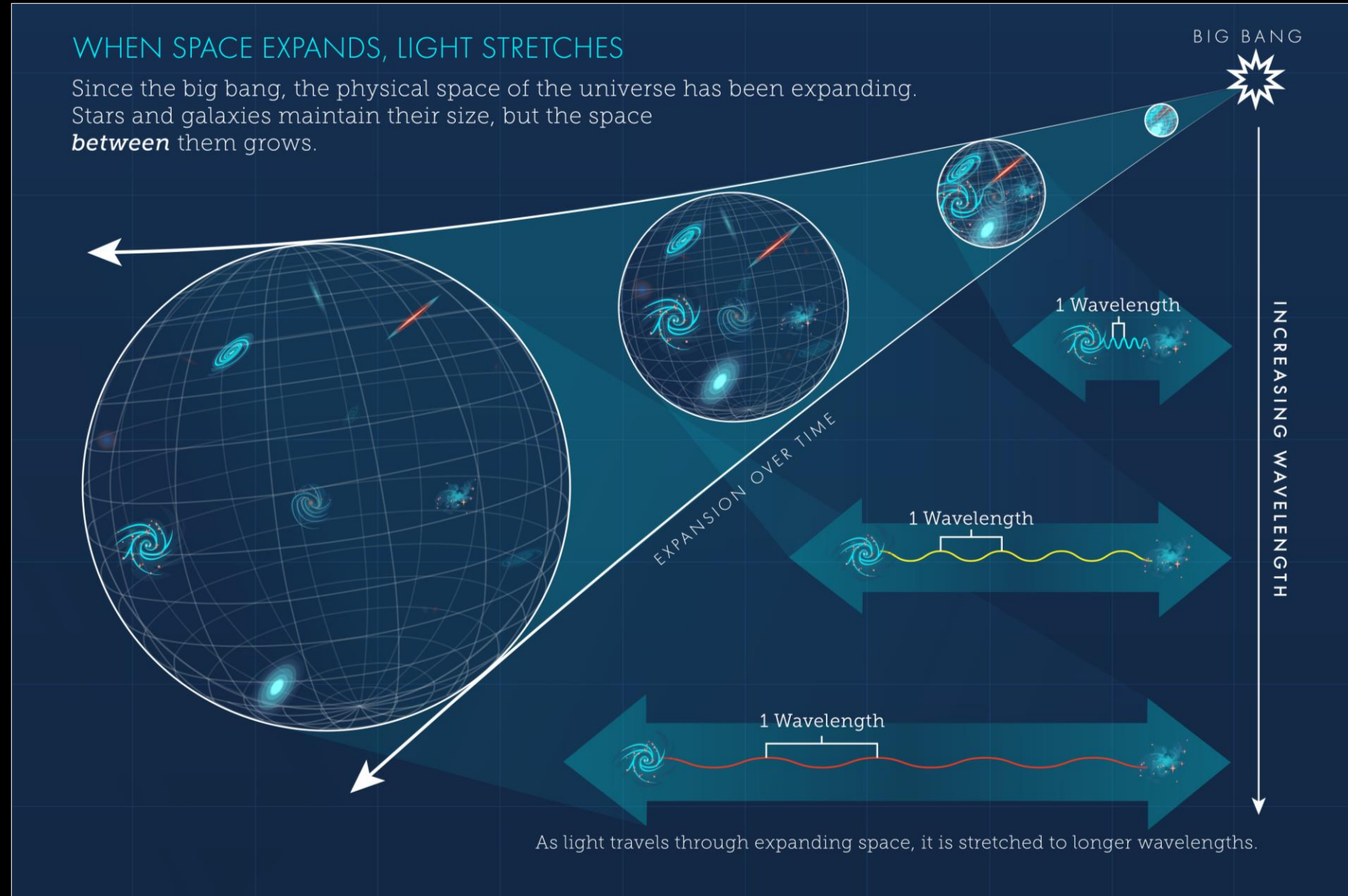
Galaxies become more massive



Clear universe, end of reionization

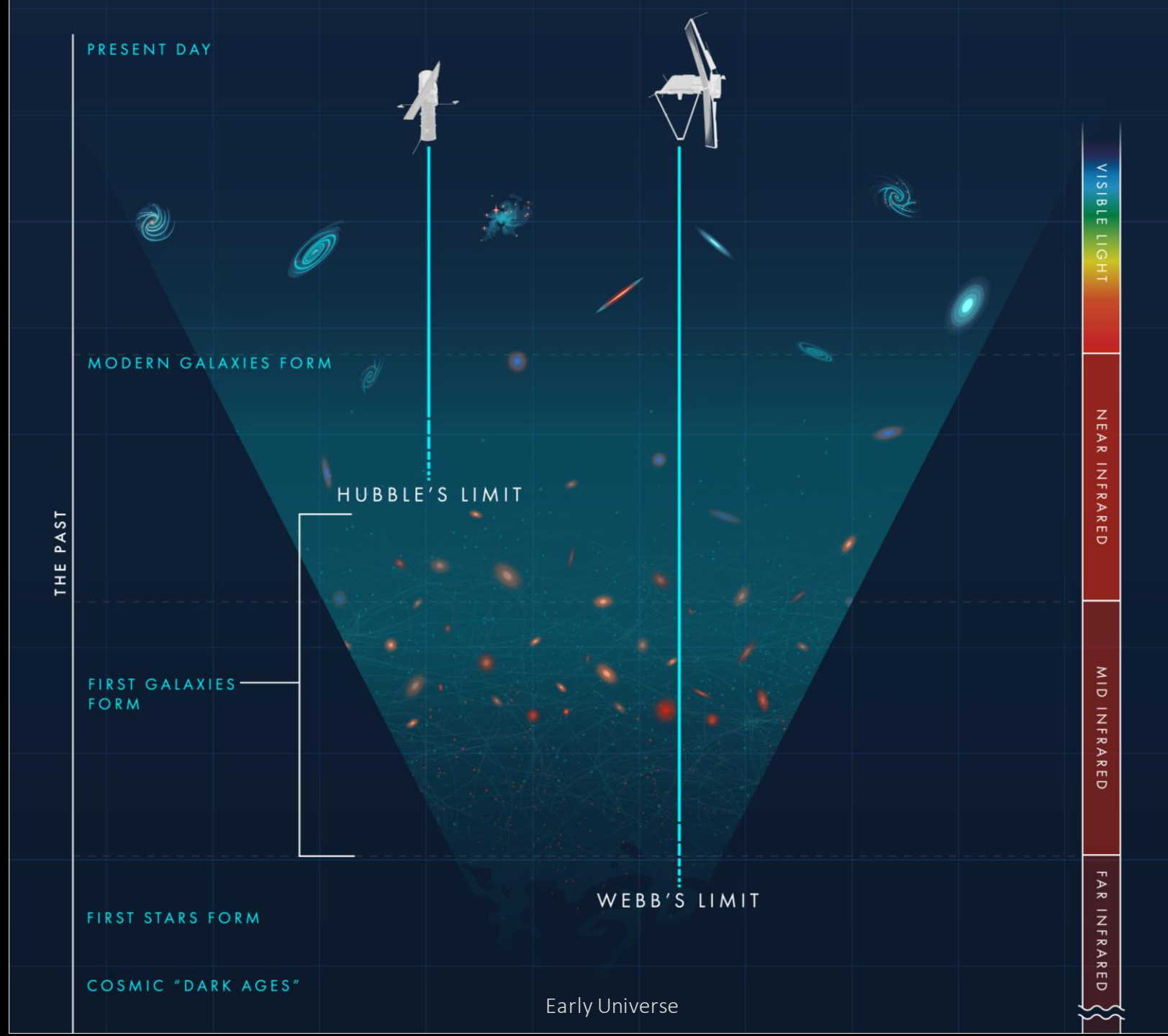
# Seeing into the past

As the Universe expands it stretches light to redder wavelengths



# Seeing into the past

*Webb will be able to see the first galaxies*



**Webb will see  
the first few  
hundred  
million years**

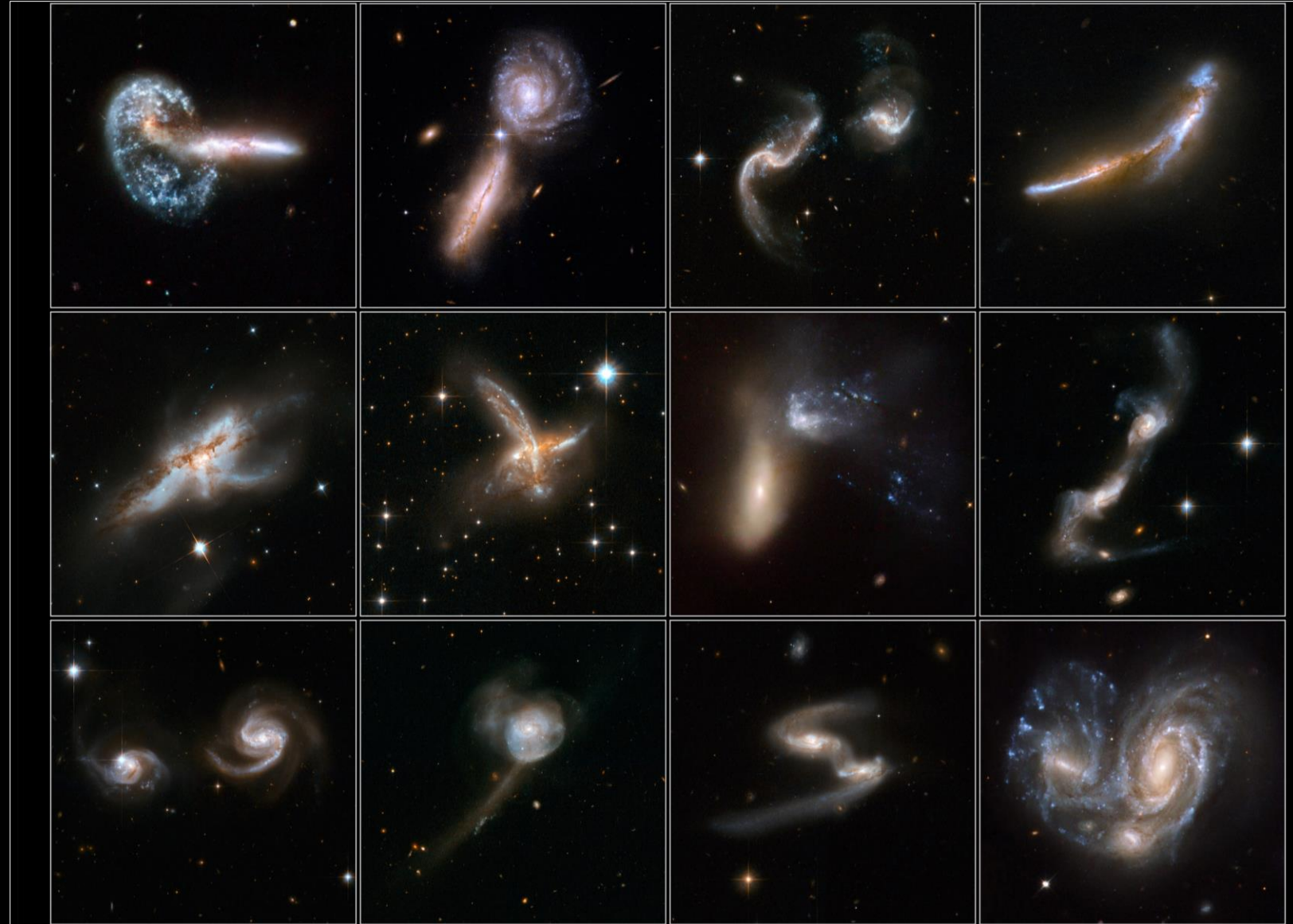


*Image credit: NASA, ESA, P. Oesch (Yale University), G. Brammer (STScI), P. van Dokkum (Yale University), and G. Illingworth (University of California, Santa Cruz)*

