

ALIENS















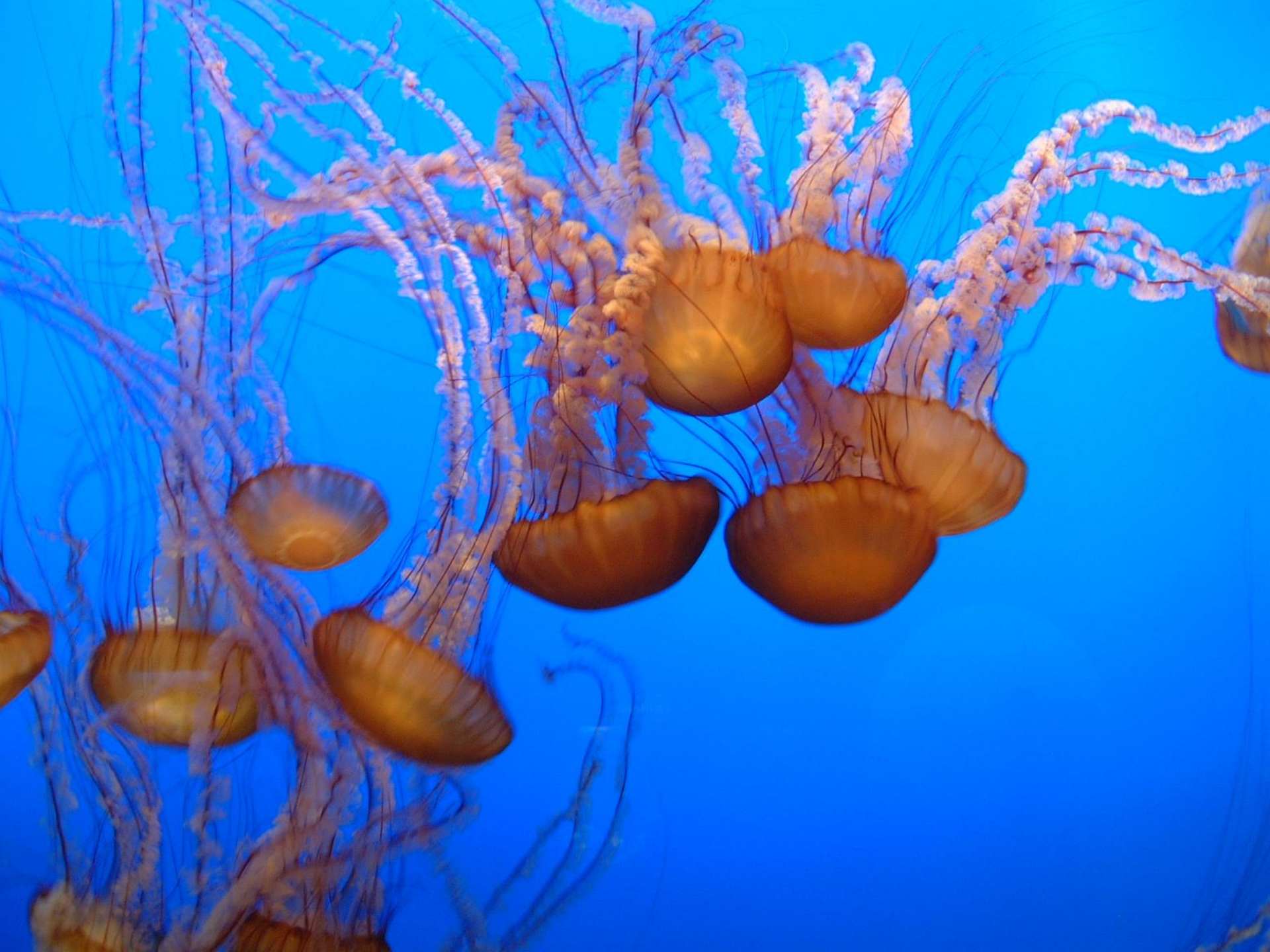


WHAT DO ALIENS LOOK LIKE?

- Movie aliens mostly look like men in rubber suits
- They almost all have two eyes, one nose, one mouth two arms and two legs.
- Faces are usually human enough to be frightening
- Motives are either all good or all bad
 - Benign welcoming us into the universe
 - Hostile wanting our land, water, women or bodies for food

WHAT DO ALIENS REALLY LOOK LIKE?

