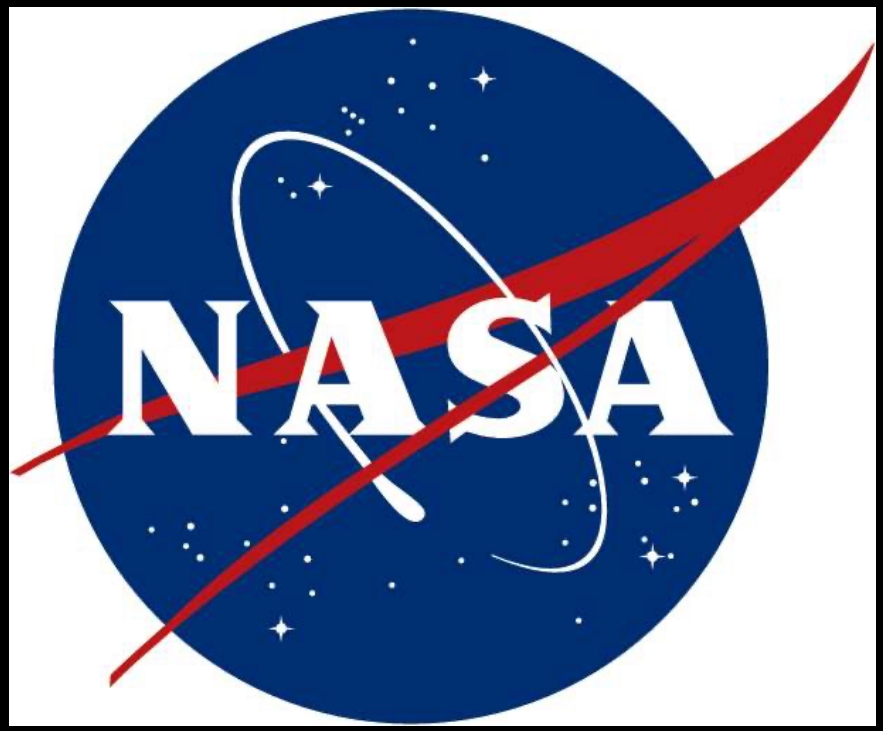
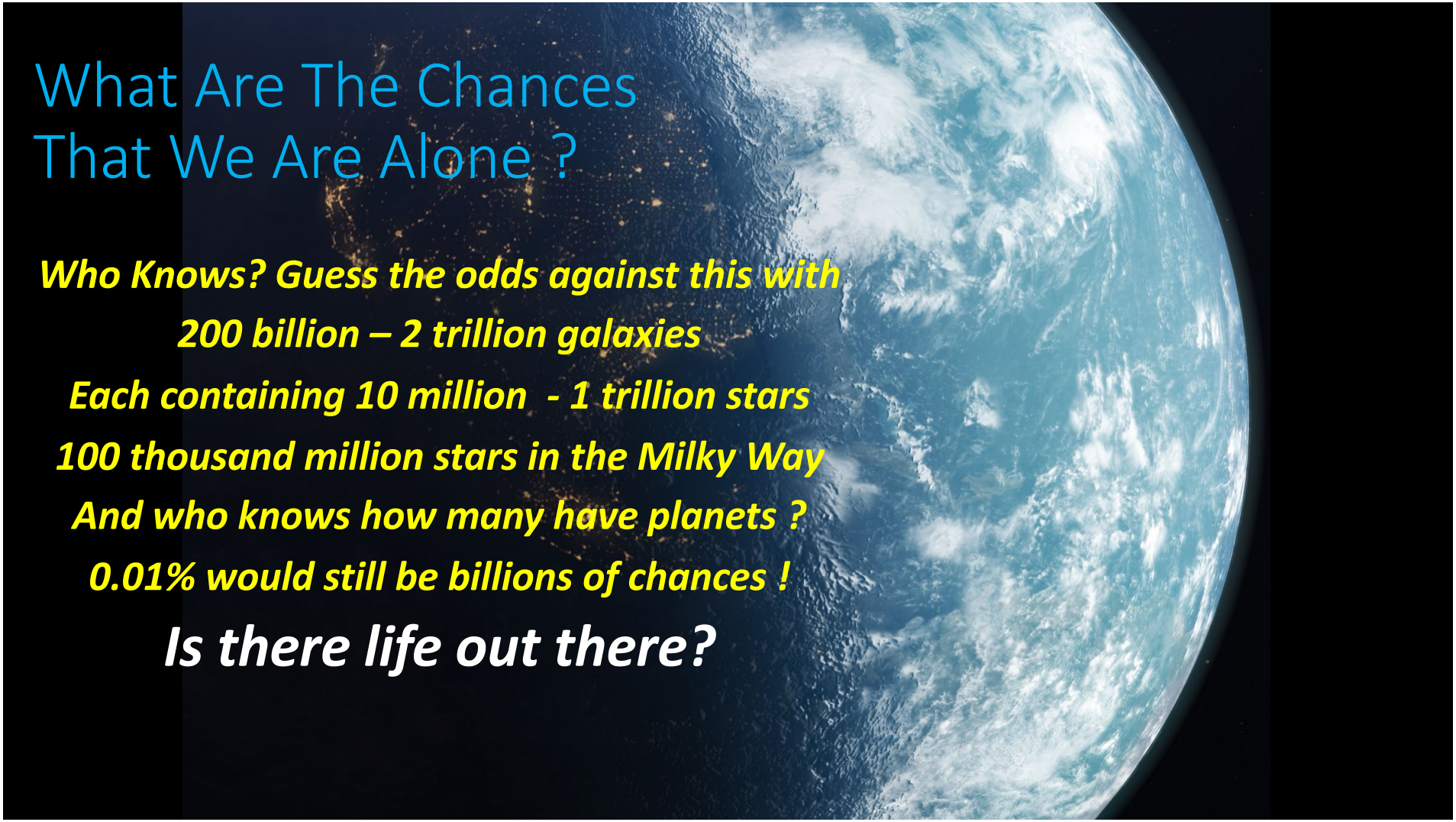
Are We Alone?
For Kids

David H. Lehman
NASA / Jet Propulsion Laboratory,
Project Manager (Retired) and
Volunteer Solar System Ambassador



What is NASA?

What Are The Chances That We Are Alone ?