# The Assembly of Galaxies Over Time

Webb will follow the history of the merger and growth of galaxies, black holes, and the history of star formation (redshift 1-6).

Webb allows us to study the dust and gas in these galaxies.



*Image credit: NASA, ESA, the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration, and A. Evans (University of Virginia, Charlottesville/NRAO/Stony Brook University)*

# The Birth of Stars and Protoplanetary Systems

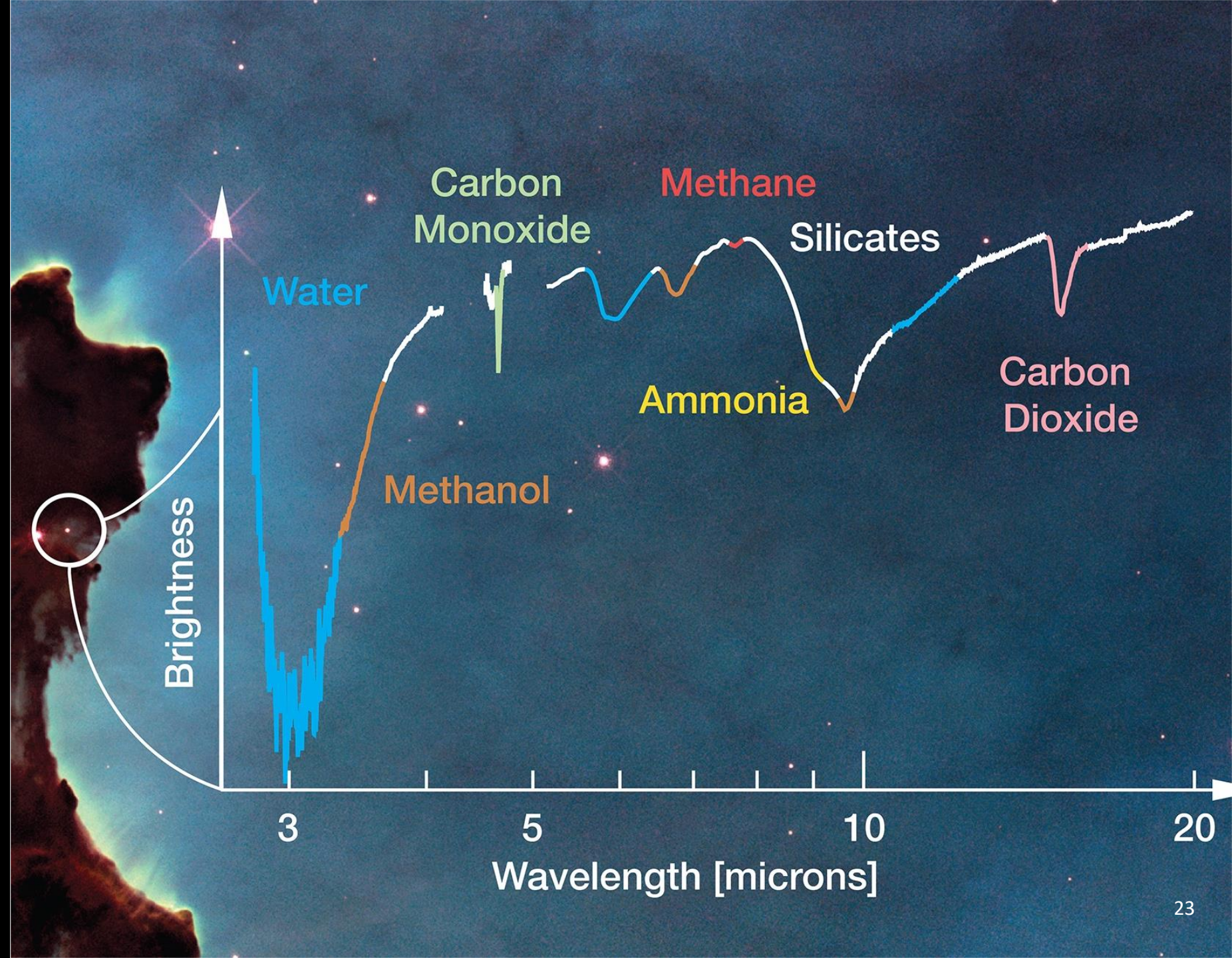
Infrared wavelengths allow us to see through the dust, allowing surveys of molecular clouds and star-forming regions.