- We won't know until we see one
- Probably not much like us
- Probably not much like any Earth creature







TARDIGRADE



BANANA



ALIEN VISITORS

- Are they here?
 - Probably Not
 - Difficulty in keeping secret
 - Not seen by astronomers
 - Why do people see UFO's

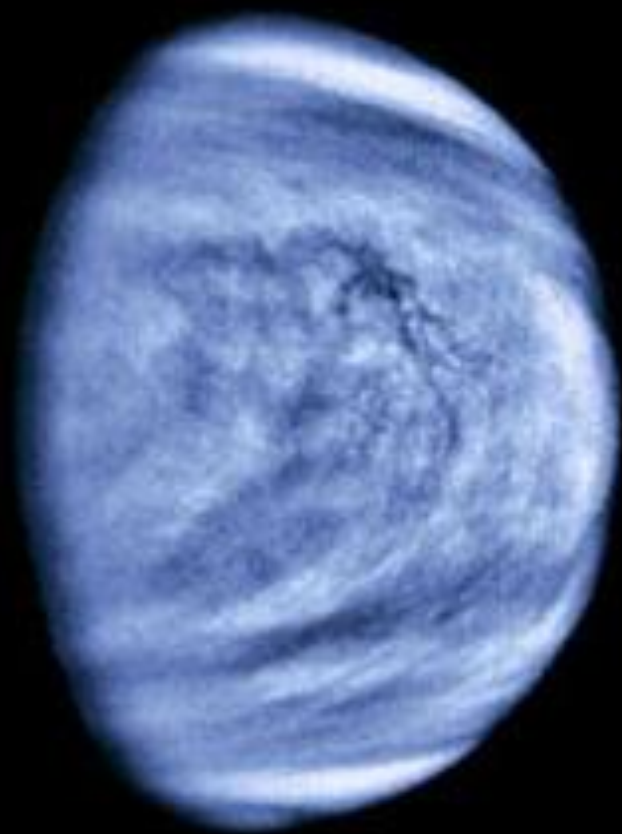


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ALIENS

- What do we know for sure about Alien life?

NOTHING!

- How many examples of Alien life do we have?

ZERO!

DO ALIENS EXIST?

- Very likely
- Size of the universe.
 - 1,000,000 Stars for every grain of sand on Earth.
- We don't know if any aliens life is close enough for us to learn about it.
- We need to understand the parameters of life on Earth to know where to look.

WHAT DO WE KNOW ABOUT LIFE

- We have only one example of life to draw upon – life on Earth.
- By studying the history of life on earth we can begin to understand how life might develop on other planets.

WHAT DO WE KNOW ABOUT LIFE

- It arose soon after Earth cooled
- It only arose once
- For $\frac{3}{4}$ of the time life was on Earth it was single celled.
- Intelligent civilized life has only existed on Earth for a very short time.
- Life on Earth requires liquid water.
- Wherever there is liquid water on Earth, there is life.











ALIEN LIFE IN OUR SOLAR SYSTEM

- If not in our solar system, it may be a long time before we can study it.
 - 70,000 Years for our fastest spaceship to reach the nearest star
- Where are we looking
 - Mars
 - Some moons