Who Knows? Guess the odds against this with

200 billion – 2 trillion galaxies

Each containing 10 million - 1 trillion stars

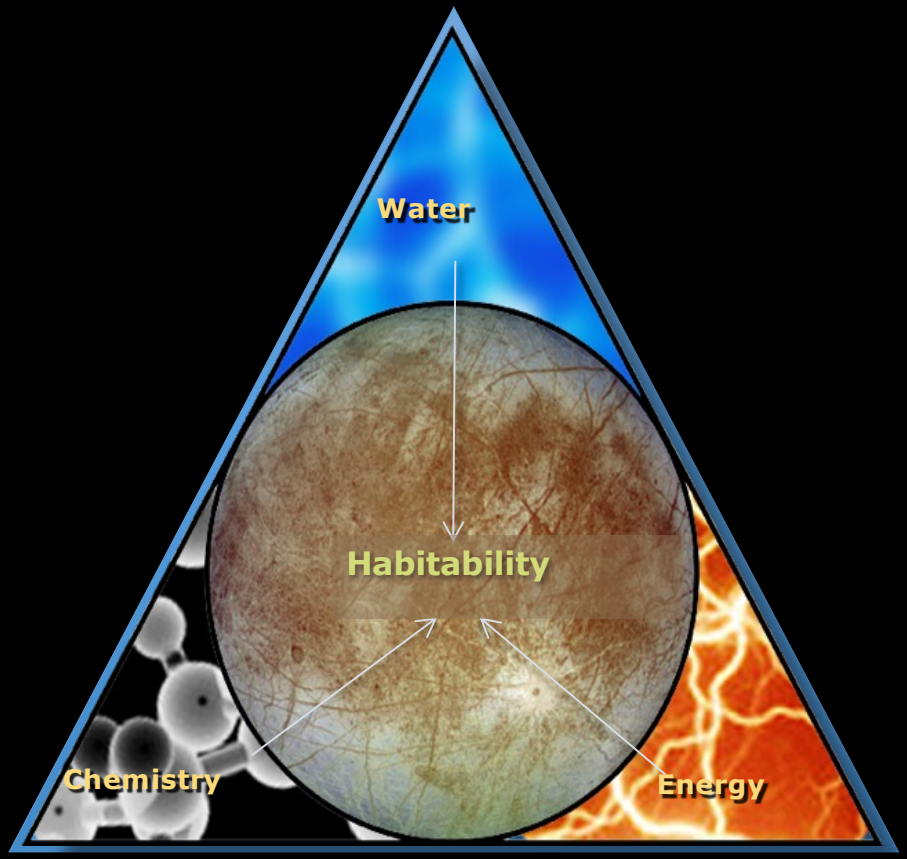
100 thousand million stars in the Milky Way

And who knows how many have planets ?

0.01% would still be billions of chances !

Is there life out there?

What are the ingredients of life?



If you are going to be looking for life, you better know what you are looking for! What are the characteristics of life?

Something that has a boundry/skin/membrane?

Something that moves?

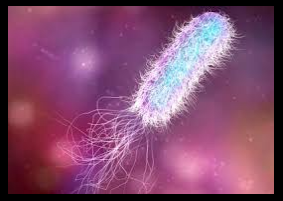
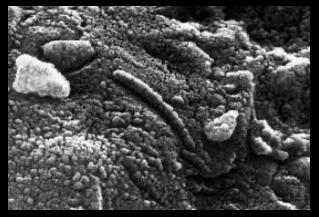
Something that multiplies?

Something that has metabolism, eats/excrets, oxygen/CO_2?

What else?

For humans it is easy to tell if something is alive or not? How do we know?



What are examples of humans searching for life?

- Earth based telescopes
- Space based telescopes
- Exploring our Solar System
  - Mars Sample Return
  - Europa Clipper Spacecraft

The SETI Institute

- SETI's mission is to lead humanity's quest to understand the origins and prevalence of life and intelligence in the universe.
- Today, the Institute has approximately 100 scientists as well as specialists in administration, education, and outreach.

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Karl G. Jansky Very Large Array (VLA) radio telescope array

UCLA SETI

We conduct searches for radio techno-signatures with the largest fully steerable telescope on Earth, the 100-meter Green Bank Telescope in West Virginia.

More on the UCLA SETI

- The mission of UCLA SETI is to find evidence of other civilizations in the Galaxy.
- Our searches are sensitive to signals emitted thousands of light years away, enabling contact from a large fraction of the Milky Way Galaxy.
- Since 2016, we have observed over 55,000 stars and detected over 82 million candidate signals.
- All of the signals that we have analyzed so far appear to be due to RFI.
- We are excited to expand our search capabilities by launching a collaboration with citizen scientists, and we are grateful for your involvement in the search!
- Web Site:

https://www.zooniverse.org/projects/ucla-seti-group/are-we-alone-in-the-universe/about/research

The Team

From left to right: Ella, Jay, Megan, Jeremy, Priscella, Jean-Luc. Not pictured: Liam, Paul.

Dr. Jean-Luc Margot is a planetary astronomer and UCLA professor who conducts research on the properties of planetary bodies with a variety of spacecraft and telescopes. He also conducts a search for technosignatures with UCLA SETI, which has involved more than 150

The Team

InoSenpai
@InoSenpai
TRANSLATOR

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TESTER

NandoSpain
@NandoSpain
MODERATOR TESTER

Mr. Kevvy
@Mr._Kevvy
MODERATOR TESTER

sanchitasark
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TRANSLATOR

Barbalbero
@Barbalbero
TRANSLATOR

The James Webb Space Telescope

- **Purpose of Webb**
  - **First Light and Reionization**
  - **Assembly of Galaxies**
  - **Birth of Stars and Protoplanetary Systems**
  - **Planetary Systems and Origins of Life**
- **Launch and deployment in December 2021**

The JWST Primary Mirror is coated with gold that is 1000 atoms thick. How much does this coating of gold weigh?

A. Each atom of Gold weighs ~0 pounds so all the Gold in the mirror weighs ~0 pounds
B. It is as heavy as one Karl G. Jansky Very Large Array (VLA) radio telescope
C. It is as heavy as the weight of the average kid at **Barnhart School**
D. It is as heavy as a golf ball

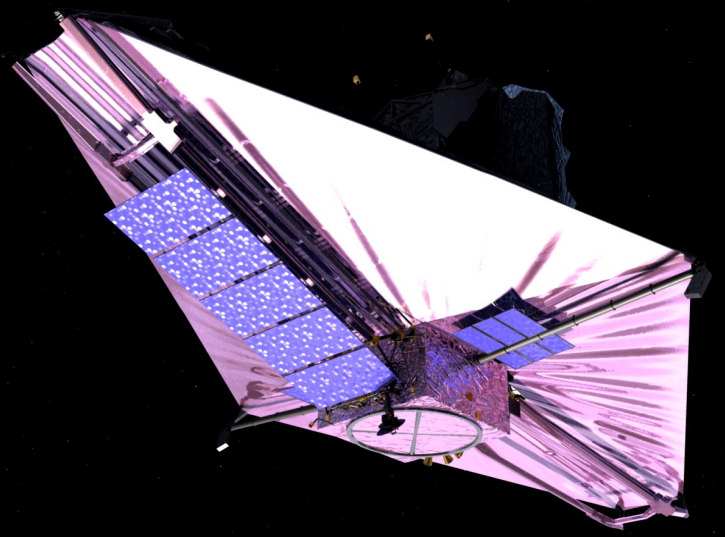
Spacecraft and Telescope

Optical Telescope Element (OTE)

Primary Mirror
Secondary Mirror
Backplane

Spacecraft Element

Sunshield
Bus (hosts structural, communications, and propulsion components)



Integrated Science Instrument Module (ISIM)

Mid Infrared Instrument
Near Infrared Spectrograph
Near Infrared Camera
Fine Guidance Sensor/
Near Infrared Imager & Slitless Spectrograph

JWST's Search for Techno-Signatures

WHY CAN’T THE JWST SEE ALIENS FROM OUTER SPACE?

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BECAUSE SOMETIMES IT IS HARD TO SEE THINGS THAT ARE RIGHT IN FRONT OF YOUR FACE.

