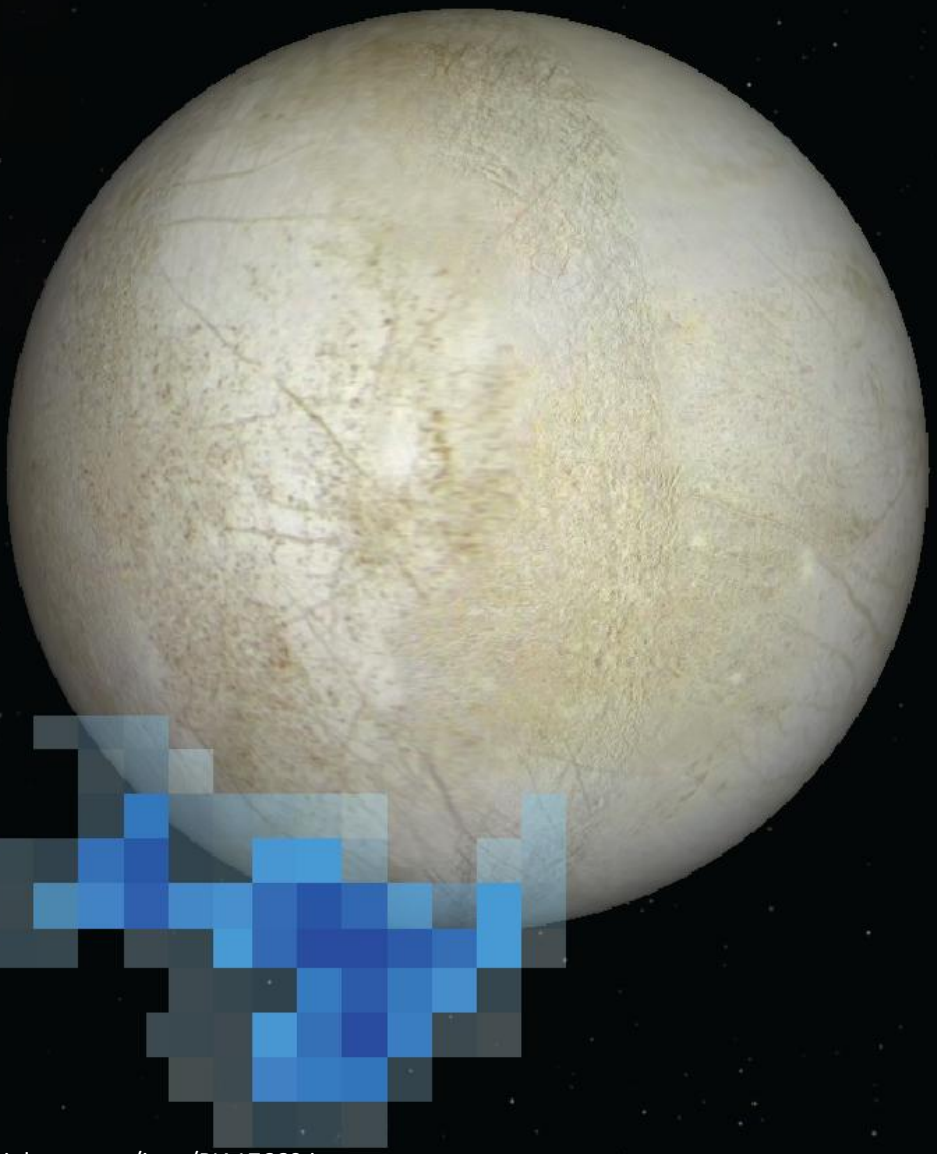
Overview of JPL

Jet Propulsion Laboratory
California Institute of Technology

Presented by: Shaun Standley

Outreach presentation at the University of LaVerne
July 11th, 2019

For Discussion Today:



jpl.nasa.gov/jpeg/PIA17660.jpg

1. Our Business
2. Our Customers
3. Sources of Revenue
4. Core Capabilities
5. Fostering Innovation
6. Product Development Flow
7. Missions in Development

Business Summary

Company name – Jet Propulsion Laboratory
Business Structure – Federally Funded Research and Development Center managed for NASA by the California Institute of Technology (Caltech). **Not for Profit!**
Ownership – NASA owns the facilities, Caltech staff the facilities and run them.
Location – La Cañada-Flintridge, California.
Company history – Designed, built and operated the United States' first satellite, Explorer 1, launched in 1958.

http://jpl.nasa.gov

Vision

To serve the nation by exploring space in the pursuit of discoveries that benefit humanity.

Quests

Has there ever been life elsewhere in our solar system?

Are there planets like Earth elsewhere in the universe?

How did the universe begin, and how is it evolving?

Search for life in the outer planets through instruments that map the surfaces of these planets.

How did our solar system form and evolve?

What changes are happening to our own planet?

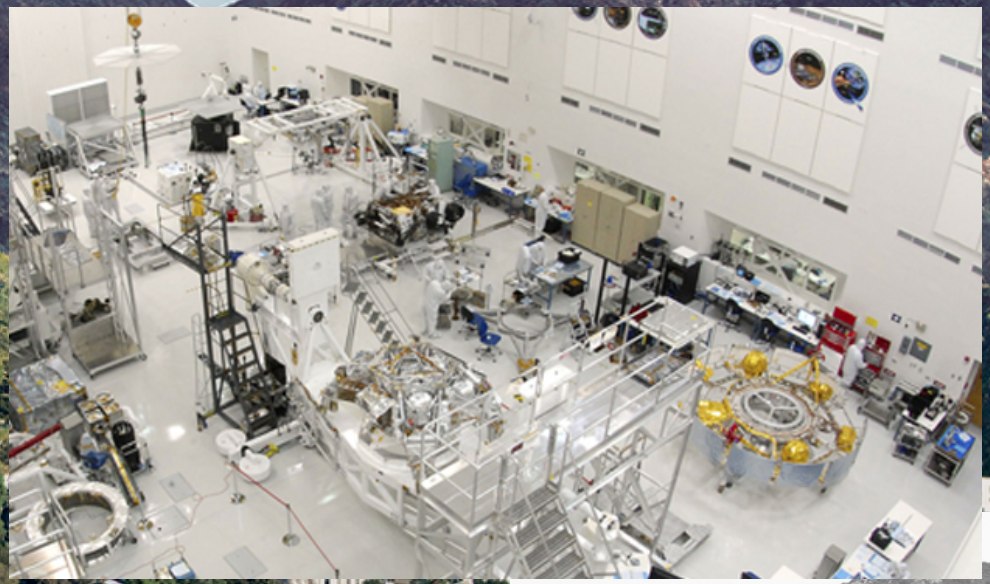
How can we help pave the way for human exploration of space?