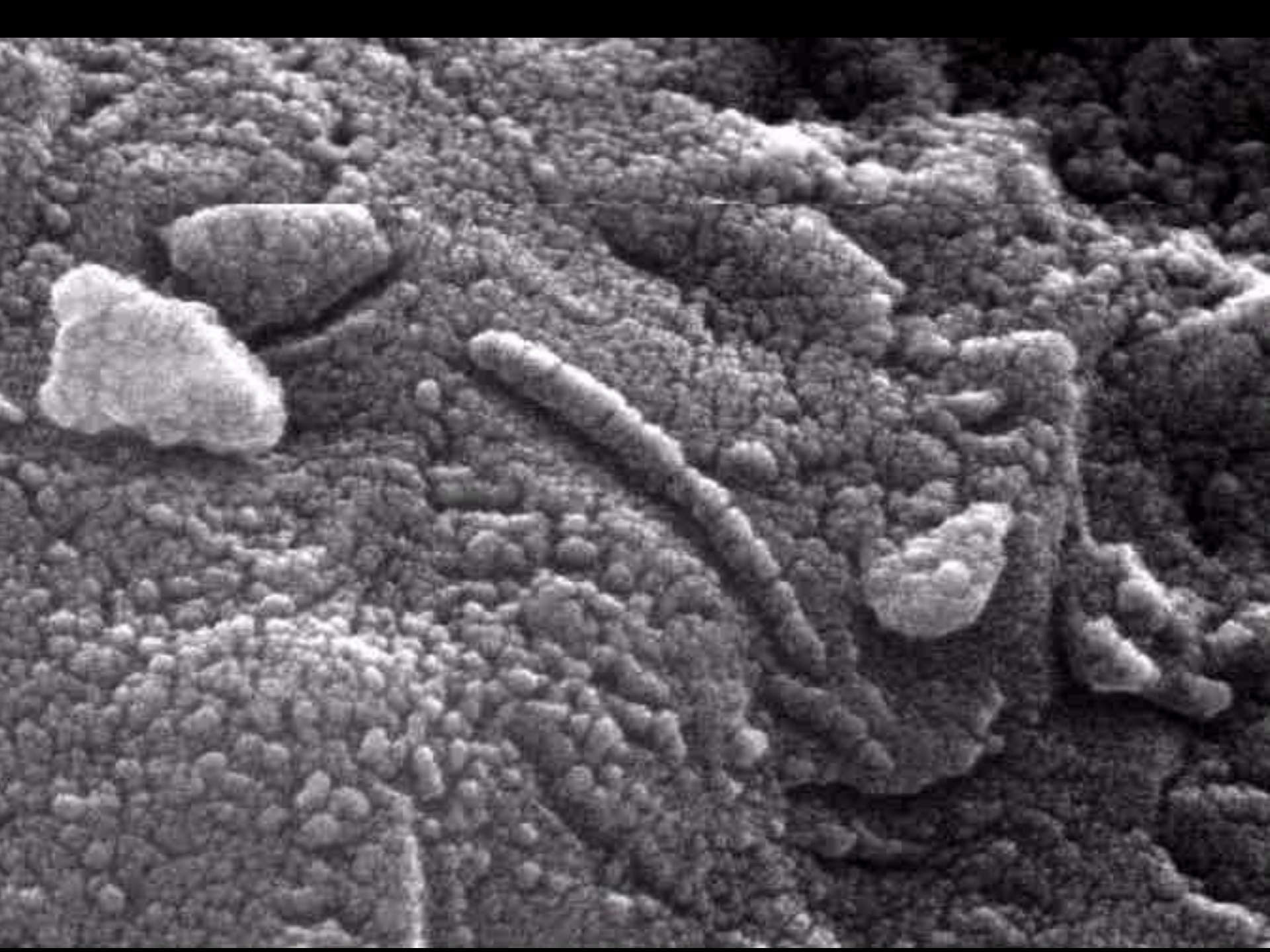




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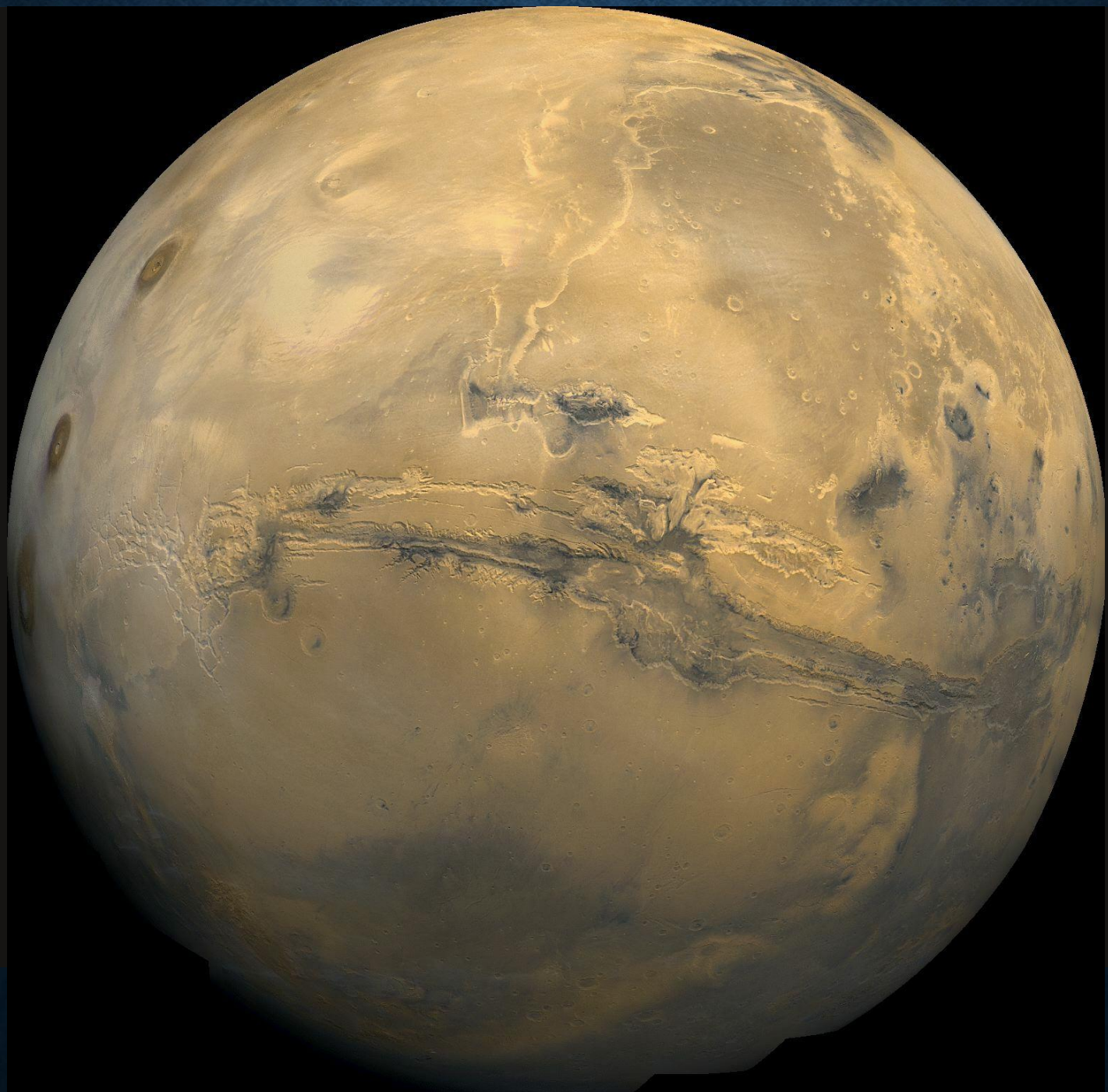
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WHAT DO WE KNOW ABOUT MARS?

- Mars once had oceans
- There is a lot of water ice in the ice caps
- There is a mysterious source of Methane
- There may still be liquid water underground