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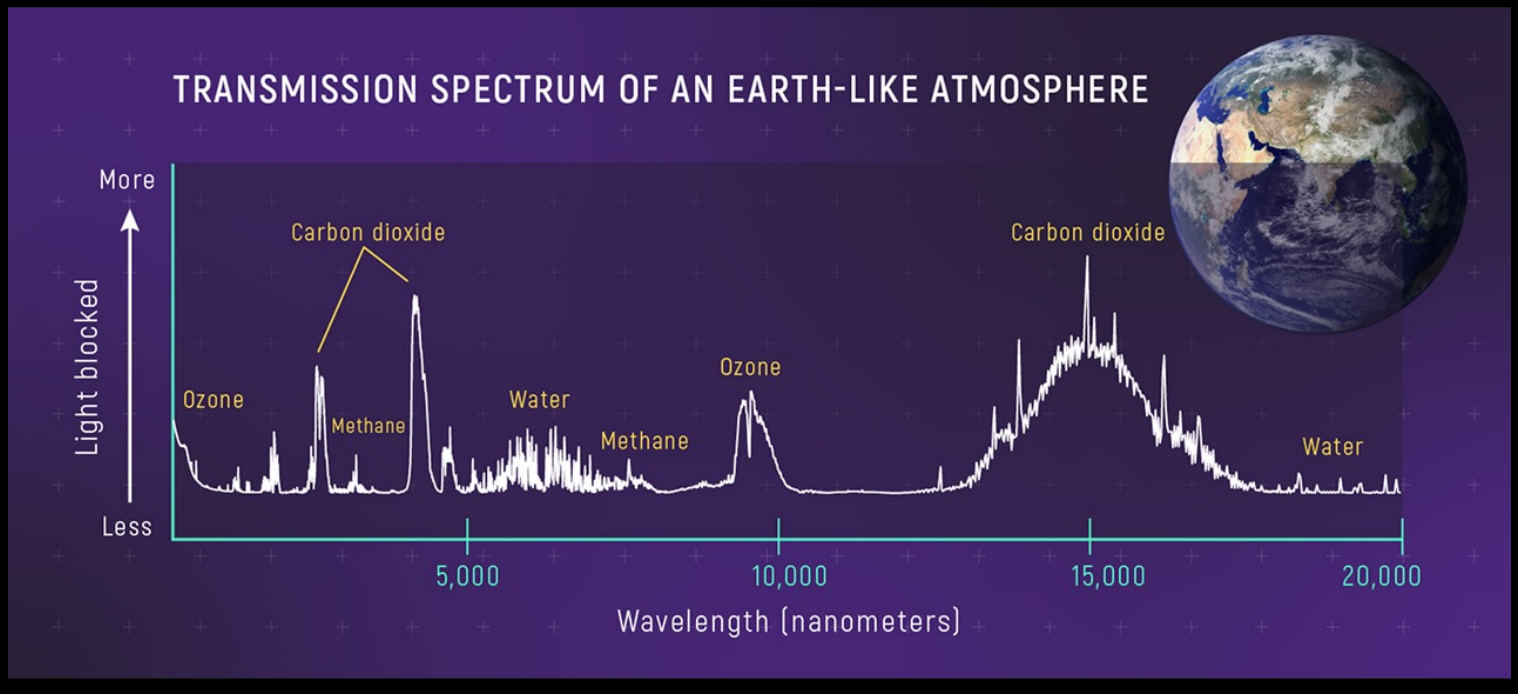
"...Researchers have shown that if the James Webb Space Telescope was pointed at Earth from a distant star, *it could detect the signatures of intelligent life in our planet's atmosphere*. The finding raises hopes that the Webb could detect alien civilizations as it stares out toward distant worlds in our galaxy..."

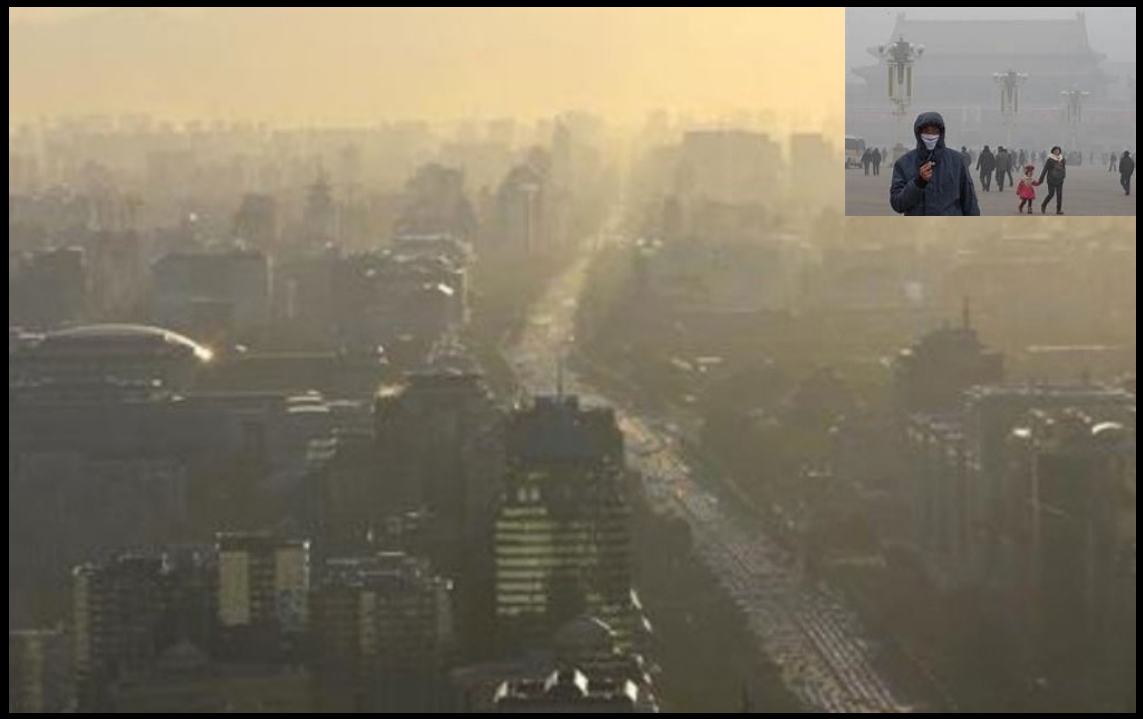
"...one of the telescope's secondary objectives is to analyze the atmospheres of nearby exoplanets, or planets beyond the solar system, to look for gases produced by biological life, known as biosignatures, and chemicals produced by advanced alien civilizations, known as technosignatures..."

"The team developed a computer model, which replicated JWST's sensor capabilities, to see if the spacecraft could detect **the key biosignatures and techno-signatures from the dataset, such as methane and oxygen, produced by biological life, and nitrogen dioxide and chlorofluorocarbons (CFCs), which are produced by humans.** The results show that JWST could detect all the key markers of non-intelligent and intelligent life in our planet's atmosphere."

