

Are we alone in the Universe?

Class 1.

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Requirements:

- Must attend all classes
- Active participation!

Also:

- Class Resources



Sabanci
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OKULU**

High School Summer Course, 2022

Who am I...?

<http://myweb.sabanciuniv.edu/ekalemci/>





What will we discuss in this course?

Some of the factors that we need to consider in order to answer the question from **interdisciplinary** scientific point of view:

- Astronomical observations & modelling
- What is life?
- Electromagnetic radiation and spectrum
- Extrasolar planetary systems
- 2019 (and recent) Nobel prize(s) in Physics
- Current advances in searching for Earth-like planets with signatures of life

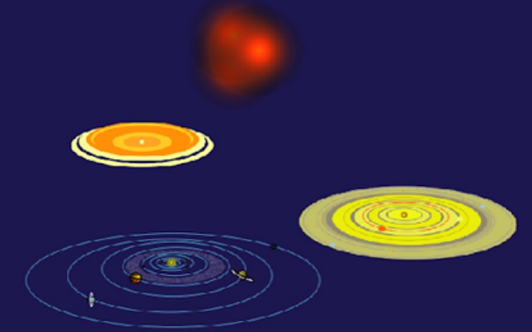
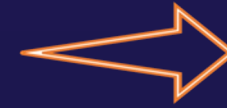
Our Map:



What are there in the Universe?
Scales involved in describing Universe



Our planet and Solar system



How did the Solar system form?
Is it unique?

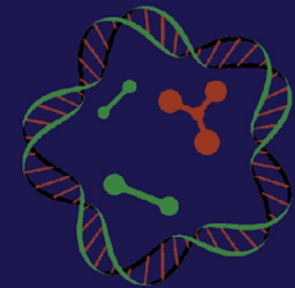
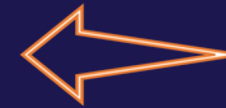
Are we alone in the universe?



What form of life would you look for and how? Possibility of life on other planets.



How can we look for ET life?
Atom and EM spectrum.



What is life?
How did life on Earth begin? Building blocks of life, first form of life on Earth.

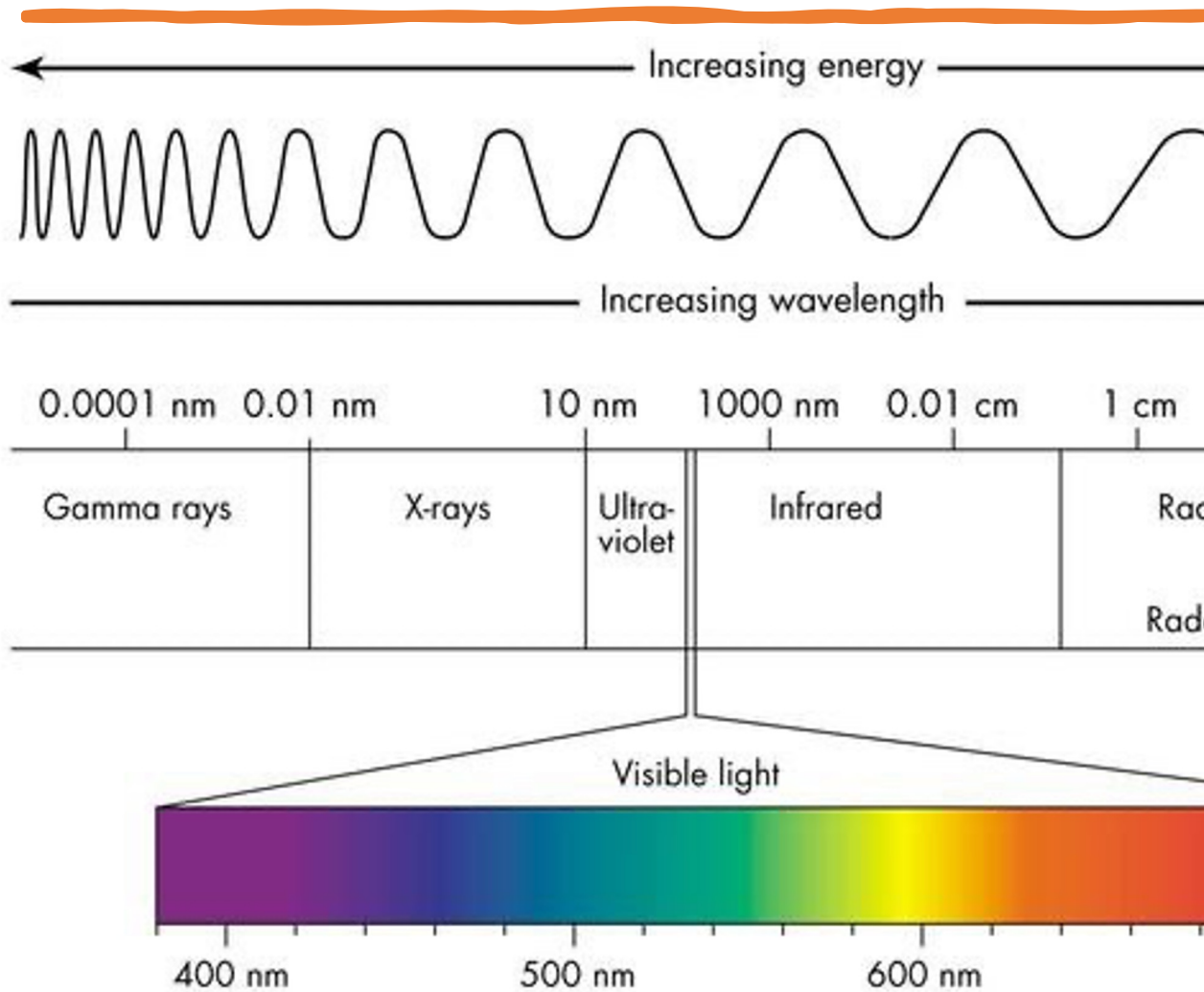
Today's goals... (learning objectives)

Class 1.