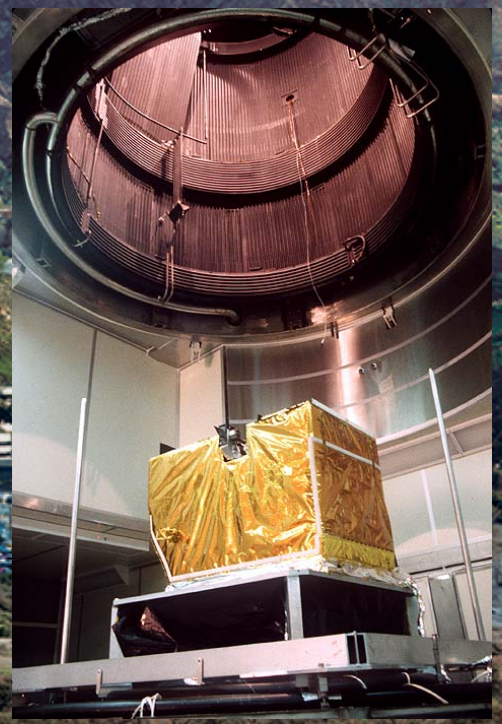
Can we use our unique expertise to serve our nation and its people?

JunoCam images of Jupiter

Jet Propulsion Laboratory

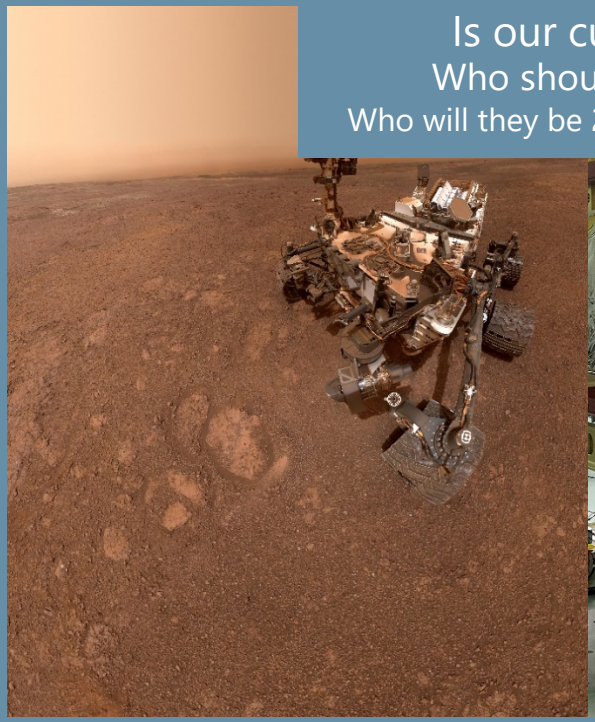
Currently 6000+ personnel on a single campus. This location has a mixture of office space and spacecraft design, build, assembly, & test facilities.

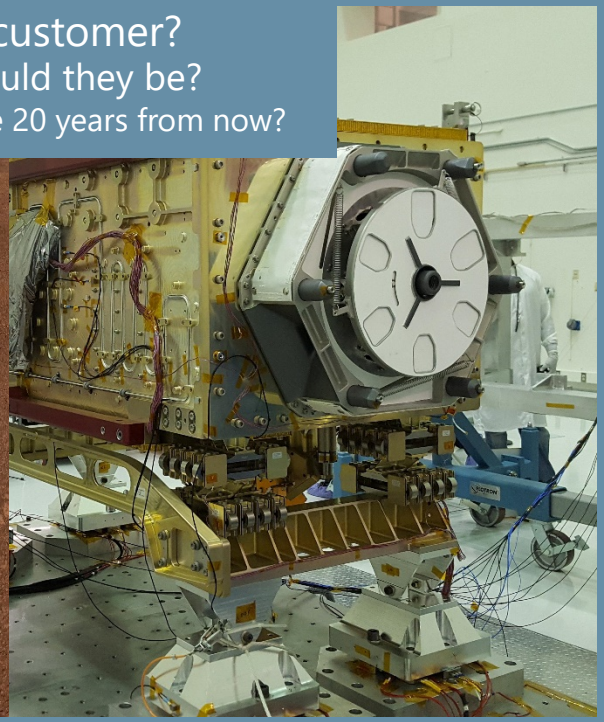




Who

Is our customer?
Who should they be?
Who will they be 20 years from now?





"The purpose of business is to create a customer.“
- Peter Drucker

Customers – Revenue $

- NASA (85%)
- Other US Government Agencies (15%)

Partners – Donations

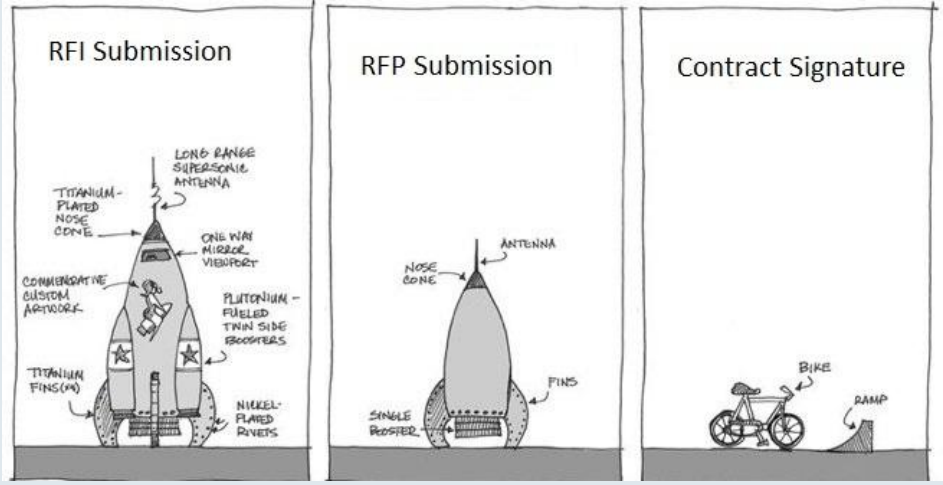
- Scientists – Principal Investigators must want to work with us
- International and National Space Agencies
- Academic Institutions
- Other National Laboratories