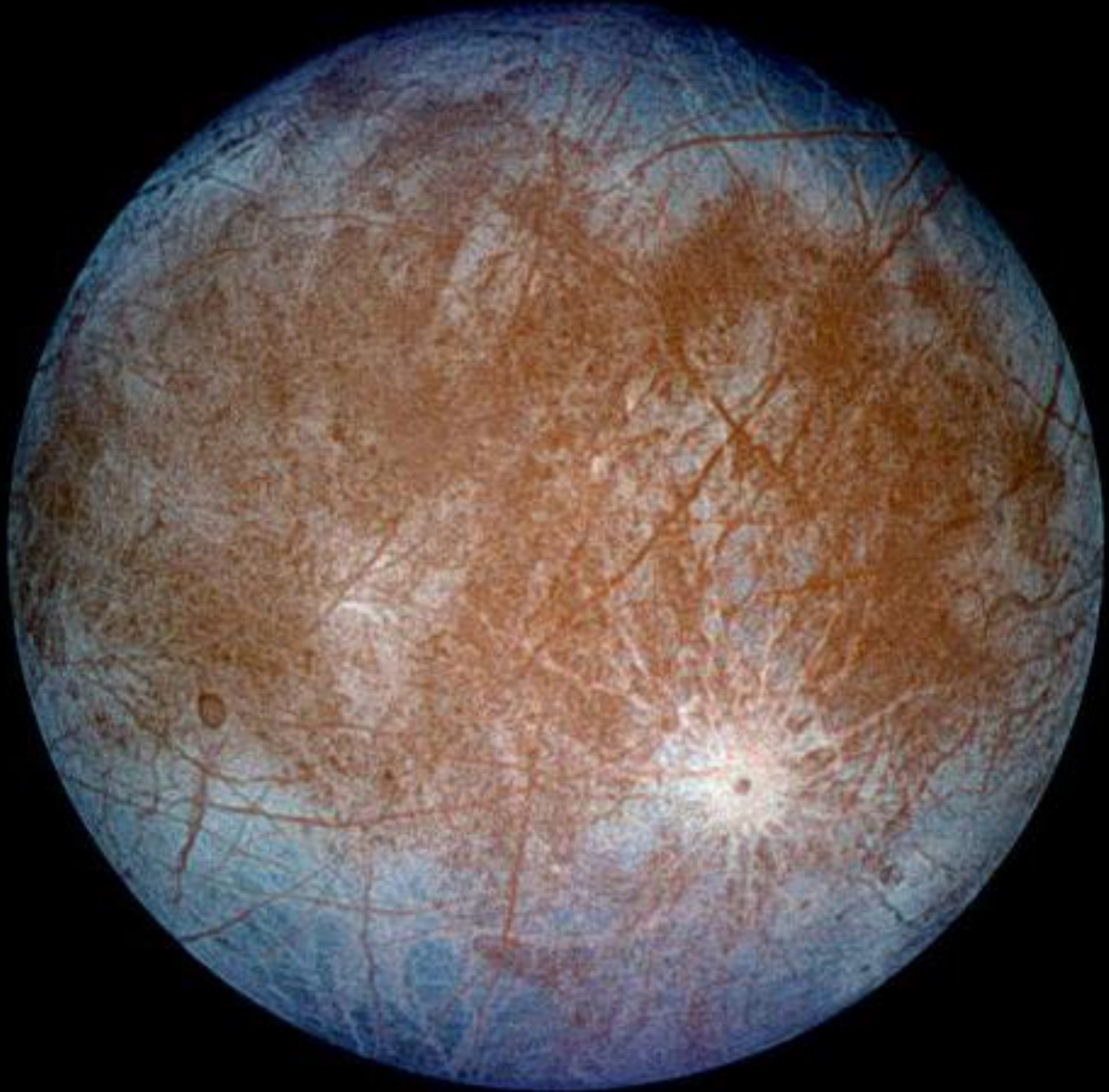




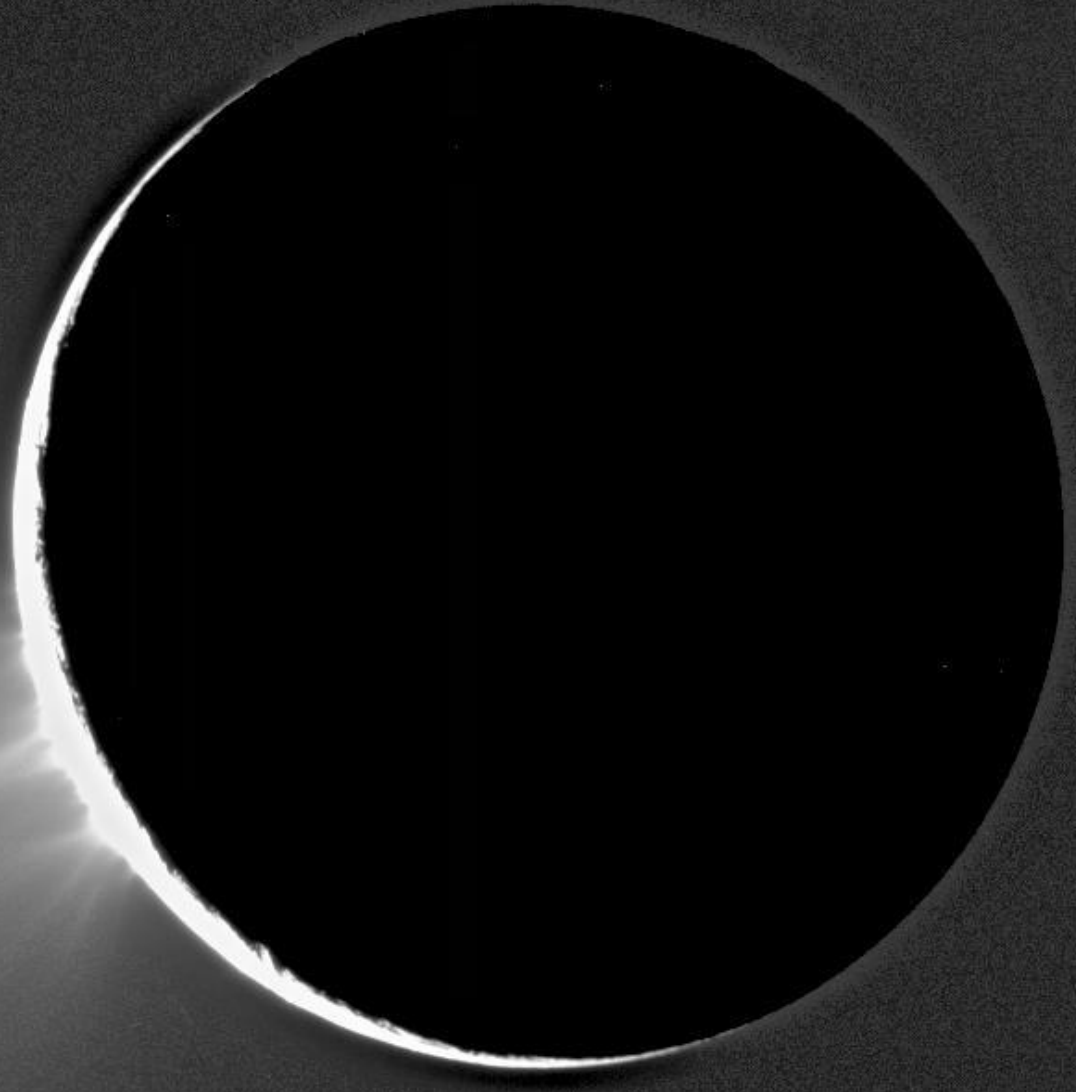
OTHER POSSIBLE WORLDS WITH LIFE IN OUR SOLAR SYATEM

- Europa
- Enceladus
- Titan (not water based)