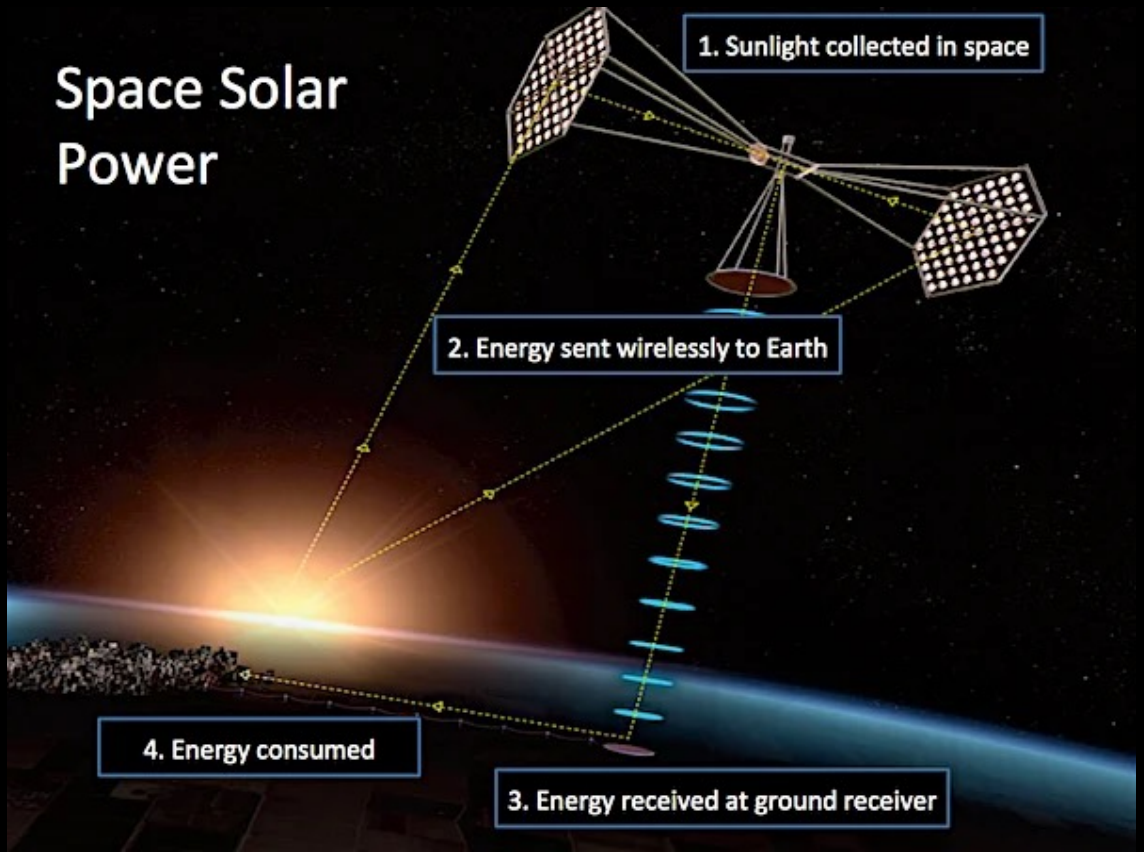


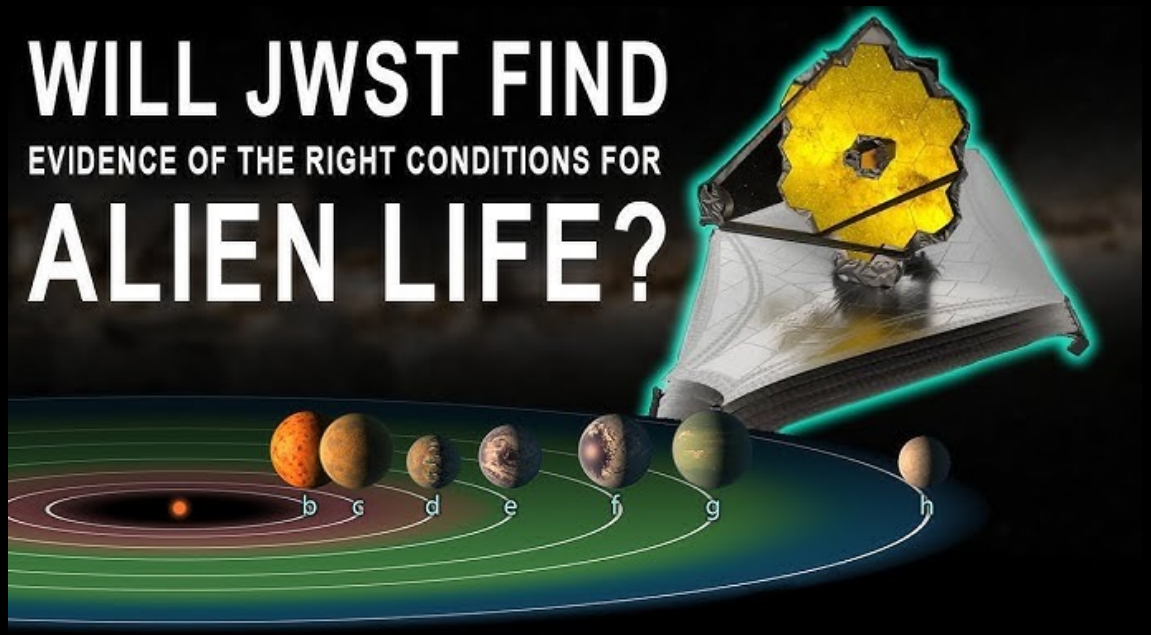
Light pollution

Atmospheric pollution from factories, combustion engines, etc. “…This air pollution is composed of solid and liquid particles made up of ash, metals, soot, diesel exhaust, and chemicals…”



Webb will be looking for atmospheric signs of civilization such as
Structures for Space Solar Power





"...maybe there are Aliens
from Outer Space everywhere!..."

"…So why do human kidnappings by Aliens from Outer Space only occur at night?..."

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“…It is 8 o’clock at night and you are only now just asking me for a human that you need for school tomorrow…”

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Exploring our Solar System:
Is there life in our solar system?

Where do you look for life?

- It cannot be too hot
- It cannot be too cold
- There must be liquid water

Intriguing Mars Rock [Mars Sample Tube #22 collected on July 21, 2024]


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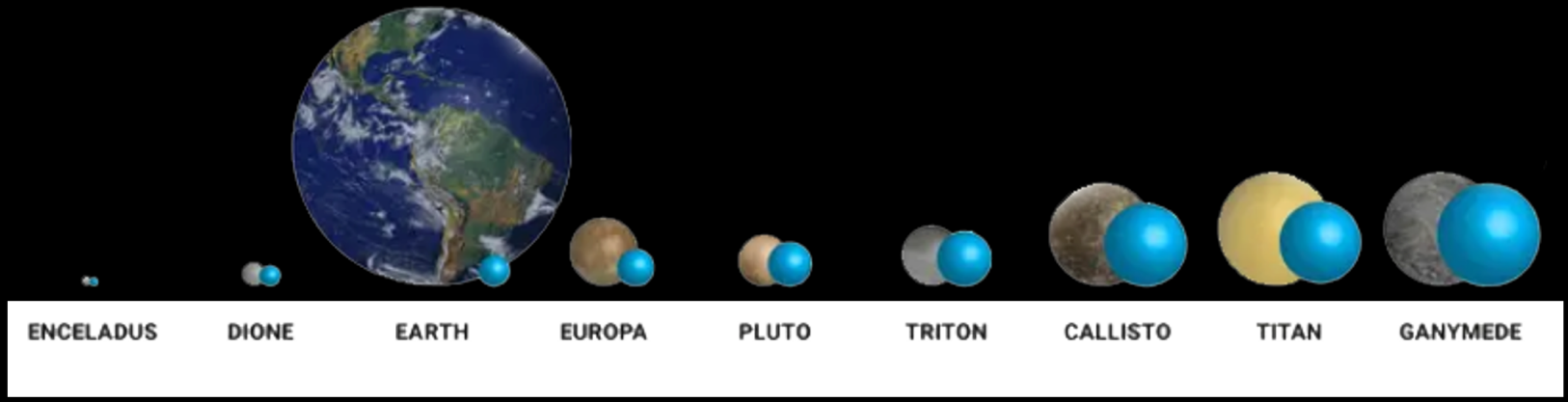
Where is water in the solar system?