Marketing - Inspiration

- Capturing the imagination of the public
- Inspiring students
- We have a moral obligation to train the next generation of scientists and engineers

https://www.jpl.nasa.gov/
https://photojournal.jpl.nasa.gov/

Sources of Revenue

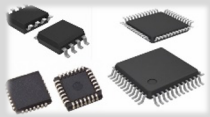


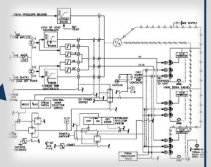
- NASA Directed Missions – Complete, self-standing investigations that are assigned directly to JPL by NASA.
- NASA Announcement of Opportunity (AO) Selected Missions – complete, self-standing investigations open to competition by submission of a proposal.
  - Three tiers of funding – Explorer, Discovery, New Frontiers
- Missions of Opportunity (MO) – these projects are an element (instrument or other hardware contribution) of another mission, often led by a foreign space agency. MOs are conducted on a no-exchange-of-funds basis with the organization sponsoring the full mission. NASA typically solicits proposals for MOs from JPL and other NASA centers.
- Non-NASA Customers

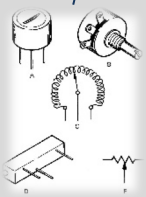
https://explorers.gsfc.nasa.gov/missions.html
https://deepspace.jpl.nasa.gov/files/Discovery-2014-final-AO.pdf

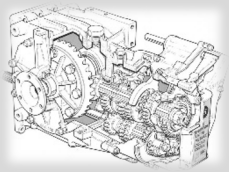
What do we do?

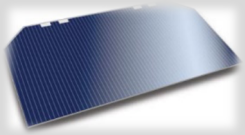
Product Development Flow











Parts Procurement and quality control

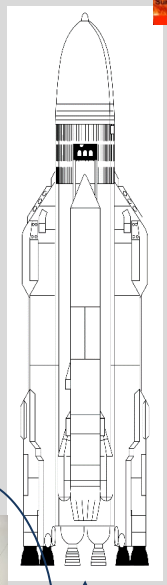
Assembly, test, delivery

Assembly Procurement or build

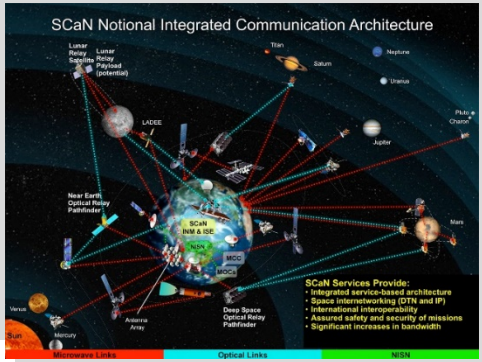
System assembly, integration, and test

Spacecraft shipment to launch site

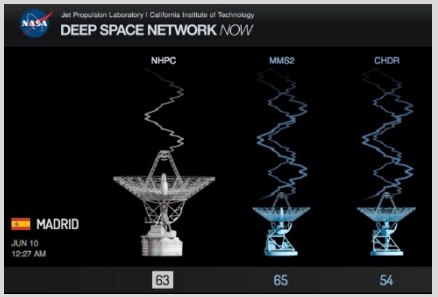
Fueling and encapsulation



Launch Operations



Near-Earth Network



Deep Space Network

Mission Operations

Core Capabilities:

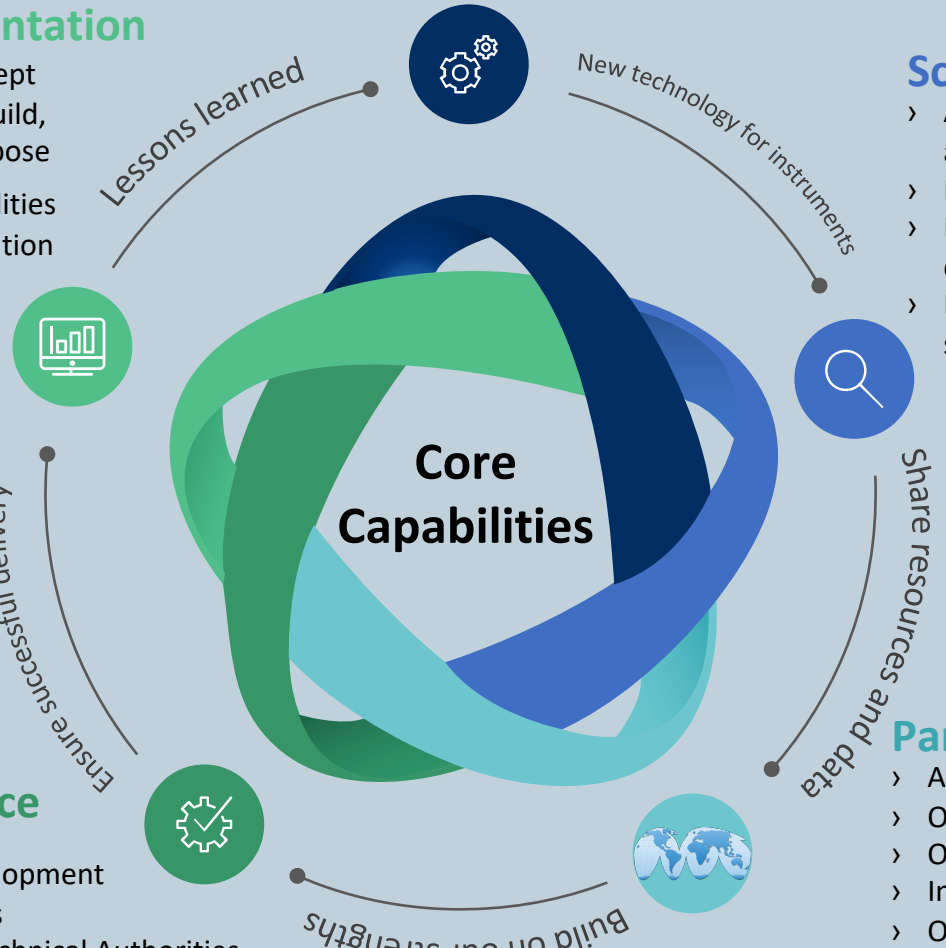
integrate science, engineering & technology that provide end-to-end implementation of space missions, through use of its experienced workforce or in collaboration with industry, academia, and other space agencies