Europa



Enceladus

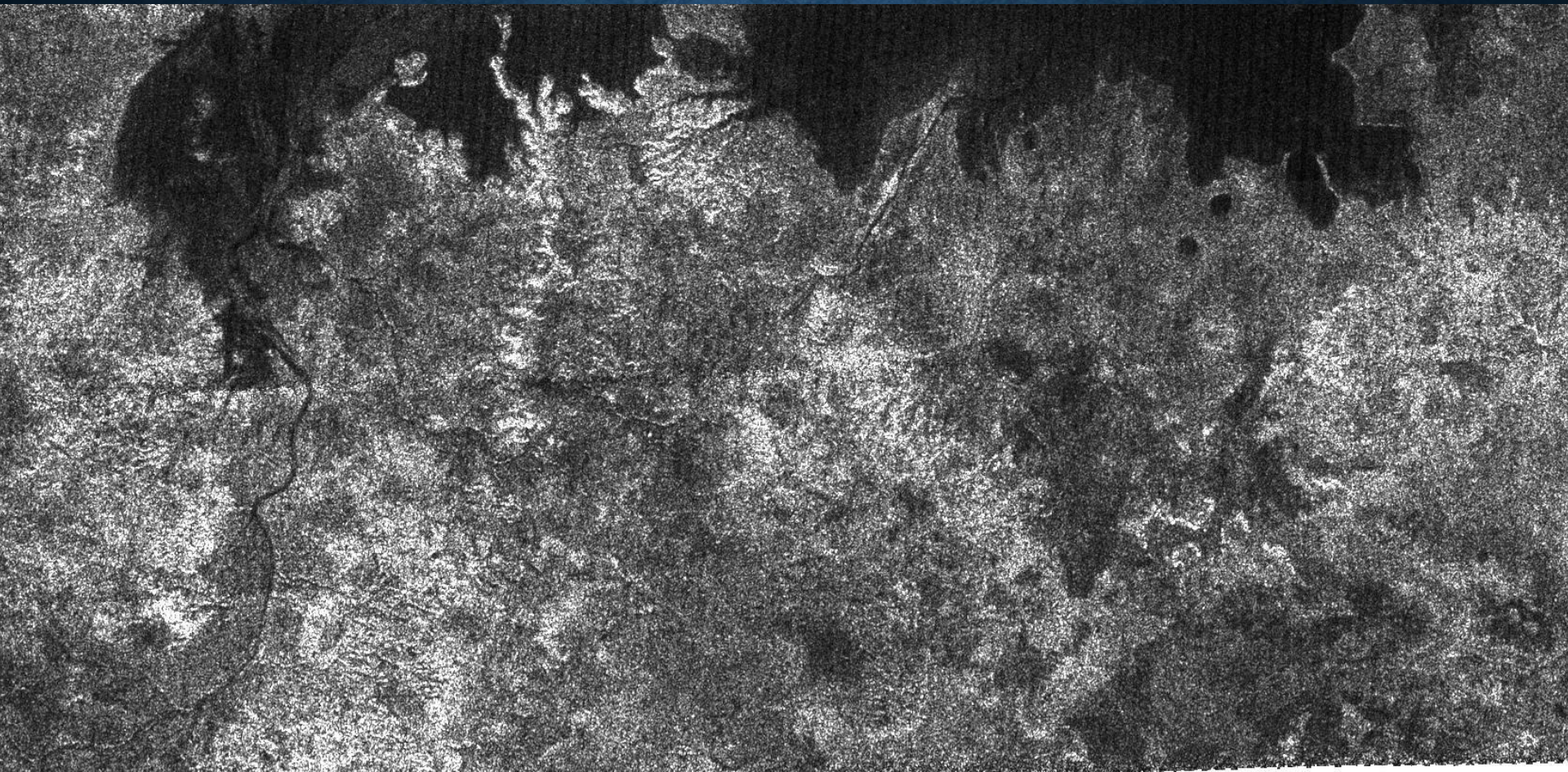


Titan



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Titan



WHAT IF WE FIND ALIEN LIFE IN OUR SOLAR SYSTEM?

- The life we find will not be intelligent nor will it have civilizations or technology.
- Most likely we would find only single cell creatures.

-BUT-

- It will either be the same or not the same as Earth life.

WHAT ABOUT ALIEN LIFE BEYOND OUR SOLAR SYSTEM

- First we need to find habitable worlds.
 - What is a habitable world
 - We assume liquid water is a requirement.
 - We assume that life would not arise on a giant planet or a gas planet.
 - The habitable zone.
 - Part of the Galaxy where life can arise
 - Part of a solar system where liquid water can exist.

SEARCHING FOR PLANETS

- We have found 3529 planets and 585 solar systems. There are also 4,496 Kepler candidates.