By the end of this class, you should be able to:

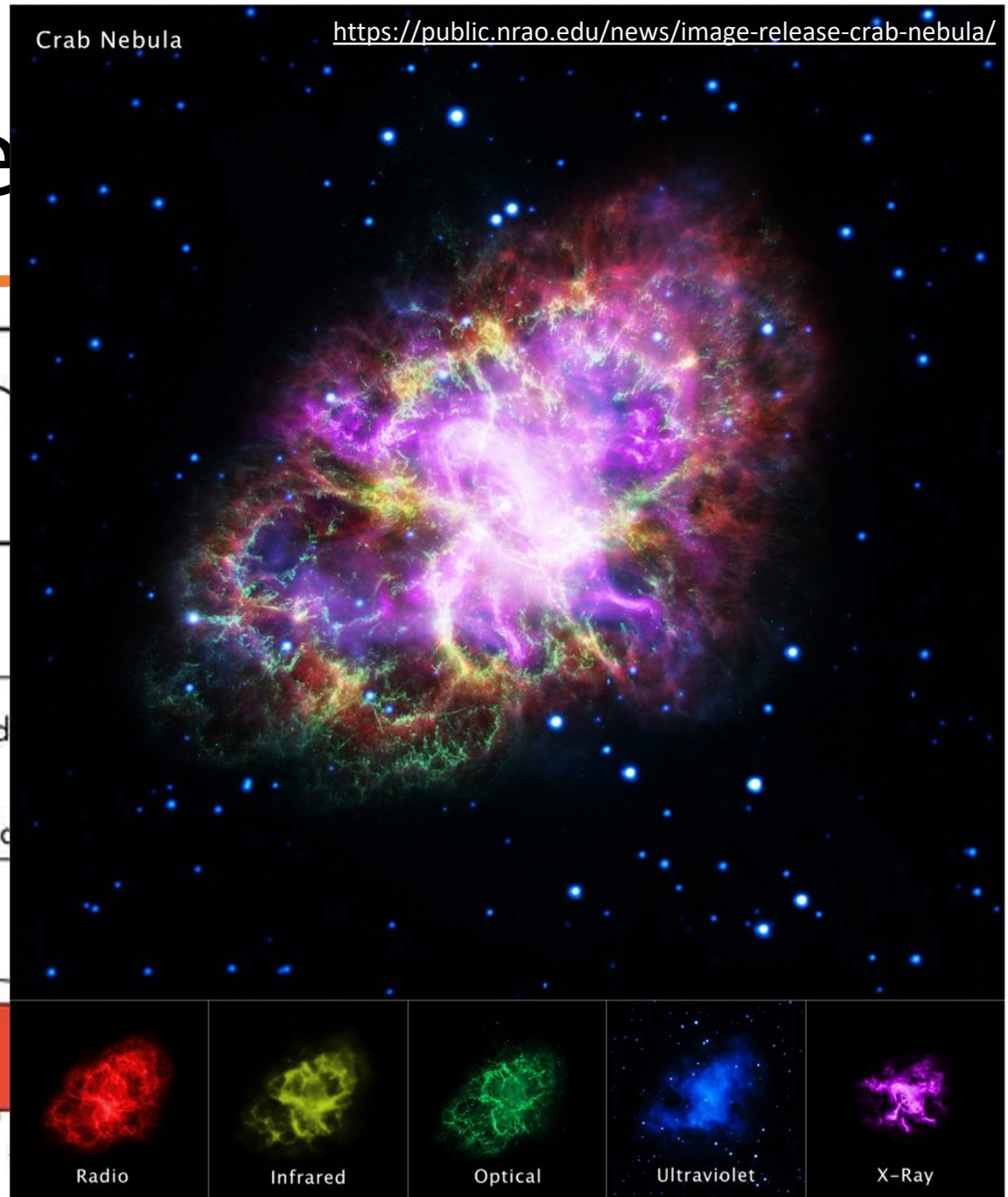
1. Outline how we may study the possibility of **extraterrestrial life**
2. Describe what we study in **astrobiology**
3. State what **Drake equation** estimates