*Image credit: M. McCaughrean (Max-Planck-Institute for Astronomy), C. Robert O'Dell (Rice University), and NASA; NASA, ESA, and the Hubble Heritage Team (STScI/AURA); NASA, ESA/Hubble and the Hubble Heritage Team*

# You can study molecules

*In planetary atmospheres or nebulas*

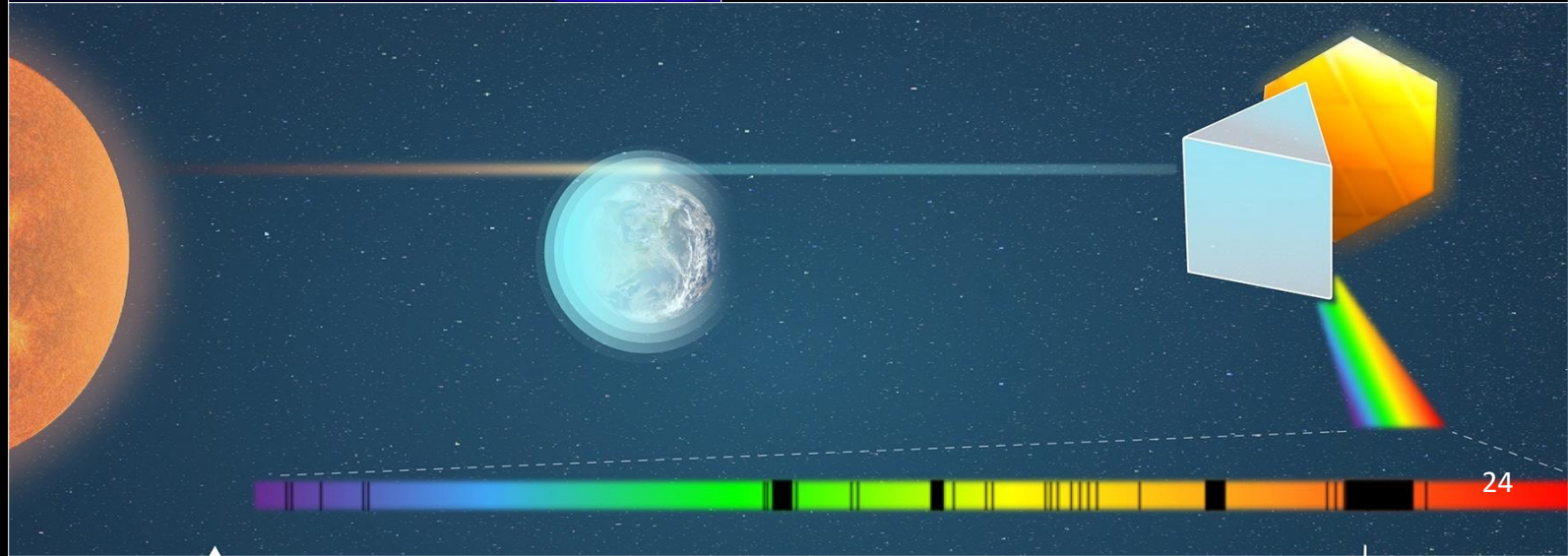
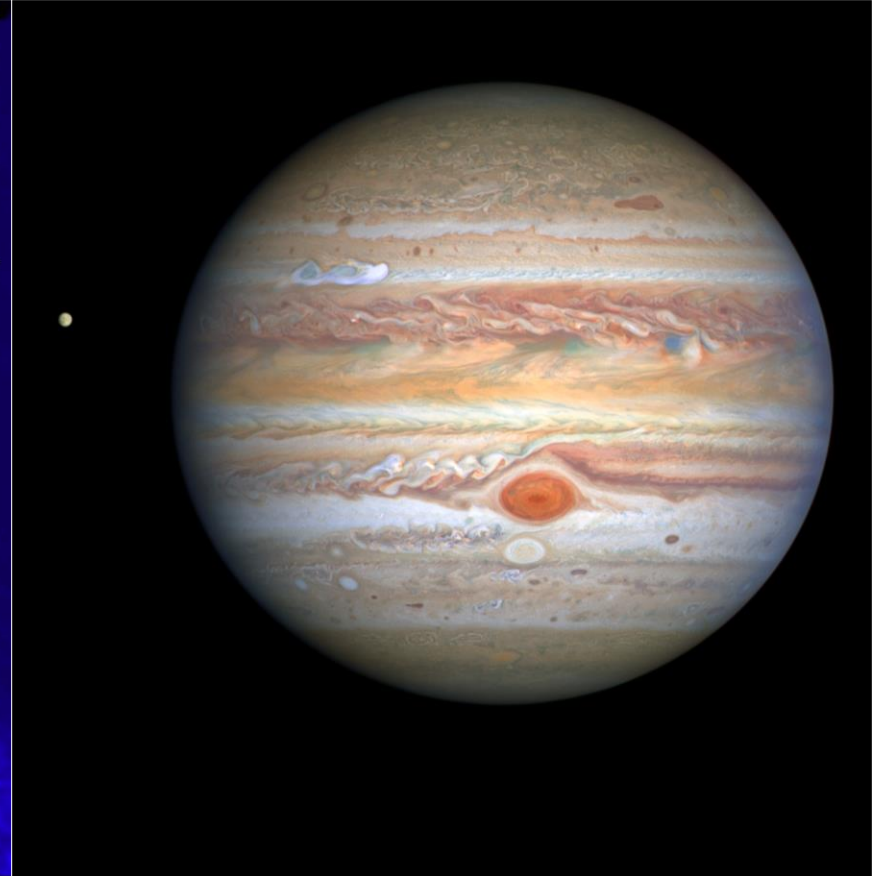
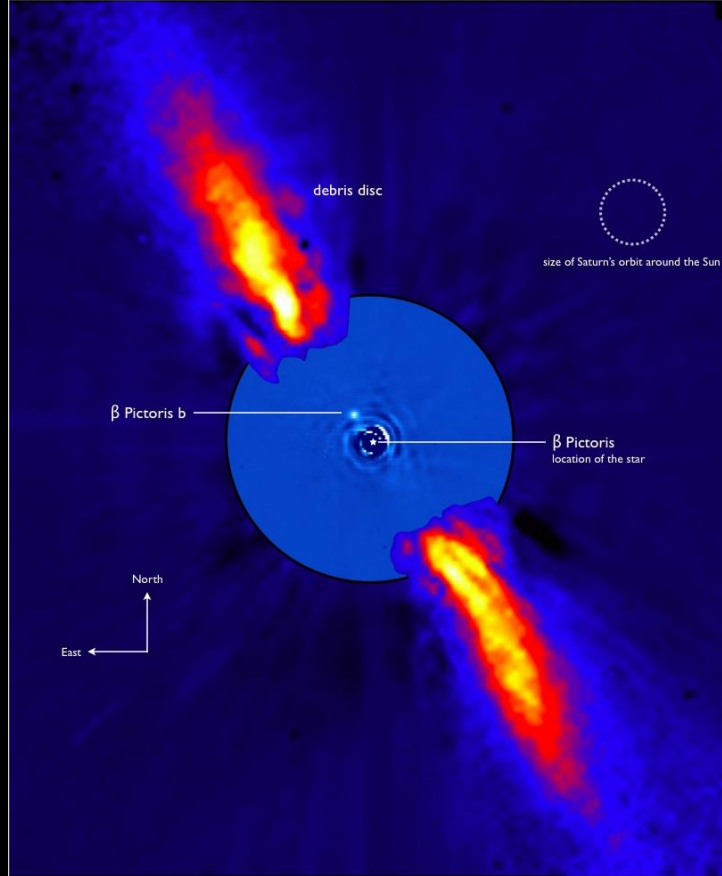


*Image credit: NASA, ESA, the Hubble Heritage Team (STScI), and M. McClure (Universiteit van Amsterdam) and A. Boogert (University of Hawaii)*

# Other Worlds

Webb will be able to observe exoplanets and their atmospheres.

It can also observe solar system objects beyond the orbit of Mars.