- Of all the planets we found, only 372 are about Earth's size. All the rest are bigger.
- We estimate that most of the stars in the galaxy have planets, 400,000,000,000 solar systems.

HOW WE FIND PLANETS

- 648 by Radial Velocity
- 2750 by Transit
- 44 by Direct Imaging
- 49 by Gravitational Lensing
- The rest by various small variations in a star's motion.

Of all the planets we found, only 372 are about Earth's size. All the rest are bigger.

SETI (SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE).

- An effort to find other intelligent beings
- Searches for radio signals which might be used for communications
- Odds of success are low but..
 - If found it would be the most profound discovery in history.
 - How can we not look?



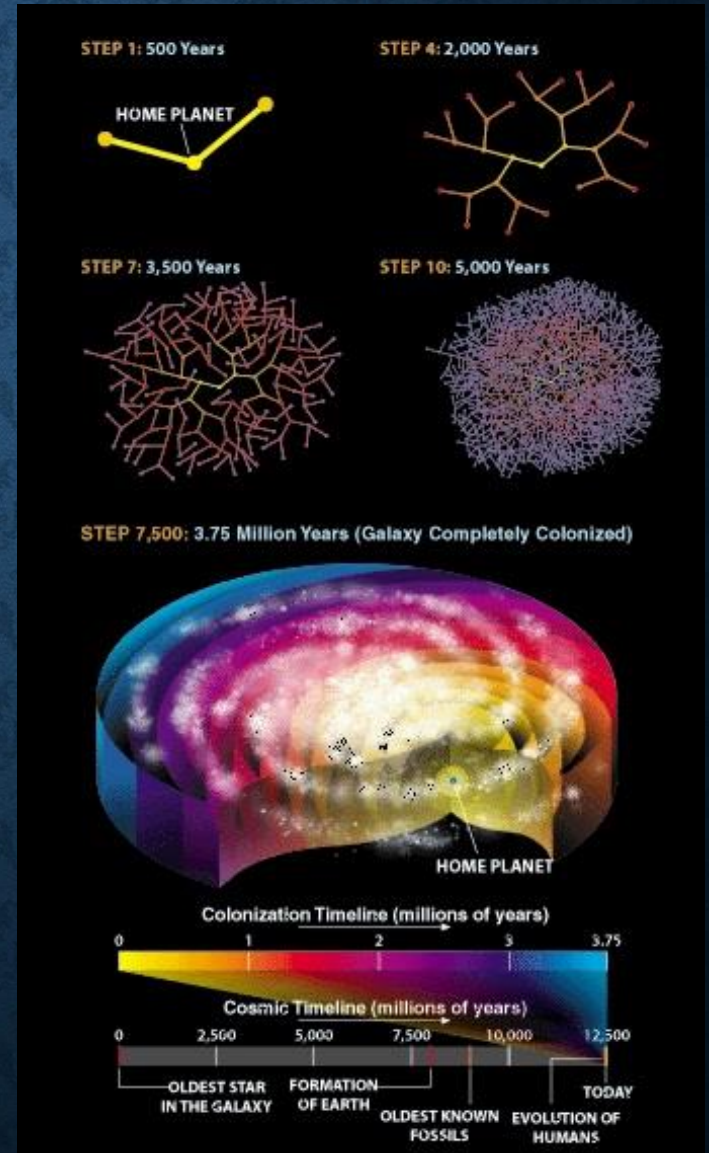
ARE WE GOING TO THE STARS?