Electromagnetic Spectrum

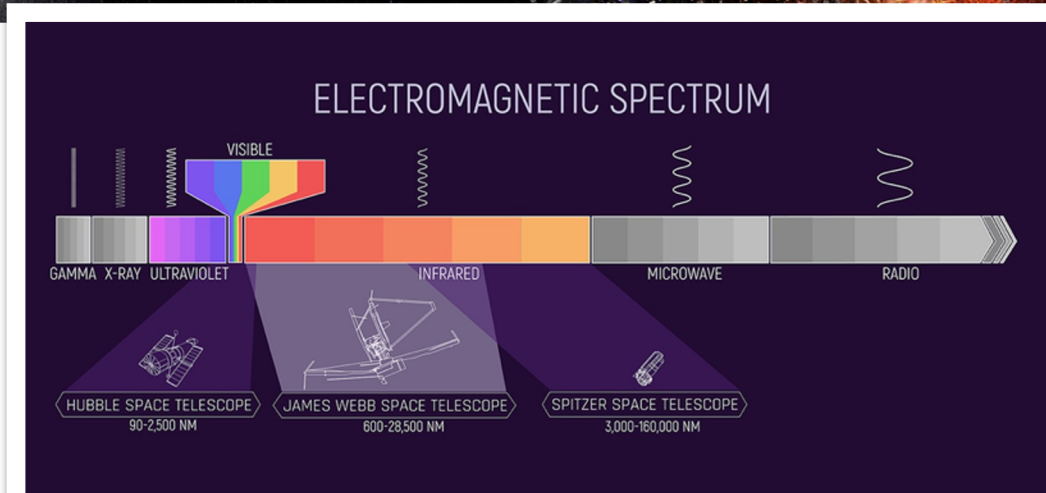
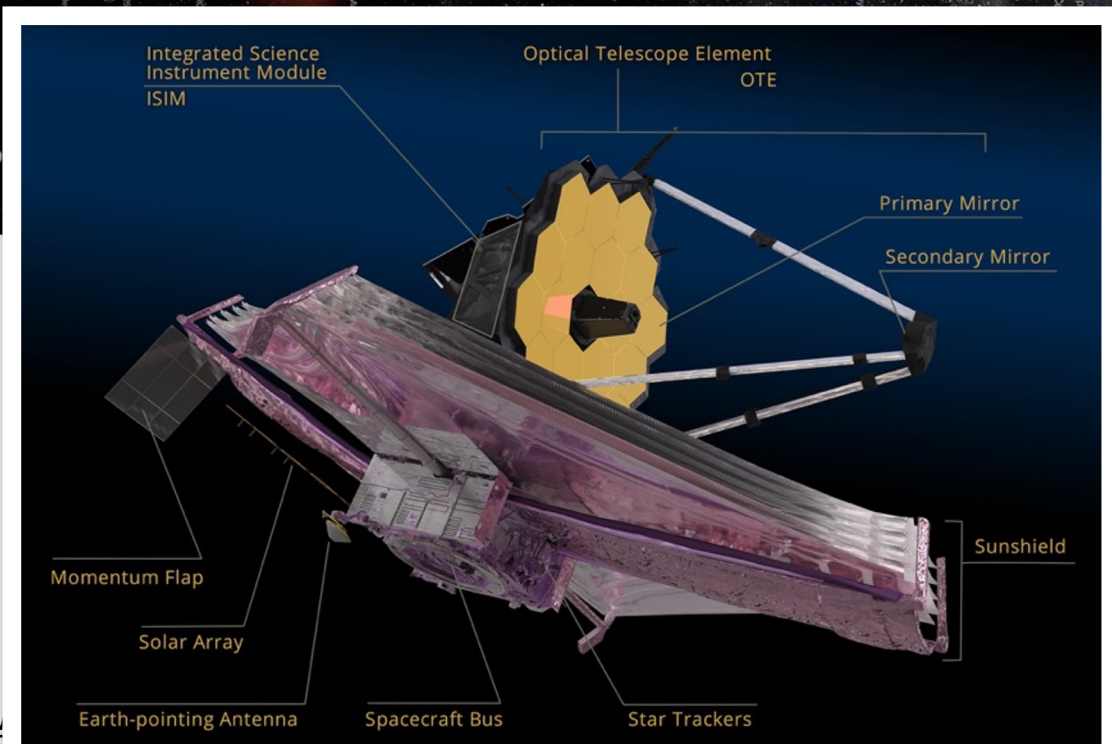
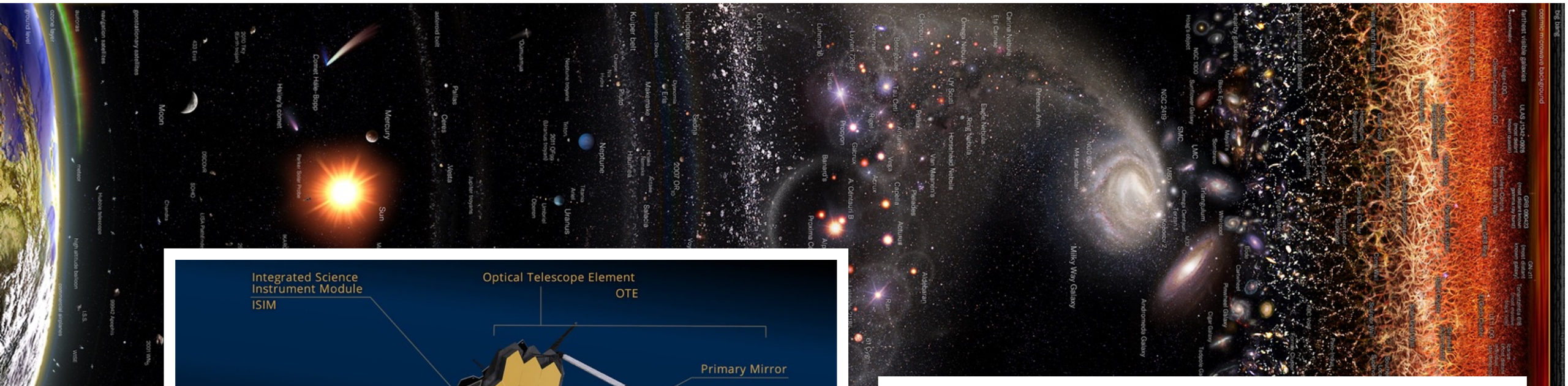