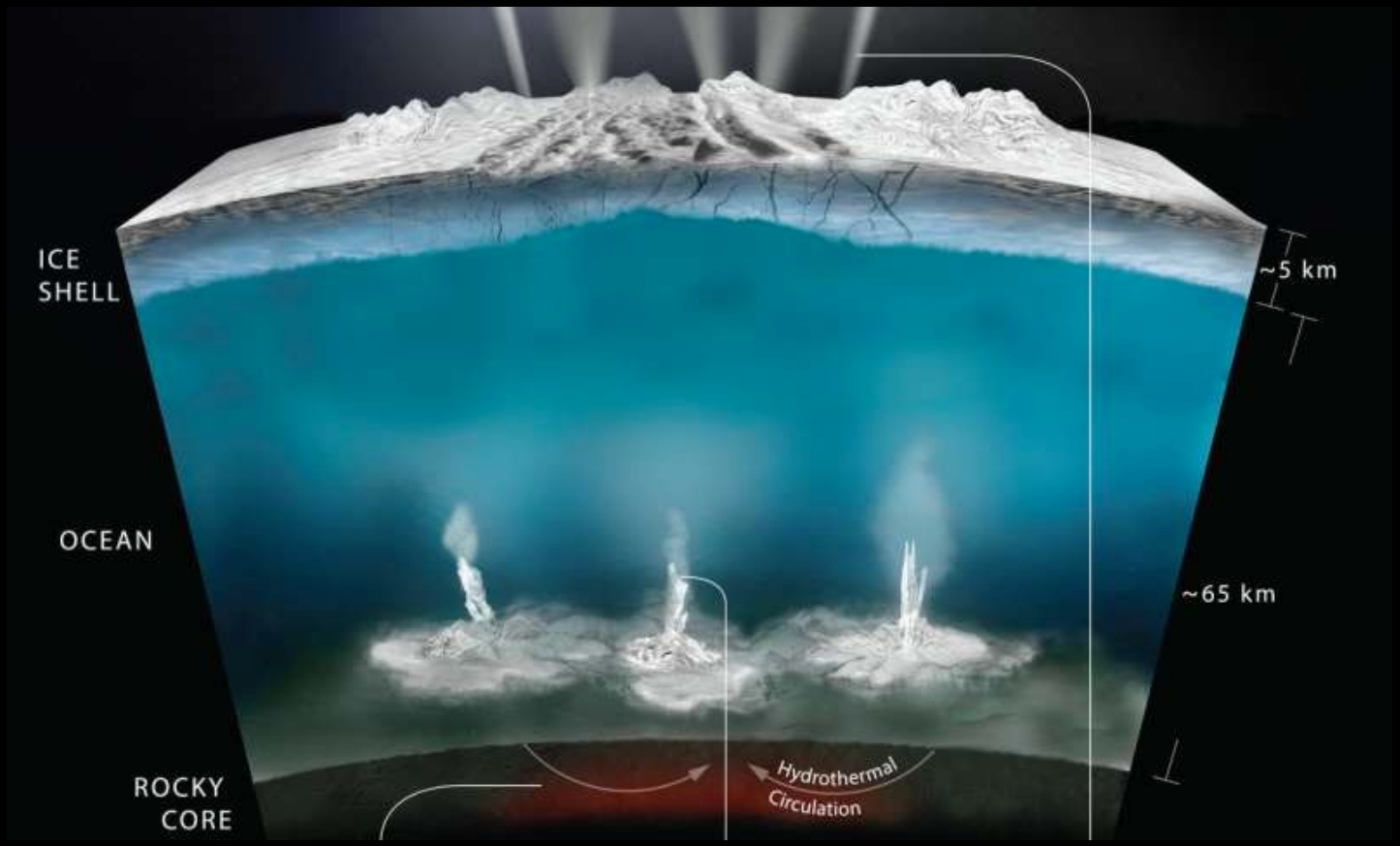


What is the Europa Clipper Mission?

- Europa Clipper launched Oct. 14, 2024, on a journey to explore Europa, Jupiter's ocean world.
- There’s scientific evidence that the ingredients for life may exist on Europa right now.
- The spacecraft will travel 1.8 billion miles (2.9 billion km) to reach Jupiter in April 2030. It will orbit Jupiter and conduct 49 close flybys of Europa.
- Mission: Determine if Europa has conditions suitable to support life.

Ocean worlds!

Europa:
a Moon of
Jupiter



Credit NASA/JPL
Images: NASA/JPL

JPL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Confirmed sightings of life existing beyond Earth *

- While astrobiology and space exploration efforts have identified potentially habitable environments, no direct evidence of extraterrestrial life has been discovered or confirmed by any scientific body.

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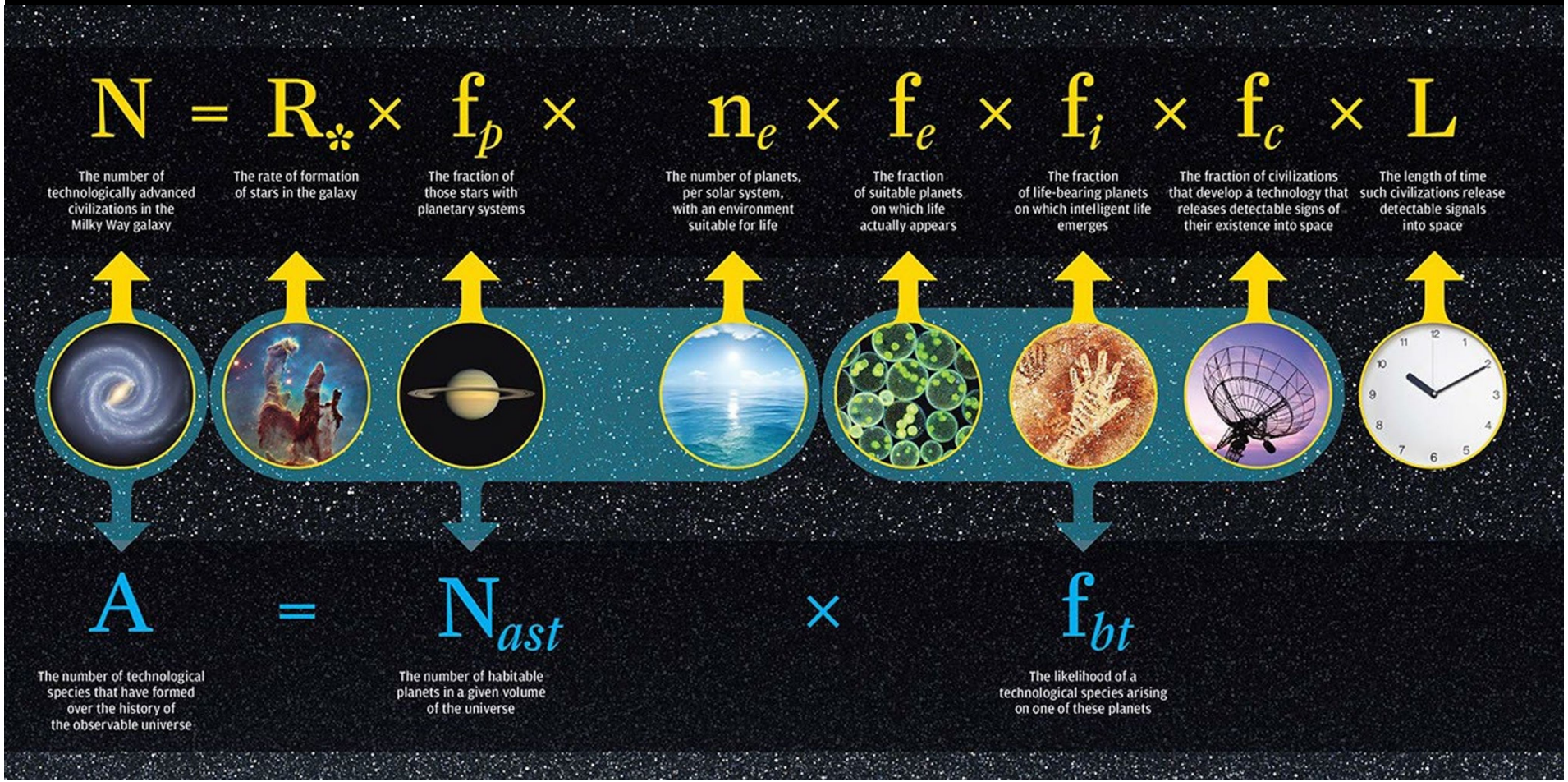
* Reference: NASA's Habitable Worlds Program, Dec. 18, 2024: https://astrobiology.nasa.gov/research/astrobiology-at-nasa/habitable-worlds/?utm_source=chatgpt.com