Technology

- Nurture an innovative and creative R&D environment
- Apply emerging technologies to space research
- Adapt and exploit existing technologies for space applications

End-to-End Implementation

- In-house capability for concept through proposal, design, build, integrate, test, operate, dispose
- Concurrent engineering facilities for rapid development, iteration of design concepts



Science

- Attract and develop world class academic talent
- Perform cutting edge space research
- Develop new space instrument capabilities
- Propose competitive and compelling space missions

Partnerships

Comisión Nacional de Actividades Espaciales (CONAE)
Instituto Nacional de Pesquisas Espaciais (INPE)
Indian Space Research Organisation (ISRO)
Centre National de Recherche Spatiale (CNES)
European Space Agency (ESA)
Canadian Space Agency (CSA)

- Academia
- Other NASA Centers
- Other national space agencies, NOAA
- Industry
- Other Space Agencies: ESA, ISRO, CNES…

Engineering Excellence

- Cooperative standards development
- Apply institutional standards
- Independent Engineering Technical Authorities
- Independent Safety & Mission Assurance

Fostering Innovation and Creativity

01. Environment

- Culture that supports collaboration and new ideas.
- Unstructured time for thinking.
- Failure is allowed.
- Green, open campus with a variety of work spaces.
- Artist-in-Residence team produces and installs original, space-related art throughout the lab.

02. Funding

- Funding available in small to medium increments to foster new ideas.
- Fast track, uncomplicated proposal system to get internal funds.
- Funding is held low in the organization to facilitate rapid decision-making and distribution.
- Inventors retain patent rights.

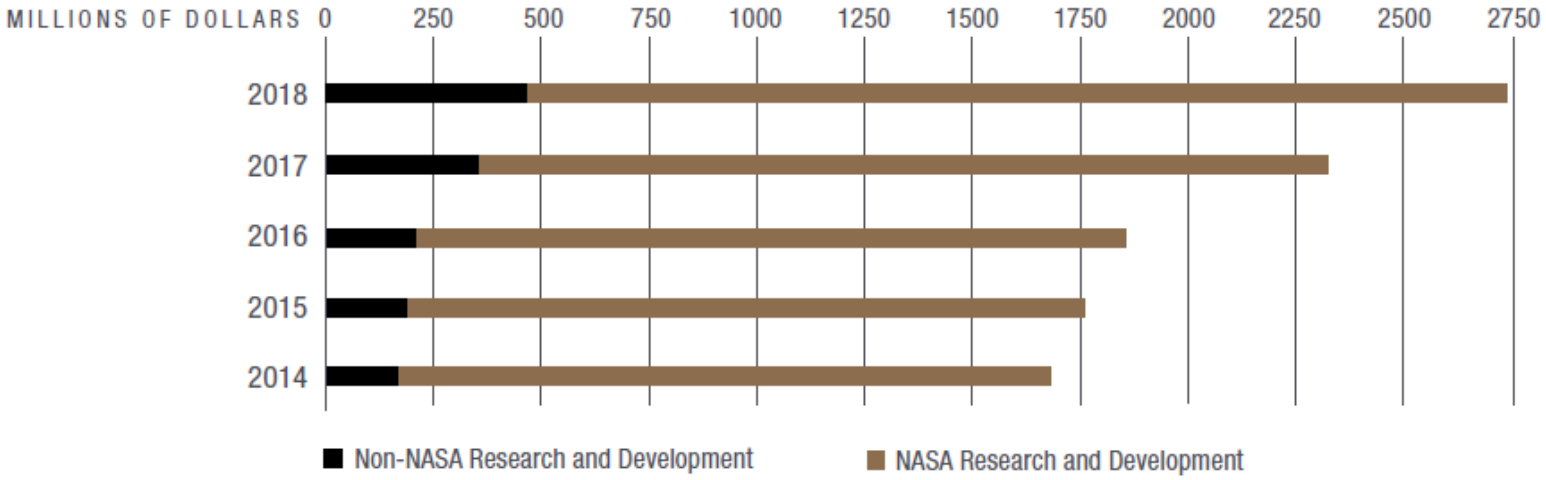
03. Infrastructure

- Dedicated creative rooms with parts and tools to brainstorm new ideas and assemblies.
- IT unit dedicated to investigating, acquiring, and rolling out new tools quickly.