Crab Nebula

<https://public.nrao.edu/news/image-release-crab-nebula/>

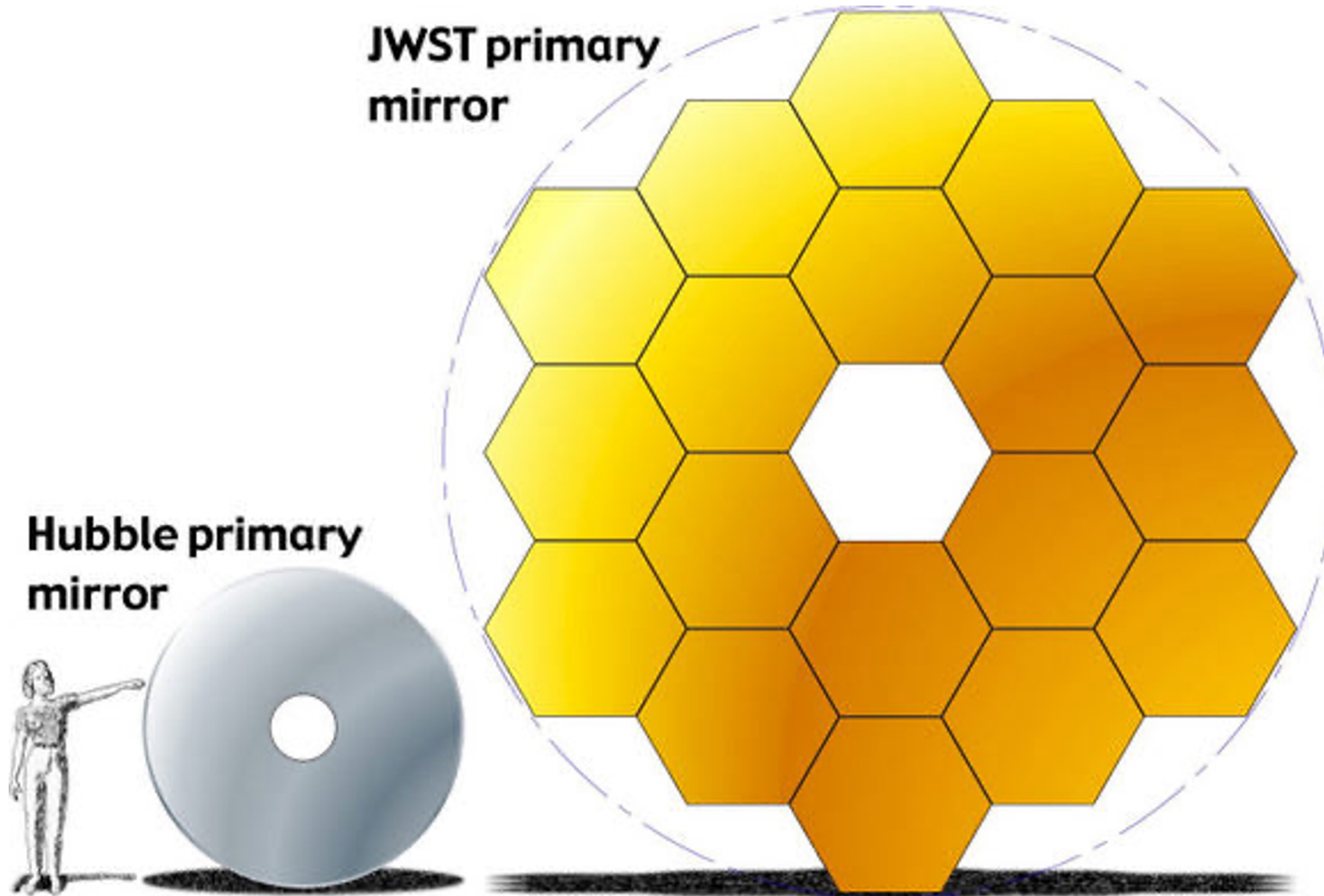


Universe?



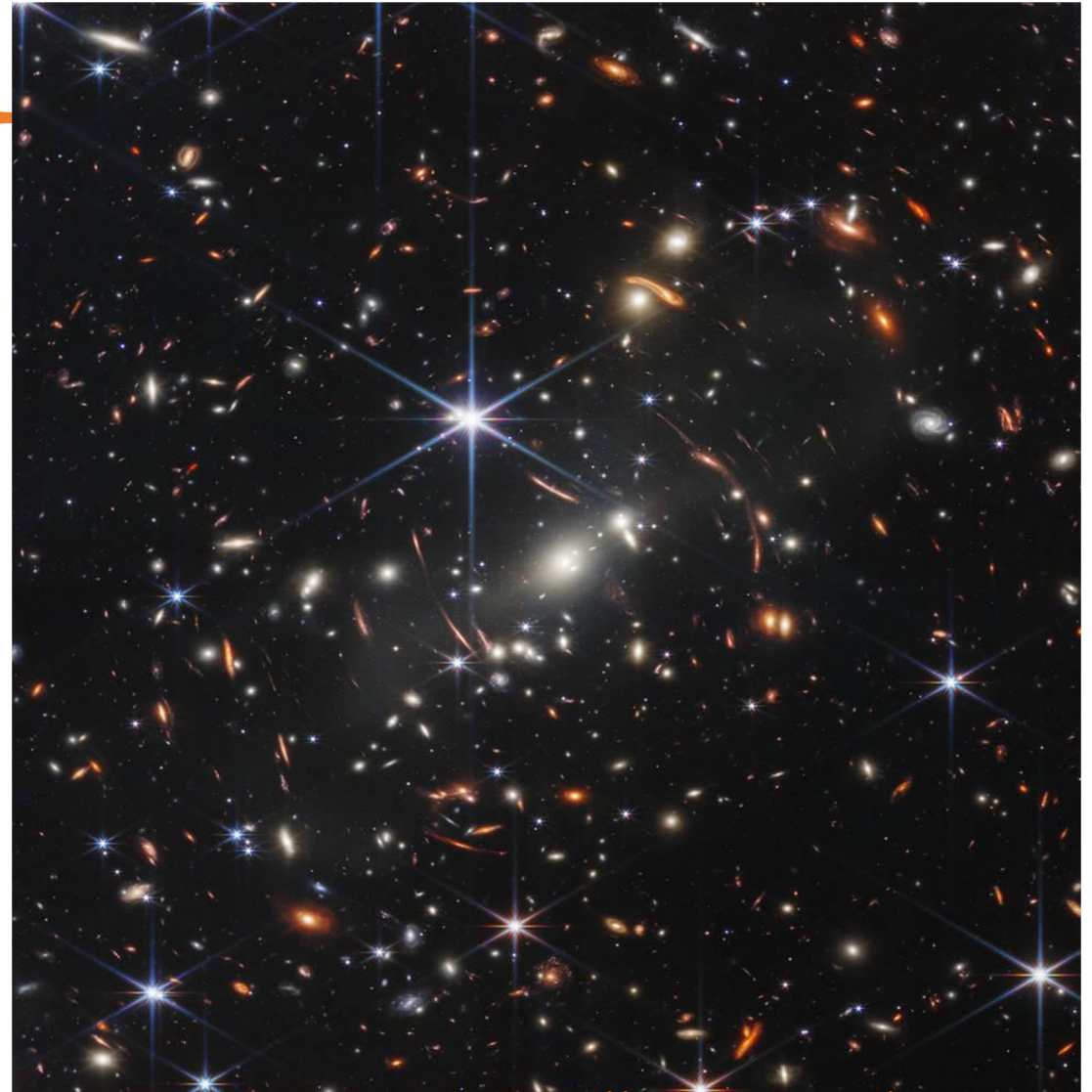
https://upload.wikimedia.org/wikipedia/commons/4/4d/Logarithmic_Map_of_the_Universe_in_a_Horizontal_layout_English_annotations.png