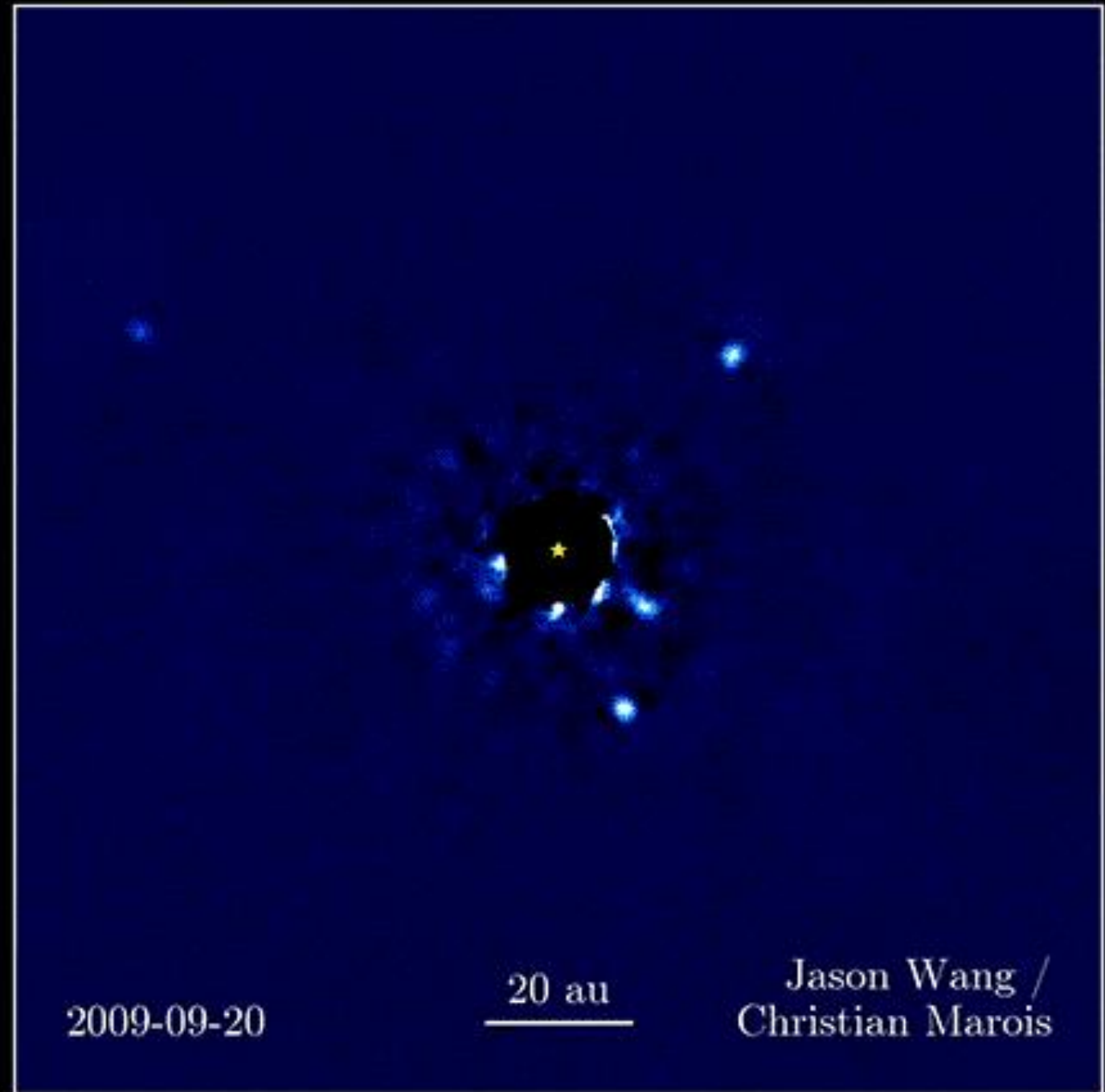


*Image credit: ESO/A.-M. Lagrange et al.; NASA, ESA, STScI, A. Simon (Goddard Space Flight Center), and M.H. Wong (University of California, Berkeley) and the OPAL team; STScI*



**Some things  
are  
intrinsically  
bright in the  
Infrared**

*Like exoplanets*



# The Telescope

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Webb will have to be:

“a large cold telescope, with a wide field of view, exceptional angular resolution and sensitivity, and wide wavelength coverage in both imaging and spectroscopy.”

-Gardner 2006

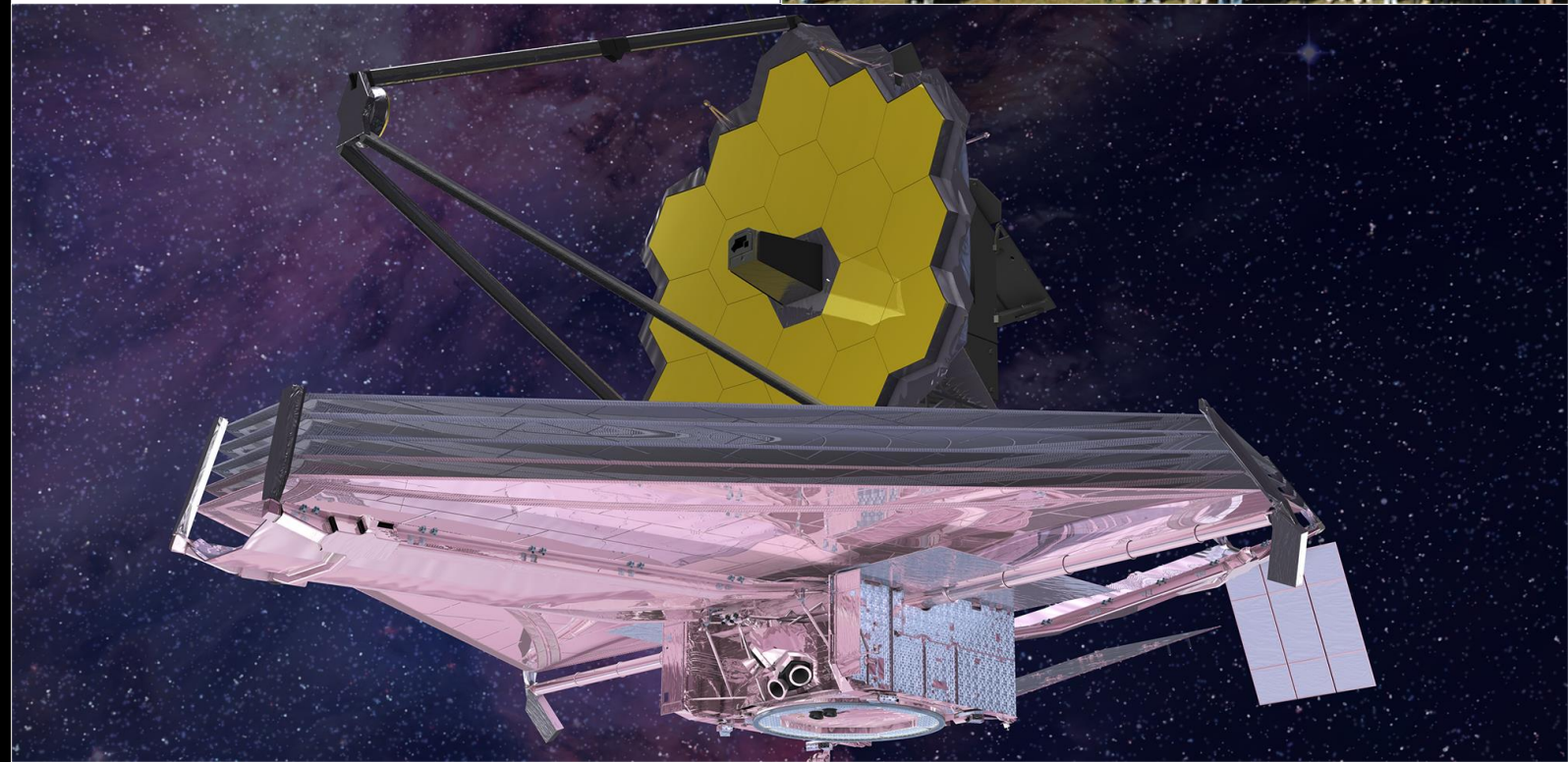
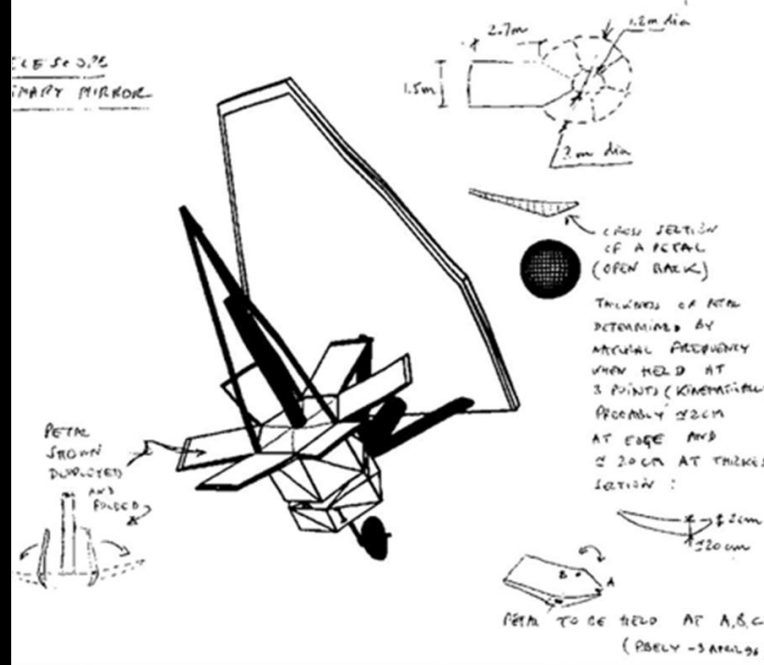