YES

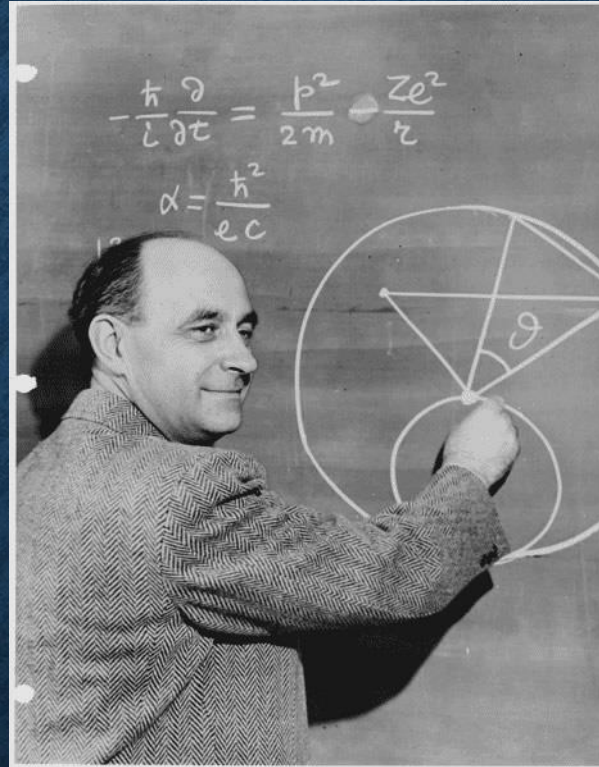
INTERSTELLAR COLONIZATION IS A RAPID, EXPONENTIAL PROCESS.

Mankind's March to the Stars

- Ships that travel at $0.01c$ and take 500 years between stars.
- 5,000 year wait time before dispatching the next ships.
- Inhabited region grows at 0.1% speed of light.
- Fills the Galaxy in 10 to 100 Million Years.



THE FERMI PARADOX



Where is everybody?

THE FERMI PARADOX

- If any civilizations have been around in our Galaxy for at least $\sim 10\text{--}100$ Myr they should have colonized the entire Galaxy by now.
- We should have been visited many times over.
- But, we have no evidence of extraterrestrial visitation, nor have we found any alien artifacts on Earth.

Where is everybody?

THE FERMI PARADOX

A number of solutions have been proposed to explain the Fermi Paradox:

- We are alone... and always have been (Rare Earth Hypothesis)
 - because civilizations blow themselves up (Doomsday Hypothesis)
 - because Nature eradicates us (Inhospitable Universe Hypothesis)
- Civilizations have not colonized the Galaxy...
 - because it's hard
 - because they don't want to
- Civilizations *have colonized the Galaxy but we don't know it*
 - *because they aren't telling us (Zoo or Prime Directive Hypothesis)*
 - *because we can't tell they are there*
- We do have evidence of their existence - but the government won't tell us (UFOs Are Real Hypothesis)

**“ANY SUFFICIENTLY ADVANCED
TECHNOLOGY IS
INDISTINGUISHABLE FROM MAGIC.”**

ARTHUR C. CLARK
APR 28, 2013

END