<https://jwst.nasa.gov/>



The James Webb Space Telescope Folds Up
<https://www.youtube.com/watch?v=30Lv8JjCqhU>

Ultra Deep Field... Hubble vs. Webb

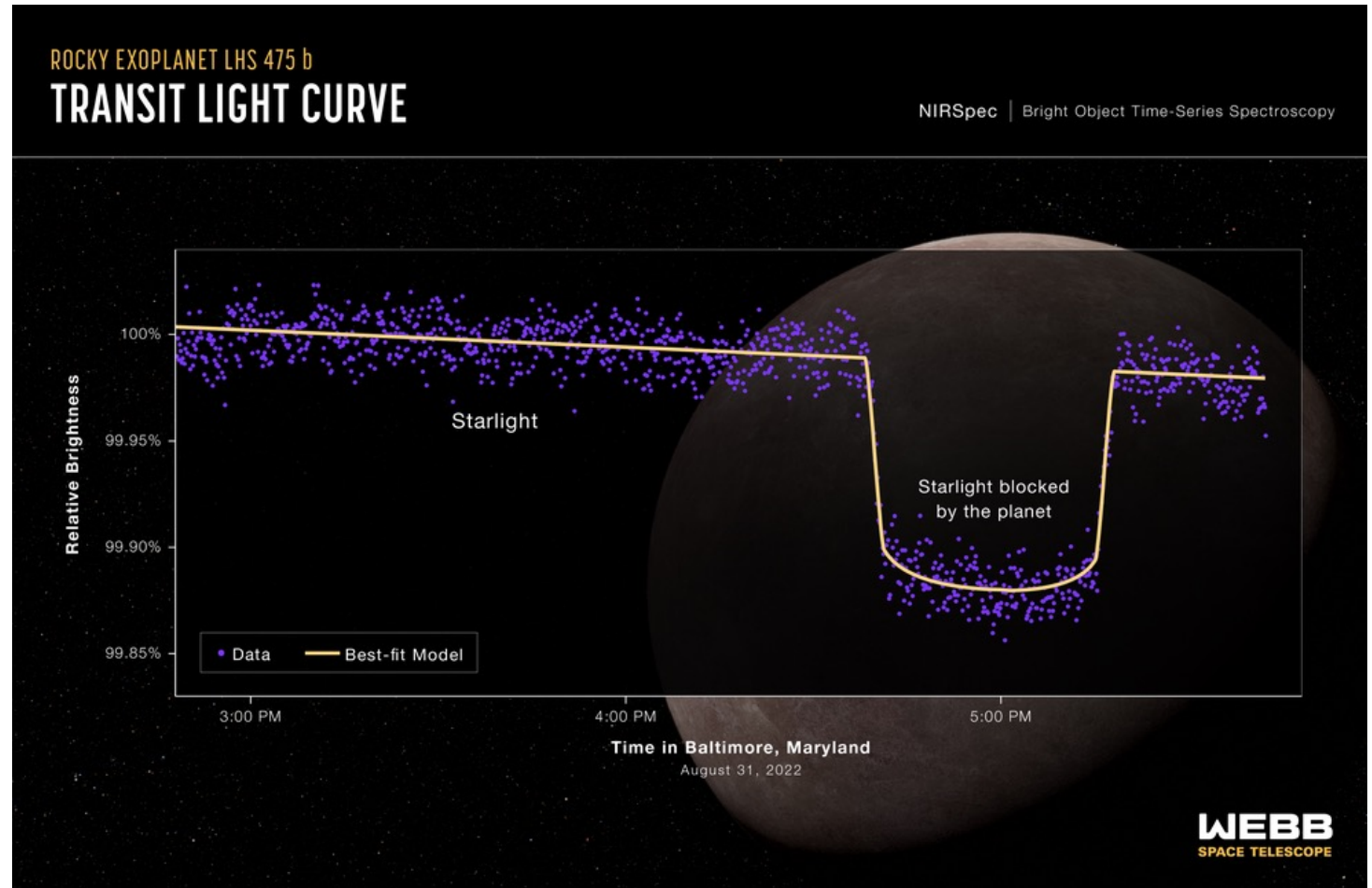


<https://esahubble.org/images/heic0611b/>

<https://www.nasa.gov/webbfirstimages>

JWST's Contributions to Exoplanet Science:

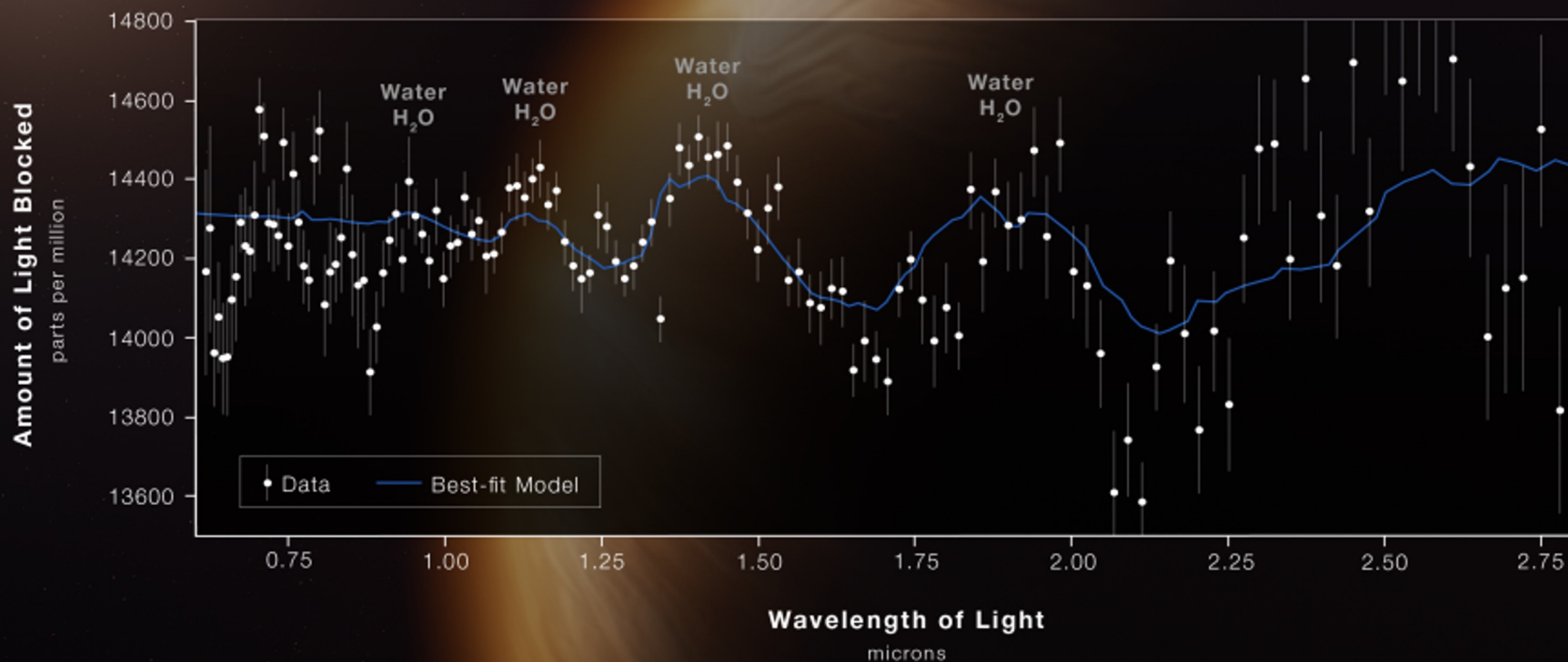
- Probing exoplanet atmospheres for habitability
- Detailed observations of transiting exoplanets
- Expanding knowledge of planetary formation and evolution
- Paving the way for the search for Earth-like worlds and signs of life



<https://www.nasa.gov/feature/goddard/2023/nasa-s-webb-confirms-its-first-exoplanet>

HOT GAS GIANT EXOPLANET WASP-96 b ATMOSPHERE COMPOSITION

NIRISS | Single-Object Slitless Spectroscopy



The Possibility of Life Beyond Earth?

The Question:

- Do we exist as a result of common, inevitable processes or are humans a fluke phenomenon?
 - “Copernican” principle vs. “Anthropic” principle
- Three perspectives:
 1. Cosmic and astrophysical
 2. Biological
 3. Intelligence/technology
 - “Fermi paradox”: Where is everybody?



Astronomy

- Oldest science, gives context of humanity's place in the universe
- Explores dynamics of the cosmos
- Presents evidence that nature acts uniformly in the universe, making terrestrial observations universally applicable



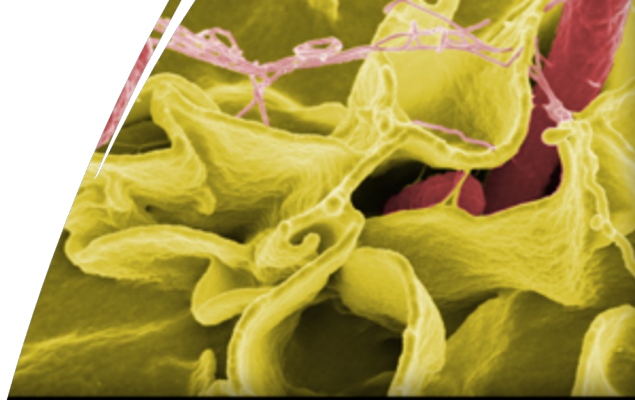


Planetary Science

- Planetary science is the study of **creation and evolution of planetary bodies, moons, asteroids, comets**, and more...
- Studying **solar system bodies** investigates why life may have formed on some worlds, and not others
- Astronomy allows planetary data to be applied to **extrasolar planets**, seeking worlds like Earth