04. Idea Champions

- All supervisors are on the lookout for great ideas and encourage them.
- Technologist posts throughout the organization whose only job is to foster innovation.
- Academics and Industrialists in successful creative endeavors are regular speakers at the lab.
- Many successful role models within Caltech and JPL

2018 Budget


MILLIONS OF DOLLARS
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250
500
750
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1250
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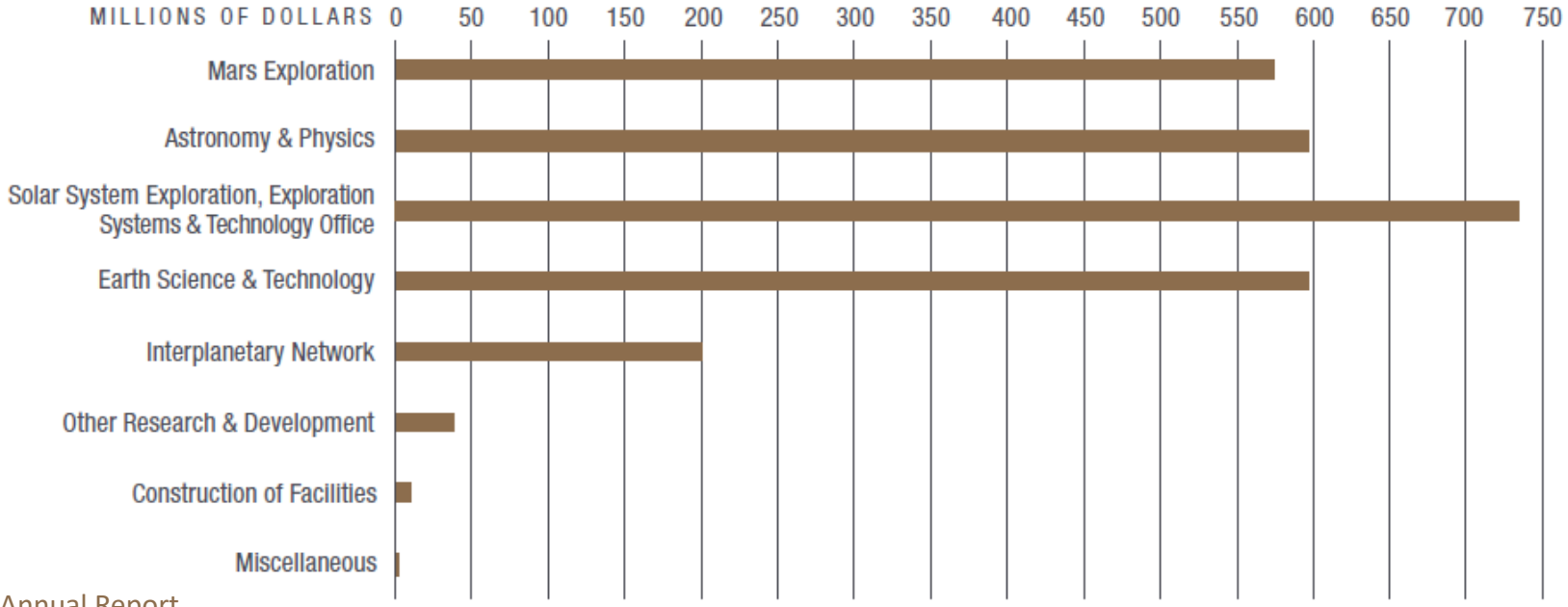
1750
2000
2250
2500
2750
2018
2017
2016
2015
2014
Non-NASA Research and Development
NASA Research and Development


MILLIONS OF DOLLARS
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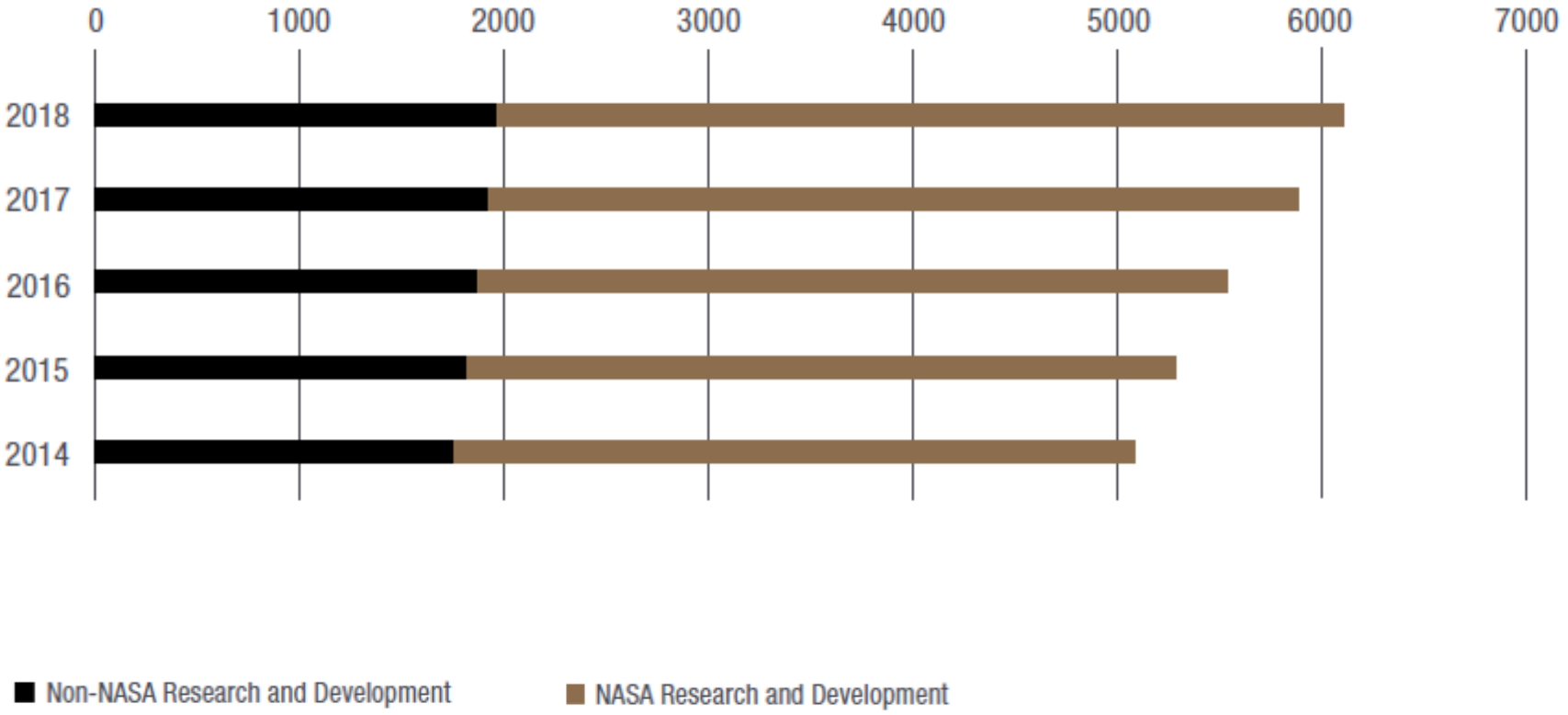
650
700
750
Mars Exploration
Astronomy & Physics
Solar System Exploration, Exploration Systems & Technology Office
Earth Science & Technology
Interplanetary Network
Other Research & Development
Construction of Facilities
Miscellaneous