Image credit: P. Bély/GSFC, NASA and the James Webb Team, NASA, ESA, and Northrop Grumman

# The Two Sides of the Webb Telescope

## Hot side

185° Fahrenheit  
(85° Celsius)

## Cold side

-388° Fahrenheit  
(-233° Celsius)

SOLAR PANEL

COMMUNICATIONS  
ANTENNA

COMPUTER

STEERING:  
REACTION WHEELS & JETS

SCIENCE INSTRUMENTS:  
DETECTORS & FILTERS

MIRRORS

light from the Sun

# Webb will orbit at L2

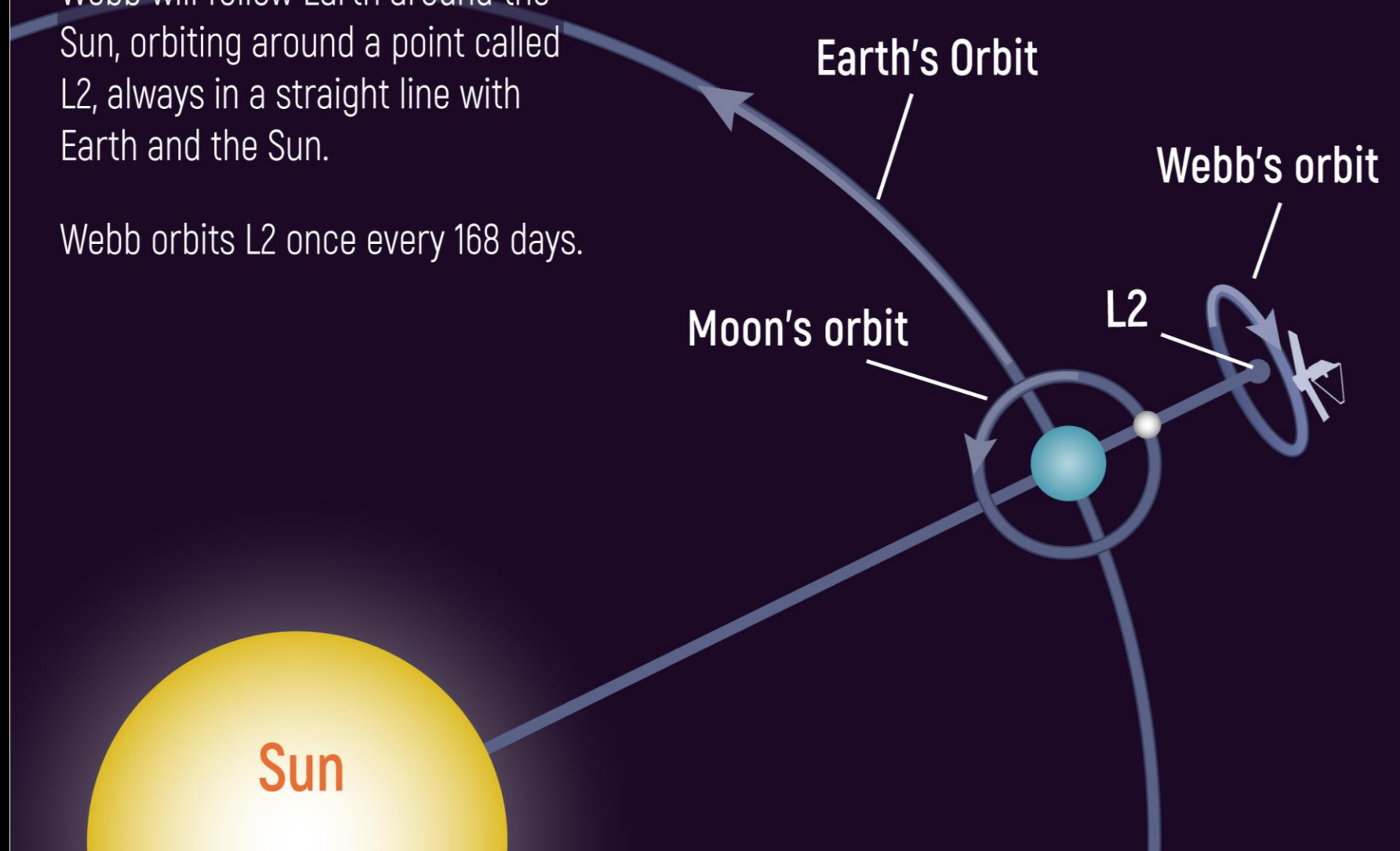
The Second Lagrange Point (L2) is a stable orbit that balances the Earth's and the Sun's gravity.

Image credit: NASA and STScI

## Webb's Orbit

Webb will follow Earth around the Sun, orbiting around a point called L2, always in a straight line with Earth and the Sun.

Webb orbits L2 once every 168 days.

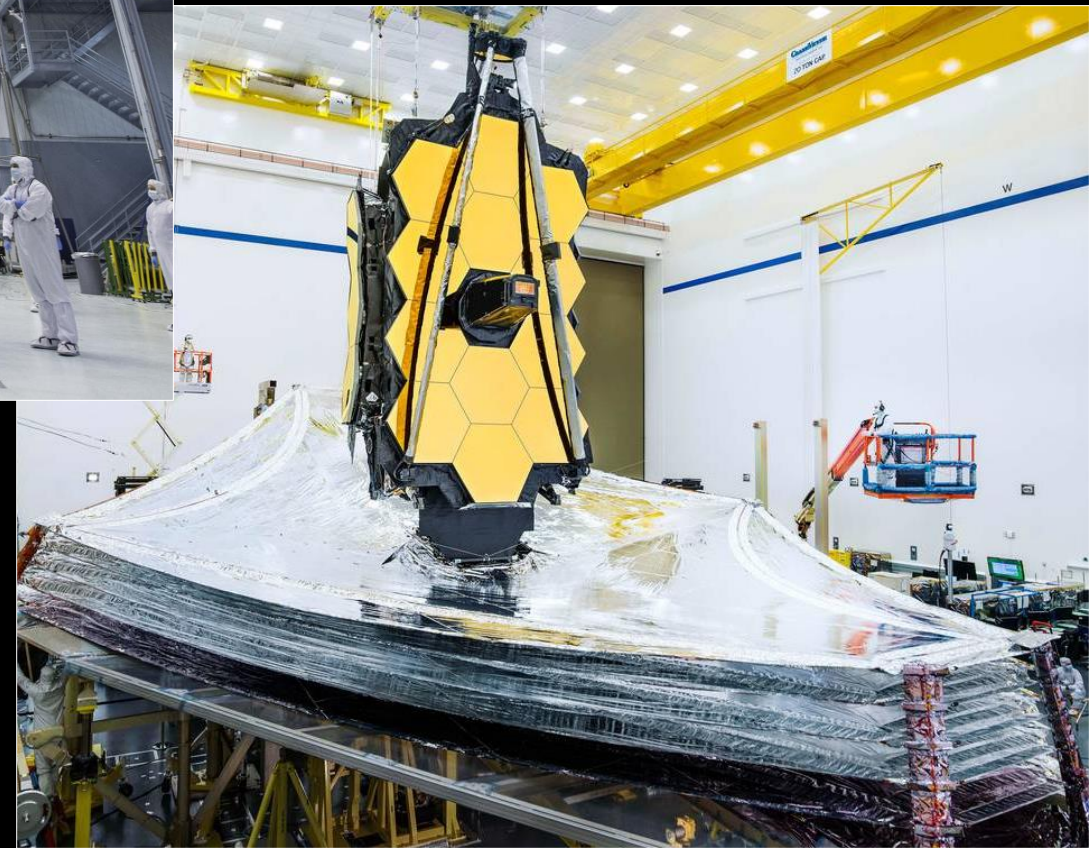


Webb is an international collaboration between NASA, the European Space Agency, and the Canadian Space Agency.