Biology

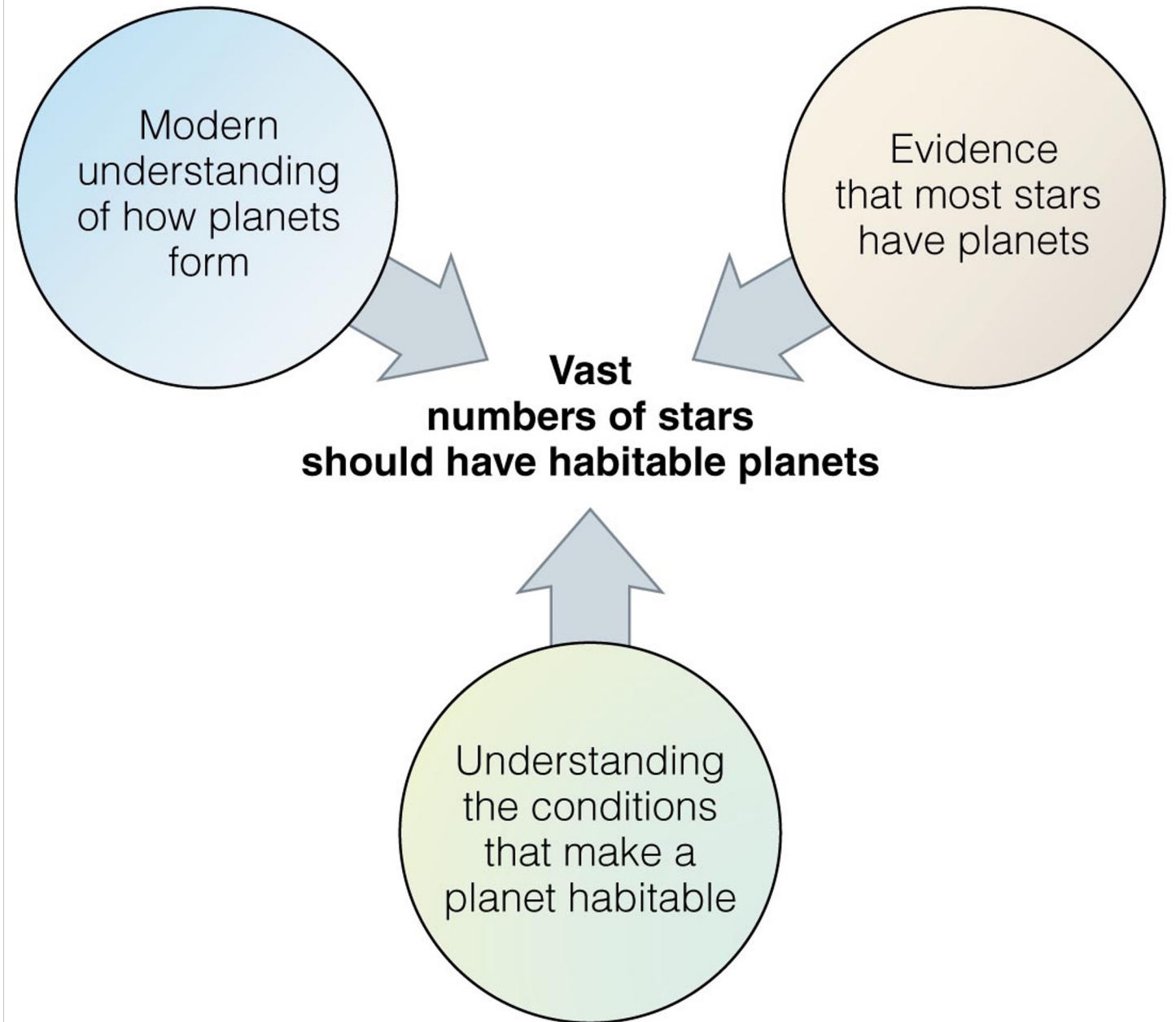
- Biology is the study of living organisms, including the formation and evolution of life
 - Planetary science and astronomy yield context for life
- Biological research is limited to Earth-based life, yielding poor context for possibilities of universal life
- Extrapolation of Earth-based life is required to find extraterrestrial life



All together....