Workforce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1000
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6000
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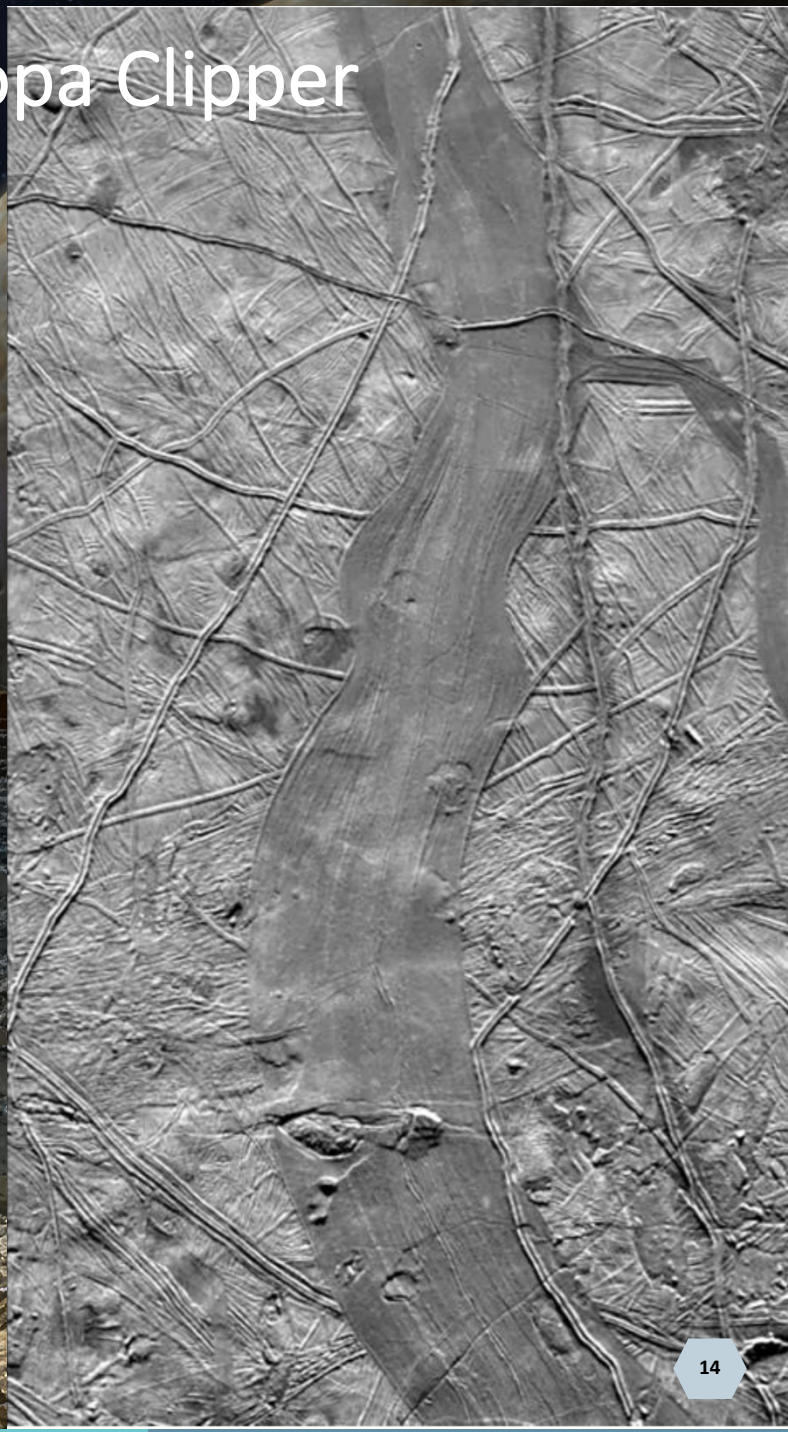
2018
2017
2016
2015
2014
Non-NASA Research and Development
NASA Research and Development

Missions in Development – Europa Clipper

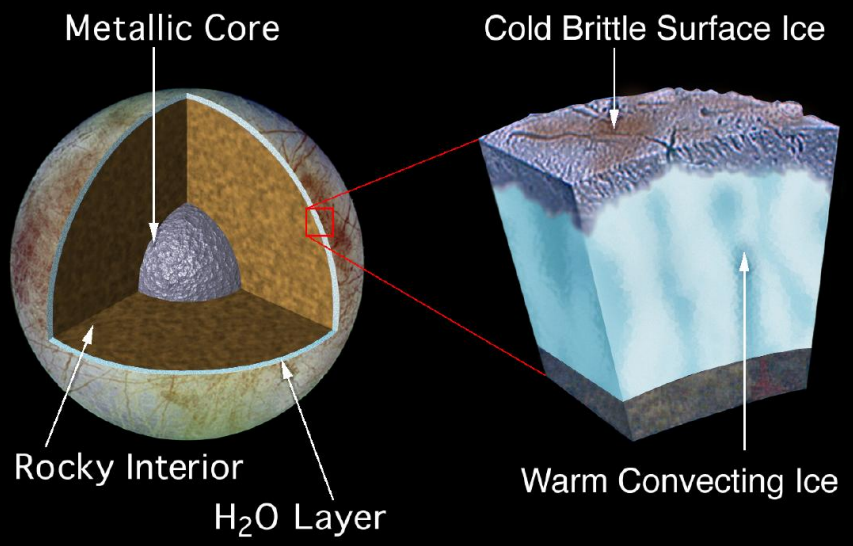
- Jupiter's magnetic field is disrupted in the space around Europa - implies a global ocean of salty water
- The surface is crisscrossed with bands and ridges with a lack of large impact craters – implies the surface is active - icy, volcanic flows, or settling of the icy crust
- Models of how tidal heating should affect Europa suggested that a global subsurface ocean might exist
- Hubble Space Telescope observed plumes of material in 2014. The plume's origin corresponds to a warm region on Europa's surface.