Drake Equation



Example of the Use of the Drake Equation

$$N = R_* \times F_p \times n_e \times f_l \times f_i \times f_c \times L$$

where:

- **N is the number of civilizations with which humans could communicate**
- **R_* is the average rate of star formation in our galaxy = 1.5 stars per year**
- **F_p is the fraction of those stars that have planetary systems = 50%**
- **n_e is the average number of planets that could potentially support life per star with planets = 2**
- **f_l is the fraction of planets that could support life where life actually appears = 33%**
- **f_i is the fraction of planets with life where intelligent life evolves = 1%**
- **f_c is the fraction of civilizations that develop a technology that releases detectable signs of their existence into space = 1%**
- **L is the length of time such civilizations can communicate = 10,000 years**

Solving for N using the above examples results in 4.95 or the number of active, communicative extraterrestrial civilizations in the Milky Way galaxy would be approximately 4.95.

This means we might expect around 5 civilizations capable of communication with us right now, based on the given assumptions and estimates.

The Fermi Paradox:
'The Great Silence'

We hear rumors all the time about UFOs and aliens visiting the Earth but

"Where are They?"

If aliens exist,

why haven't they contacted us?

Enrico Fermi, physicist

Maybe we are an Anomaly--
The “Rare Earth” Hypothesis:

Extremely

Rare

all

alone 😢

The “Hush-Hush” Hypothesis:

Maybe we have already been contacted, and the government is keeping it secret so we

Don’t Panic

The “Quarantine” Hypothesis:

Maybe aliens think we are too dangerous and do not want to meet us…

A Problem: The Inverse Square Law of Energy Propagation

- **The Law states that the intensity of a source decreases at a ratio inversely proportional to the square of the distance it travels.**
- **After two light years, our signals simply become background radiation**

What are some examples of things we can do to increase the likelihood of observing aliens?

- Have JWST focus more on the search for life
- Accelerate the schedule for Mars Sample Return
- Ask your member of Congress to investigate whether or not the government is hiding UFO information from us
- Figure out a way for astronauts to travel to where there is life

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If alien beings aren’t coming to us, then maybe we should put on our spacesuit and go to where they could be?

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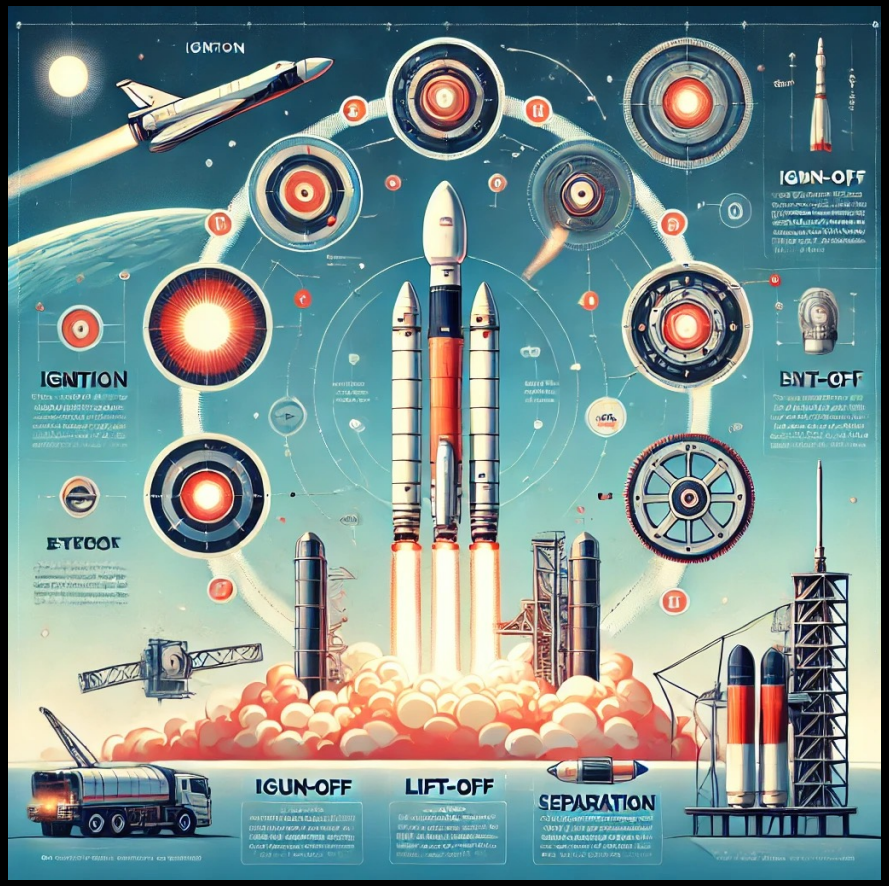
Where should we go to find life?

A. **Moon**
B. **Mars**
C. **Europa**
D. **The nearest Star and its exoplanet called Proxima Centauri b - Distance from Earth: ~4 light-years**
E. **None of the above**

How do you get to where there is life in another world?