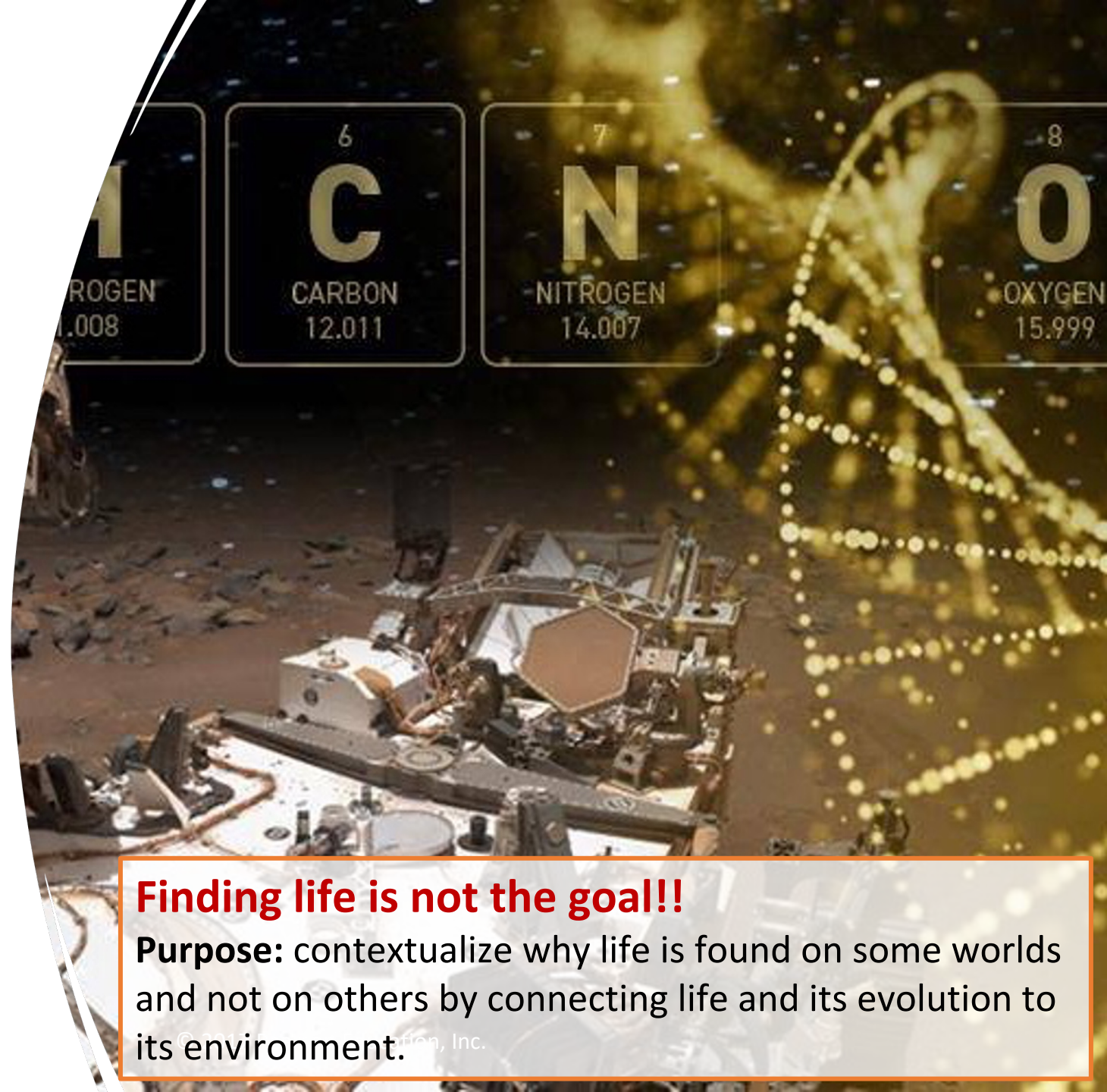
Understanding the conditions which led to life emerging on Earth helps identify potential locations for extraterrestrial life to form!

The Planetary Science Context



Astrobiology

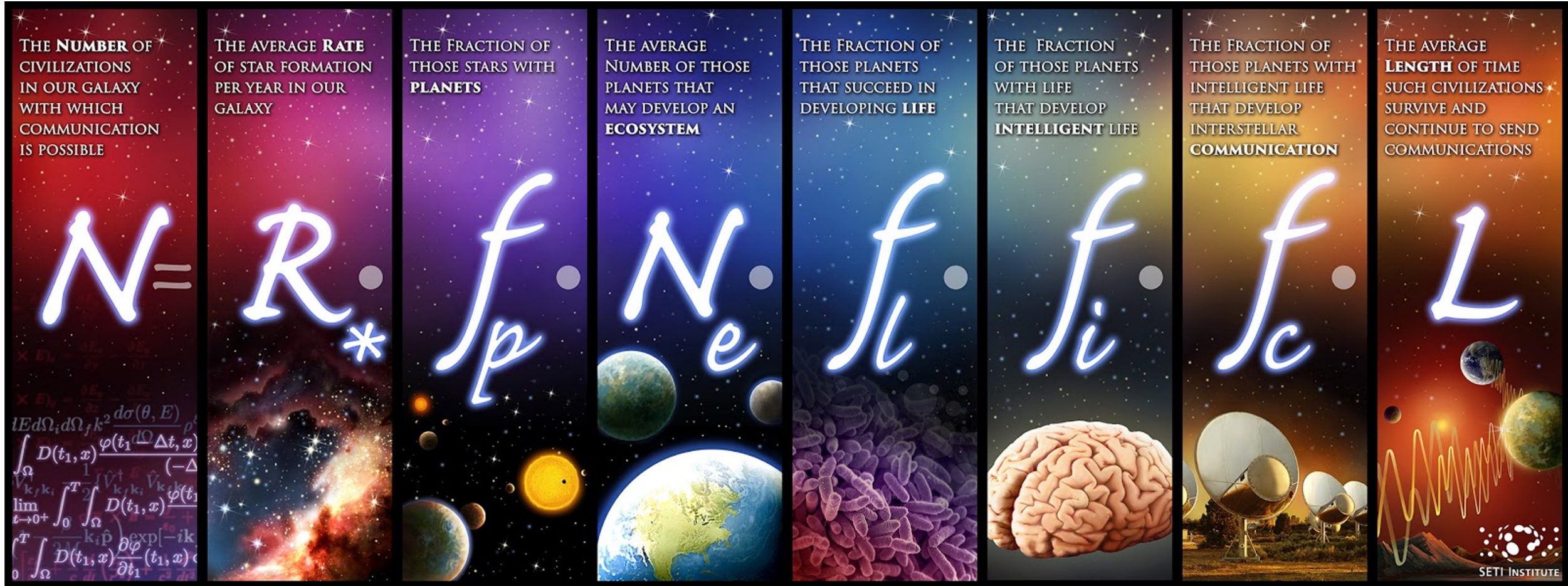
- The combined fields of science dedicated to investigating extraterrestrial life in the universe
- Research focuses mostly on:
 1. **Studying** the conditions conducive to the origin and ongoing existence of life
 2. **Looking** for such **conditions** on other planets in our solar system and around other stars
 3. Looking for the **actual occurrence of life** elsewhere



Finding life is not the goal!!

Purpose: contextualize why life is found on some worlds and not on others by connecting life and its evolution to its environment.

Drake Equation



We will explore some of the factors that affect finding **intelligent** life in **our Galaxy**.