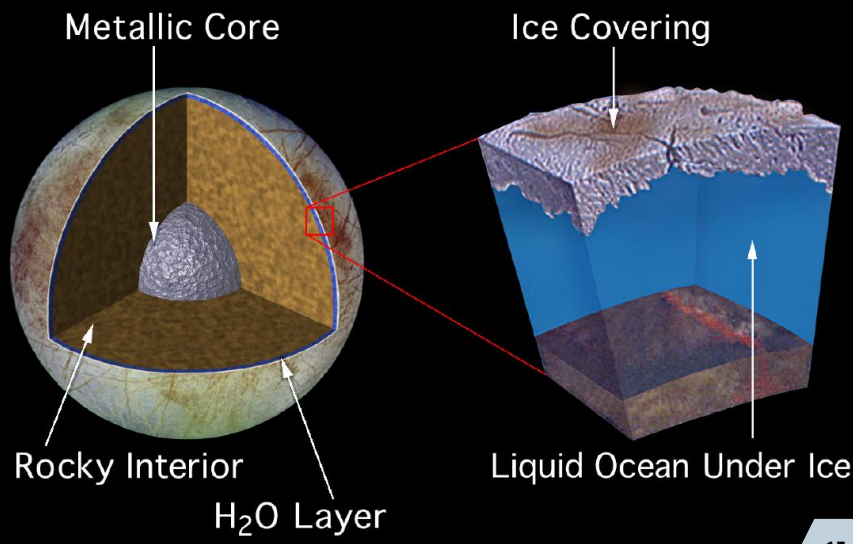


https://europa.nasa.gov/

from water does all life begin…

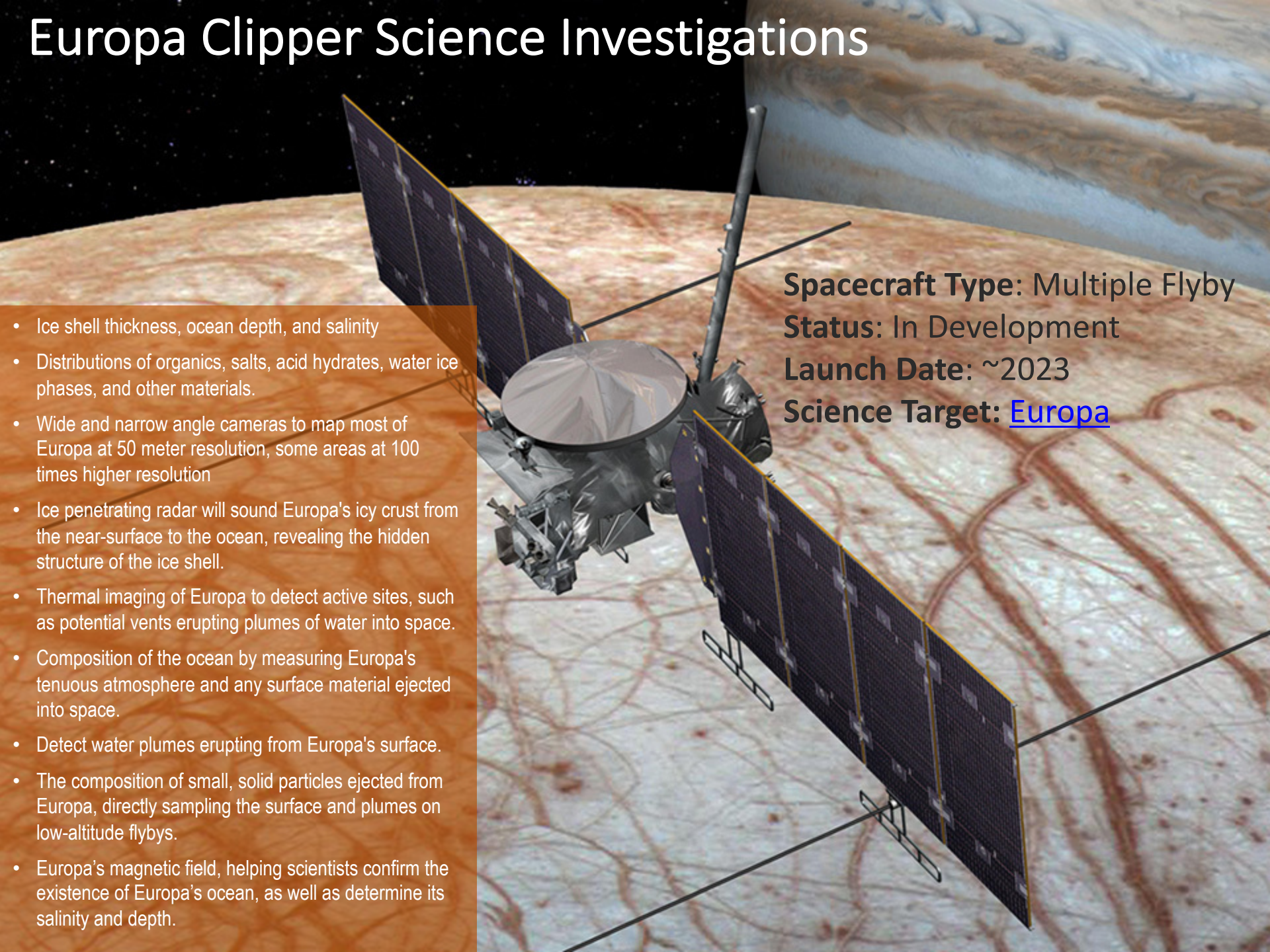
- If the ocean exists, the tides should deform the surface by about 30m; if the moon is frozen through, the tides should stretch the surface by only one meter
- What is the composition of the reddish material on the surface?
- Does this material hold clues to the composition of the ocean and whether material is cycling between the surface and the interior
- The proposed Europa Lander mission concept would land on Europa's surface to perform an in situ study of composition and habitability; Clipper will scout landing sites