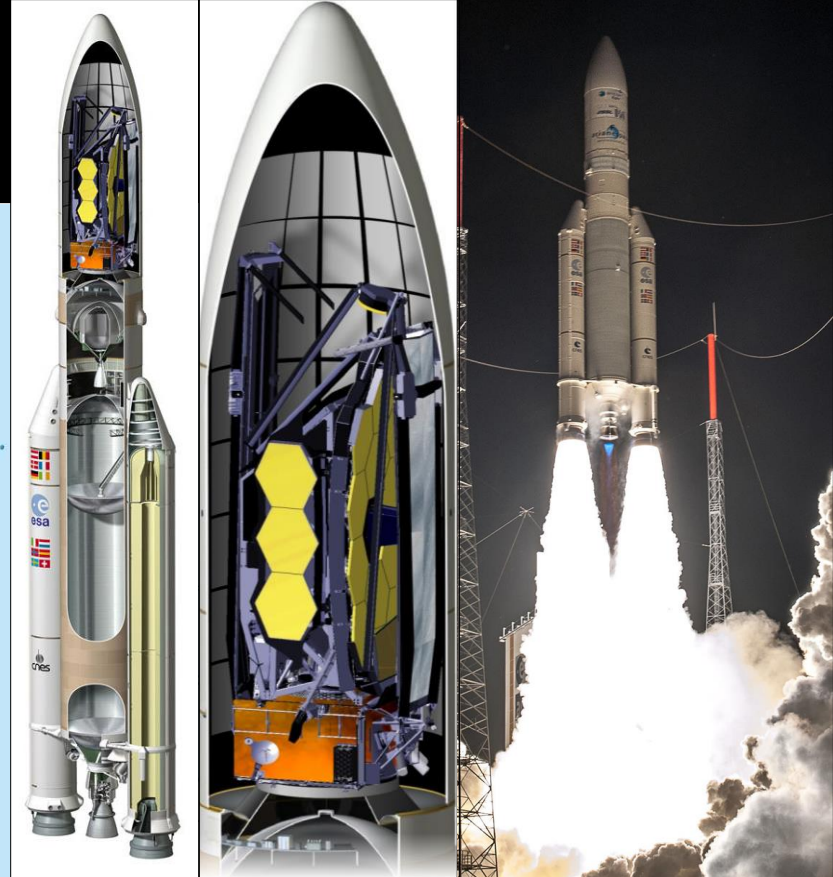


# The Main Innovations

The two most striking and novel parts of the telescope are the primary mirror and the sunshield.



**Webb will launch from Kourou, French Guiana on an Ariane 5 rocket.**





**Webb is on  
track to  
launch by  
October 2021**



**Webb will  
unfold in space  
and have a 6.5  
month  
commissioning  
period.**

We expect the  
first science from  
the observatory  
in summer 2022!



Thank you!

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Questions?



# Community Engagement: Tools and Resources

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Yesenia Perez

May 25, 2021

# Learning with Webb

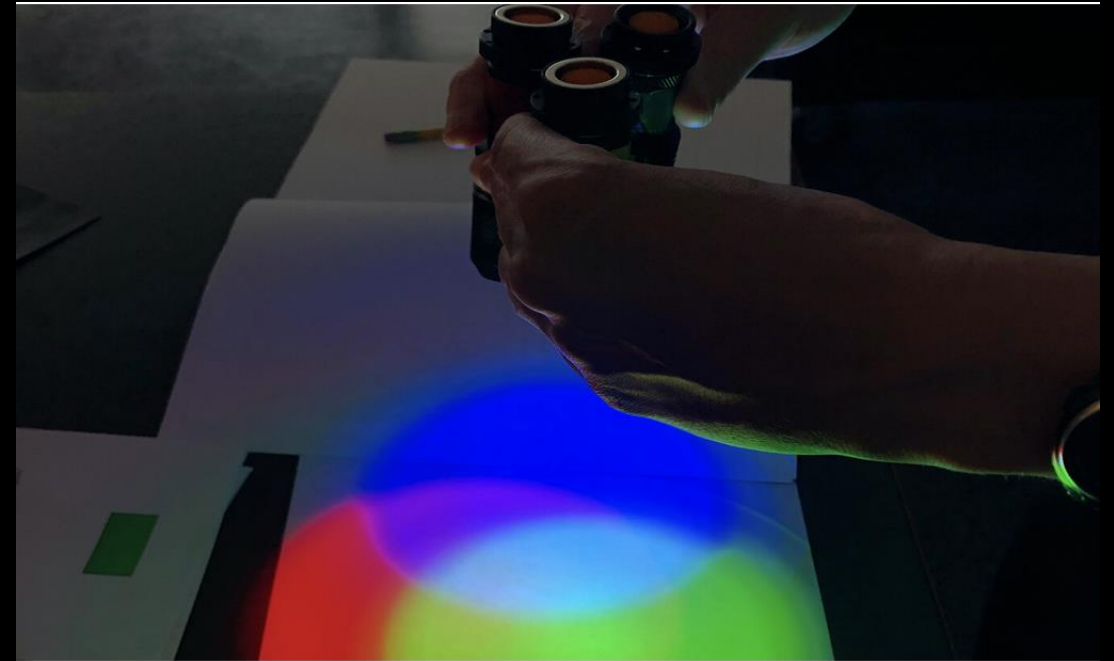
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# Learning with Webb

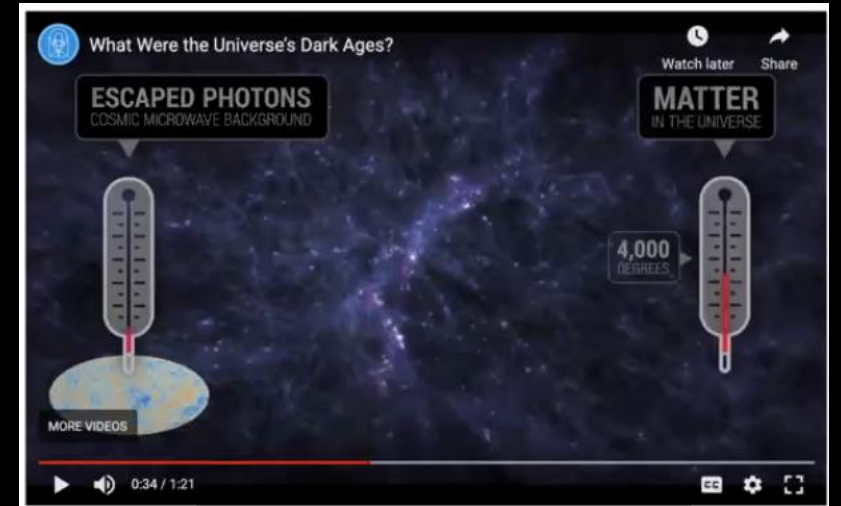
Explore our hands-on activities at:  
<https://universe-of-learning.org/gsawn>

Contact us to learn more about how are resources are being used to create successful and impactful learning engagements.