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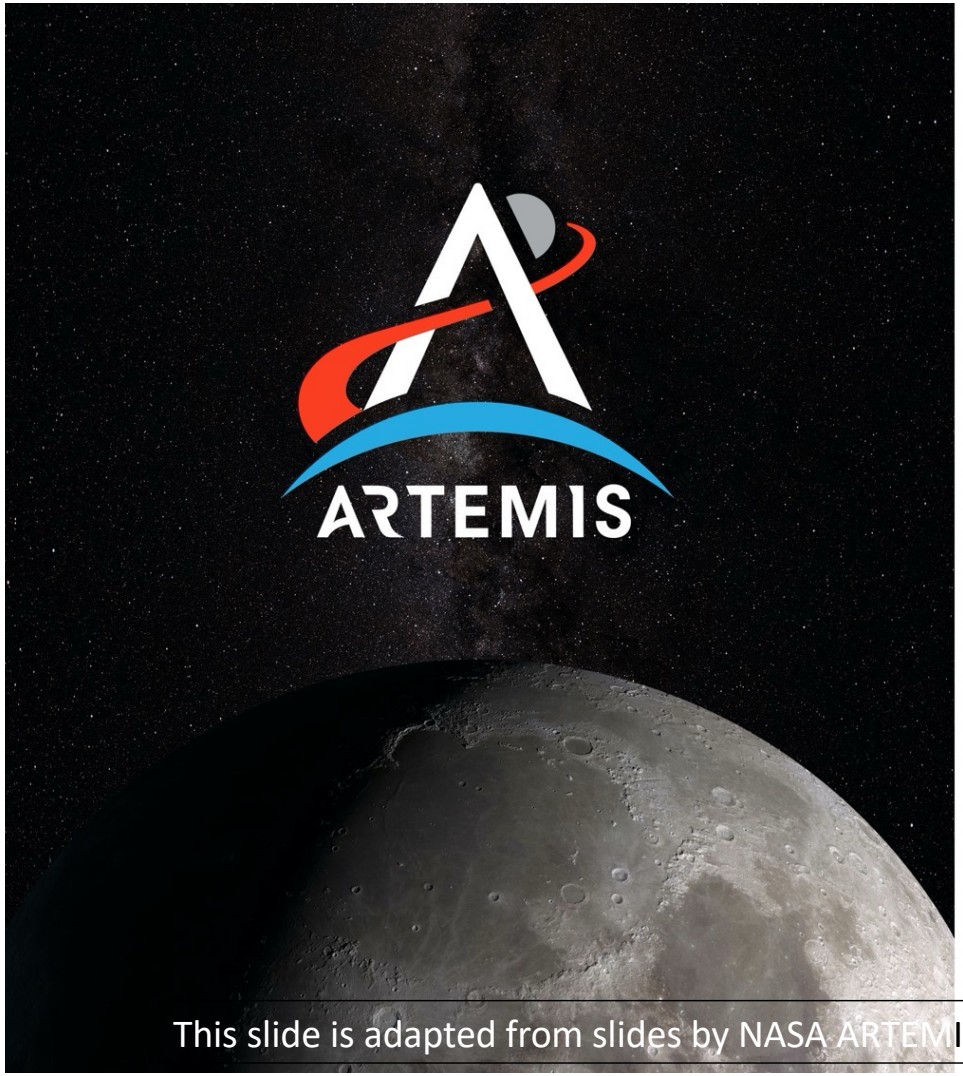
How do Rockets Work?

Experiment of the Boat by Tsiolkovsky



ARTEMIS

Twin sister of Apollo and goddess of the Moon in Greek mythology. With Artemis missions, NASA will:

- Collaborate with international and commercial partners to establish the first long-term presence on the Moon, and
- Use what we learn on and around the Moon to take the next giant leap: sending the first astronauts to Mars.

This slide is adapted from slides by NASA ARTEMIS Chief Nujoud Merancy, dated Oct. 21, 2021.

The Artemis II Lunar Flyby Mission Crew Members announced on April 3, 2023
Include (from left): NASA astronauts Christina Koch, Victor Glover, Reid Wiseman (foreground) and Canadian Space Agency astronaut Jeremy Hansen.


DO YOU HAVE WHAT IT TAKES TO #BeAnAstronaut?
NASA
U.S. citizen
Master's degree in STEM field
Two years related, professional experience
Pass NASA astronaut physical
NASA
ARTEMIS

“Reaching the Stars” by former Mars Helicopter Project Manager MiMi Aung

Hard
Work

+

Critical
Thinking

Dream ➡ Reality


National Aeronautics and
Space Administration
NASA
THE EVOLUTION OF A MARTIAN
www.nasa.gov


Thank You for being here.

Backup Charts

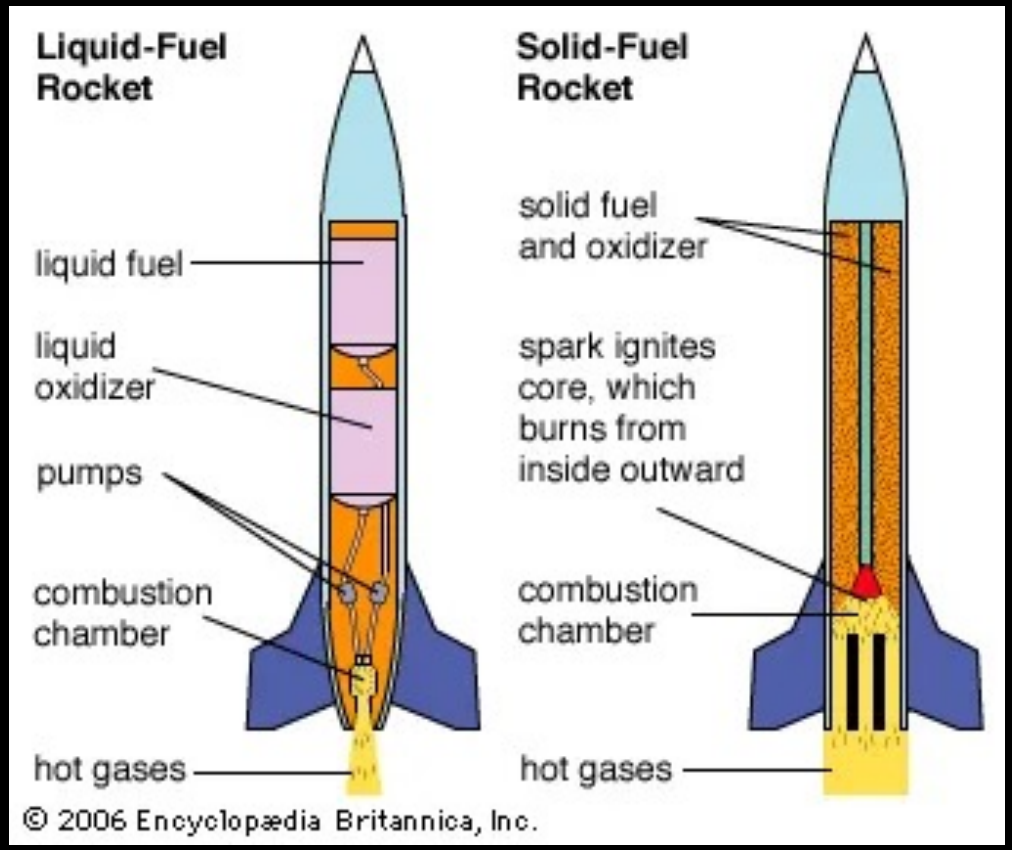
- Outline
- How do Rocket's Work
- Tsiololksky Rocket Equation
- Ms. MiMi Aung

Are We Alone? For Kids

- What is NASA?
- What are the chances that we are alone?
- What is life?
- Examples of humans searching for life
  - Earth based telescopes
  - Space based telescopes
  - Exploring our Solar System
    - Mars Sample Return
    - Europa Clipper Spacecraft
- The Drake Equation
- The Fermi Paradox
- Plan of action to increase the likelihood of observing life in outer space?