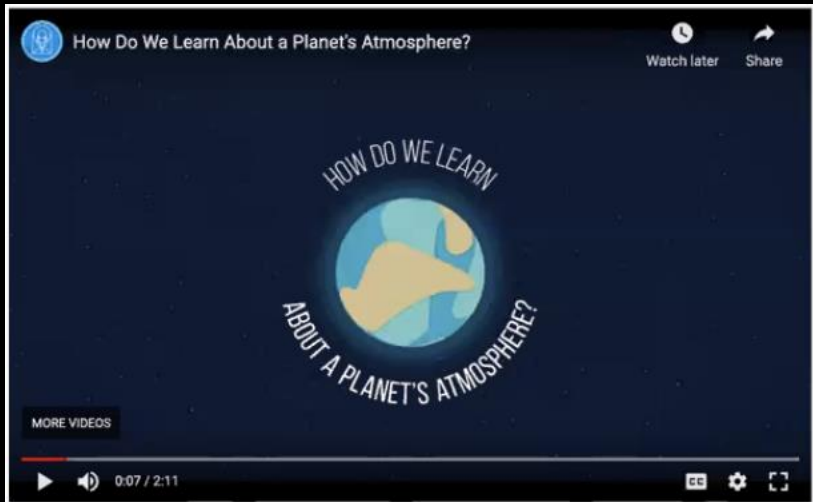


# Tools and Resources

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Explore Webb science at  
<https://webbtelescope.org>

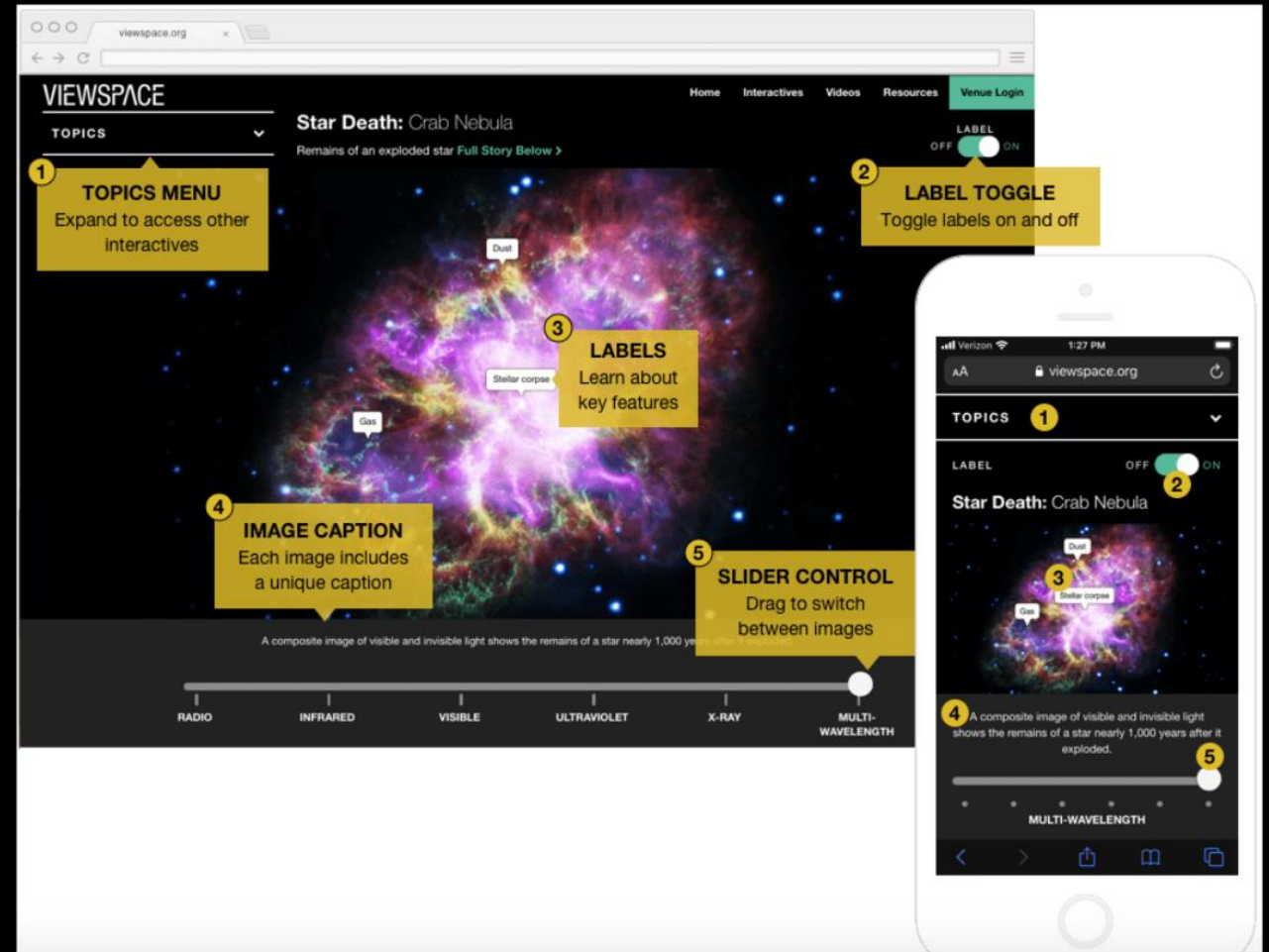






# Science Activation - NASA's Universe of Learning

- ViewSpace videos and online interactives
- MicroObservatory AstroPhoto Challenges
- Science Briefings, in partnership with:
  - Museum and Informal Education Alliance
  - Solar System Ambassadors
- Informal Learning Network Program Models
- Find Subject Matter Experts for your Webb event



# ViewSpace

ViewSpace videos feature the latest imagery from satellites and space telescopes, and provide unique insight into our understanding of the universe.



**Myth vs Reality: Seeing with Webb vs Seeing with Hubble**



**At a Glance: Seeing the Invisible—Using Infrared to See Dust**



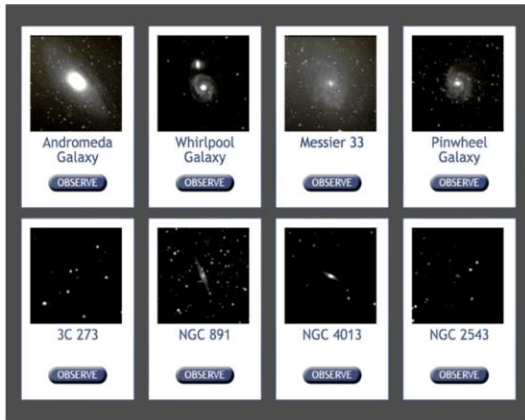
**Celestial Tour: The Journey of Light**



**At a Glance: The First Galaxies—Observing with The Webb Space Telescope**

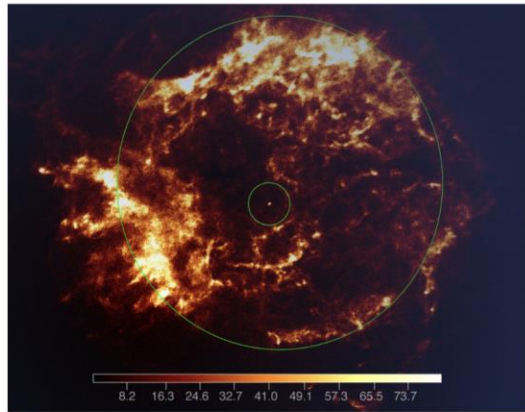
# MicroObservatory- NASA's Astrophoto Challenge

## OBSERVE



Capture Your Own Images Using [MicroObservatory](#)

## BUILD SCIENTIFIC PRACTICES



Create Your Own Composite Image with an [Astronomer's Image Processing Tool](#)

## COMPARE AND CONTRAST



Compare your MicroObservatory Composite Image with Images from NASA's Space-based Telescopes Hosted on [AstroPix](#)

## EXPLORE MORE WITH NASA DATA



Use Your Image Processing Skills and NASA Data to Create Your Own Versions of NASA Images

Explore more at: <https://www.universe-of-learning.org/nasa-astrophoto?rq=microobservatory>

# Science Briefings



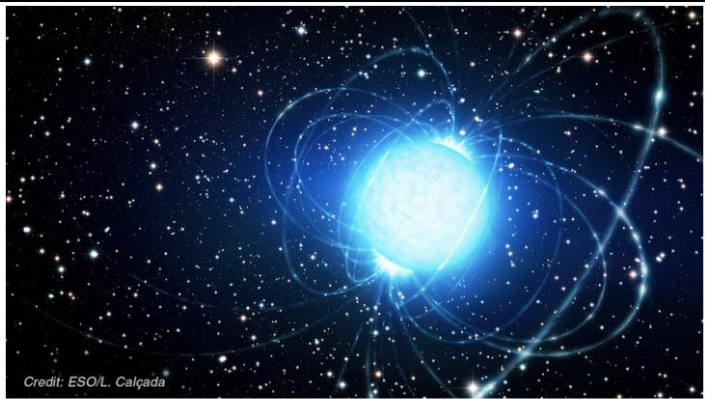
## Black Holes, Out of the Shadows

BLACK HOLES



## Exploring Exoplanets Today and Tomorrow

EXOPLANETS



## The Magnetic Universe

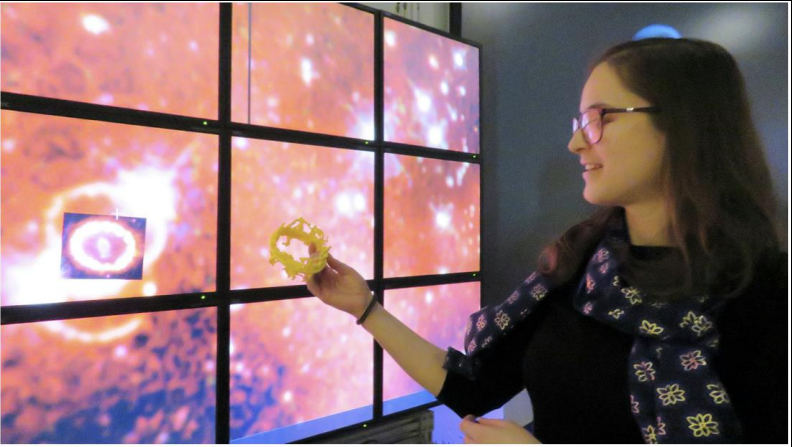
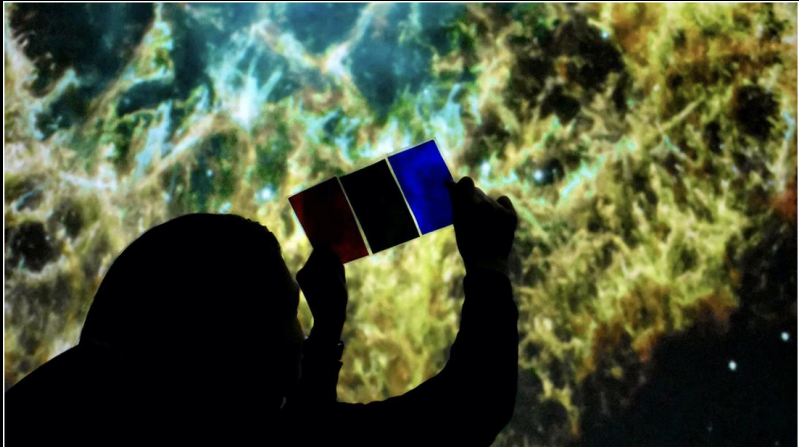
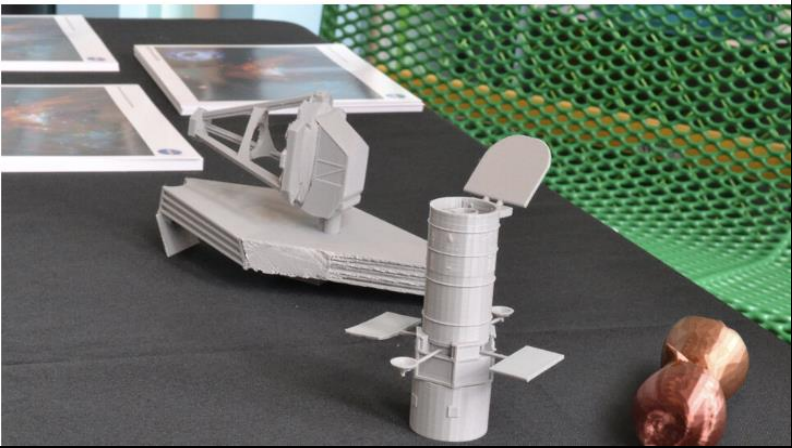
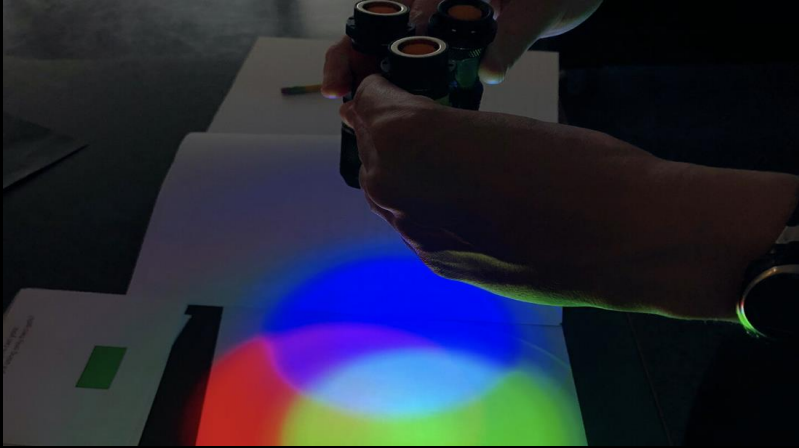
STELLAR DEATH, GALAXY EVOLUTION, MAGNETIC FIELDS



## Women in Astronomy: The Past Inspires the Future

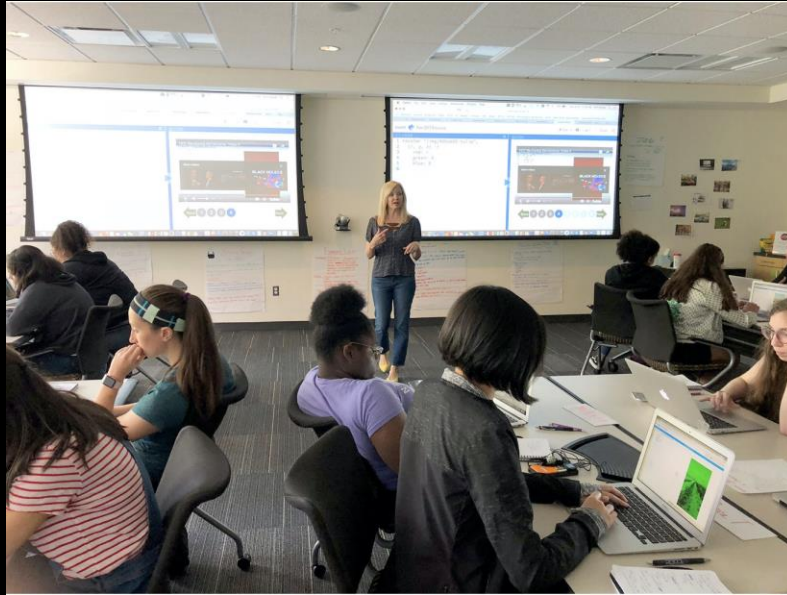
STEM, GIRLS STEAM AHEAD

# Informal Learning Network



# Subject Matter Experts

Find a SME for your Webb Event!





## Explore more from our Science Activation Partners

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### National Informal STEM Education Network (NISENet)

- Resources, activities and tool kits related to Webb
- <https://www.nisenet.org/webb>

### Bringing the Universe to America's Classrooms

- Astronomical Images in Different Wavelengths
- Analyzing Light Curves of Transiting Exoplanets
- [https://mpt.pbslearningmedia.org/collection/universe/#.YEu9\\_uZOnxU](https://mpt.pbslearningmedia.org/collection/universe/#.YEu9_uZOnxU)

### World Wide Telescope Astronomy Interactives

- Life Cycle of Stars
- Hubble's Evidence for the Big Bang
- <https://wwtambassadors.org/>

# Thank you!

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If you have any questions on the resources shared today  
please reach out to: Yesenia Perez, [yperez@stsci.edu](mailto:yperez@stsci.edu)