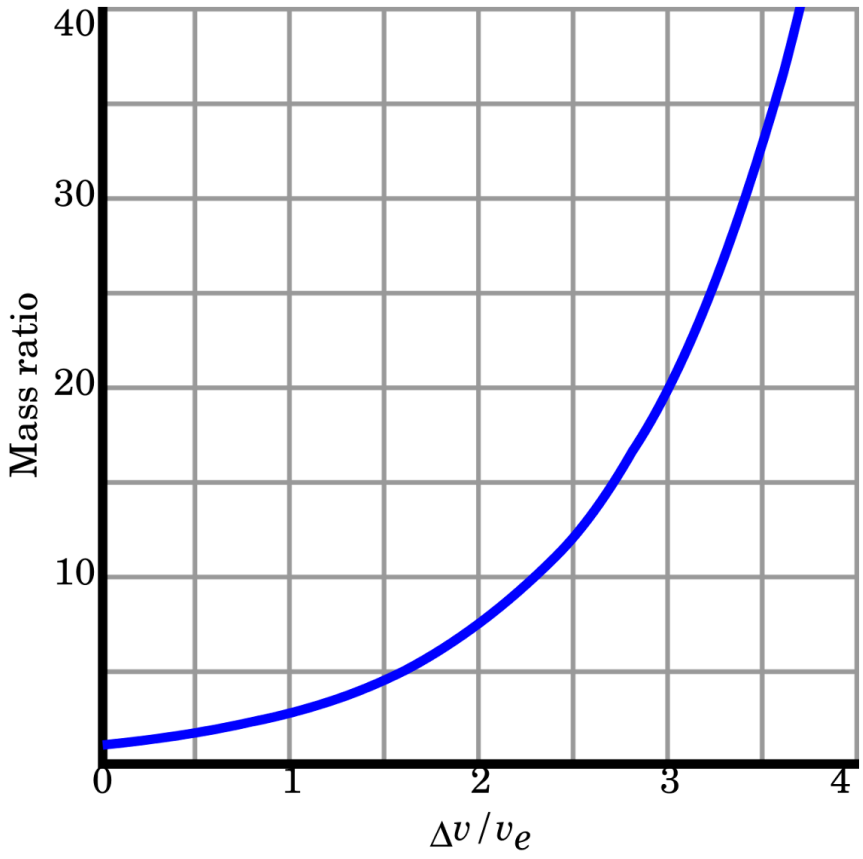
How do rockets work?

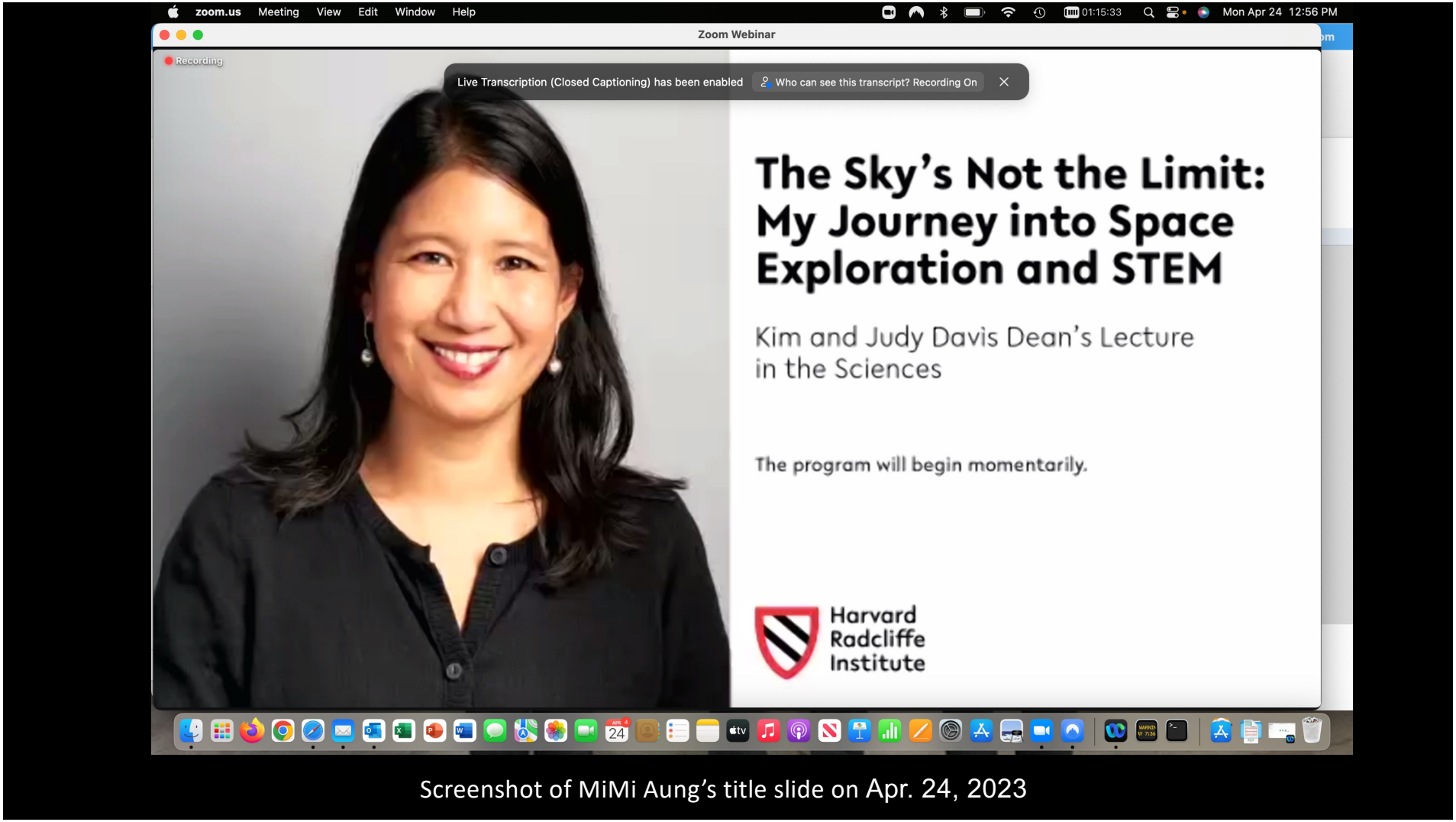
- The action is the force produced by the expulsion of gas, smoke, and flames from the nozzle end of a rocket engine.
- The reaction force propels the rocket in the opposite direction.
- When a rocket lifts off, the combustion products from the burning propellants accelerate rapidly out of the engine.



Tsiololksky Rocket Equation

- $\Delta v = v_e \ln(m_0/m_1)$ or $e^{(\Delta v/v_e)} = m_0/m_1$
  - m_0 is the initial total mass, including propellant
  - m_1 is the final total mass
  - v_e is the effective exhaust velocity
  - Δv is the delta in velocity
- Exhaust velocity for different types of rocket engines
  - Solid fuel rockets is ~2,500 meters per second
  - Liquid fuel rockets is ~4,400 meters per second
  - Ion propulsion rockets are from 20,000 to 50,000 meters per second
- In physics, escape velocity is the minimum speed needed for an object to escape from the gravitational influence of a massive body.
  - Its value is 11.2km/s for earth and 2.4km/s for moon





Screenshot of MiMi Aung's title slide on Apr. 24, 2023