https://europa.nasa.gov/

Europa Clipper Science Investigations

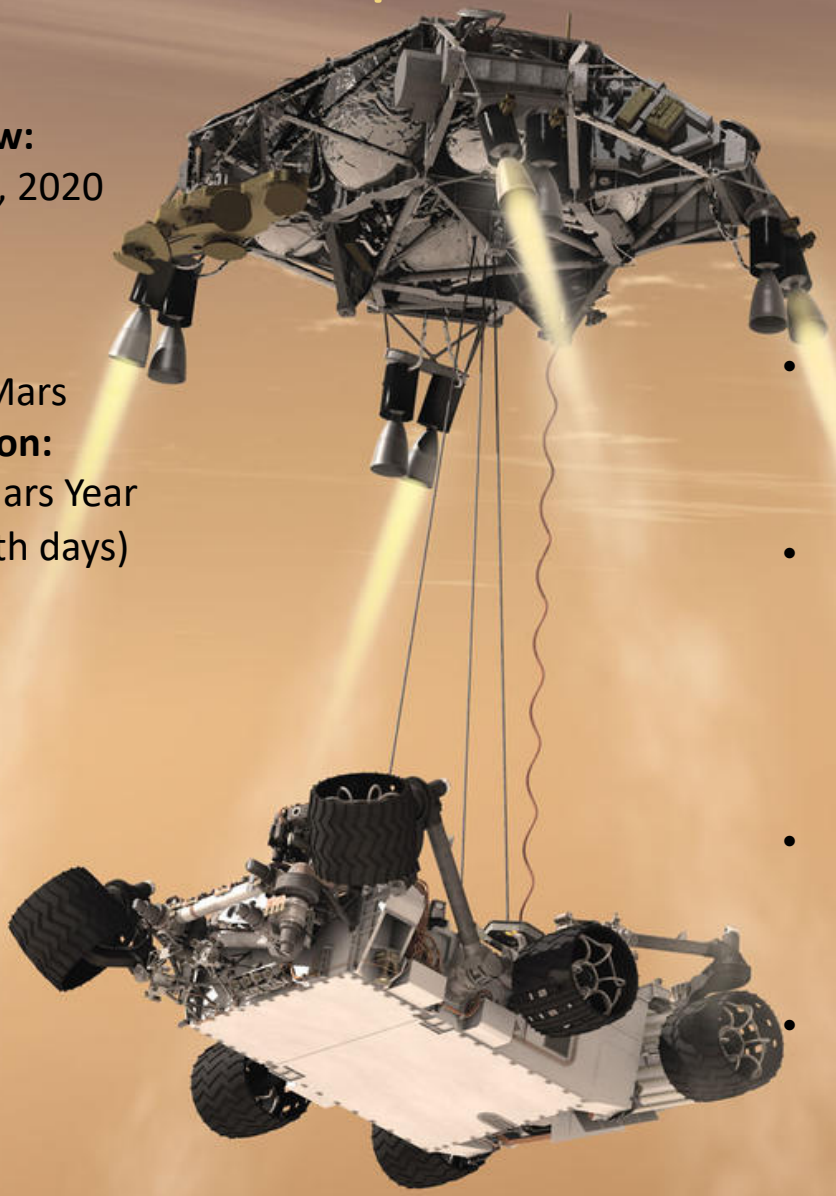


Spacecraft Type: Multiple Flyby
Status: In Development
Launch Date: ~2023
Science Target: Europa

- Ice shell thickness, ocean depth, and salinity
- Distributions of organics, salts, acid hydrates, water ice phases, and other materials.
- Wide and narrow angle cameras to map most of Europa at 50 meter resolution, some areas at 100 times higher resolution
- Ice penetrating radar will sound Europa's icy crust from the near-surface to the ocean, revealing the hidden structure of the ice shell.
- Thermal imaging of Europa to detect active sites, such as potential vents erupting plumes of water into space.
- Composition of the ocean by measuring Europa's tenuous atmosphere and any surface material ejected into space.
- Detect water plumes erupting from Europa's surface.
- The composition of small, solid particles ejected from Europa, directly sampling the surface and plumes on low-altitude flybys.
- Europa's magnetic field, helping scientists confirm the existence of Europa's ocean, as well as determine its salinity and depth.

Missions in Development – Mars 2020

Launch Window:
July 17 - Aug. 5, 2020
Landing:
Feb. 18, 2021
Landing Site:
Jezero Crater, Mars
Mission Duration:
At Least One Mars Year
(about 687 Earth days)



- **Looking for Habitability:**
  Identify past environments capable of supporting microbial life
- **Seeking Biosignatures:**
  Seek signs of possible past microbial life in those habitable environments, particularly in special rocks known to preserve signs of life over time
- **Caching Samples:**
  Collect core rock and "soil" samples and store them on the Martian surface
- **Preparing for Humans:**
  Test oxygen production from the Martian atmosphere

https://mars.nasa.gov/mars2020/mission/overview/

Send Your Name to Mars

https://marsprogram.jpl.nasa.gov/participate/send-your-name/mars2020

Missions in Development – Psyche

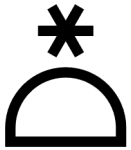
Launch Date: 2022
Launch Location: Kennedy Space Center
Destination: Asteroid 16-Psyche

One of the ten most massive asteroids in the asteroid belt; Psyche is over 200 km in diameter and is thought to be the exposed iron core of a protoplanet.

https://www.jpl.nasa.gov/missions/psyche/

Missions in Development – Psyche

Journey to a Metal World

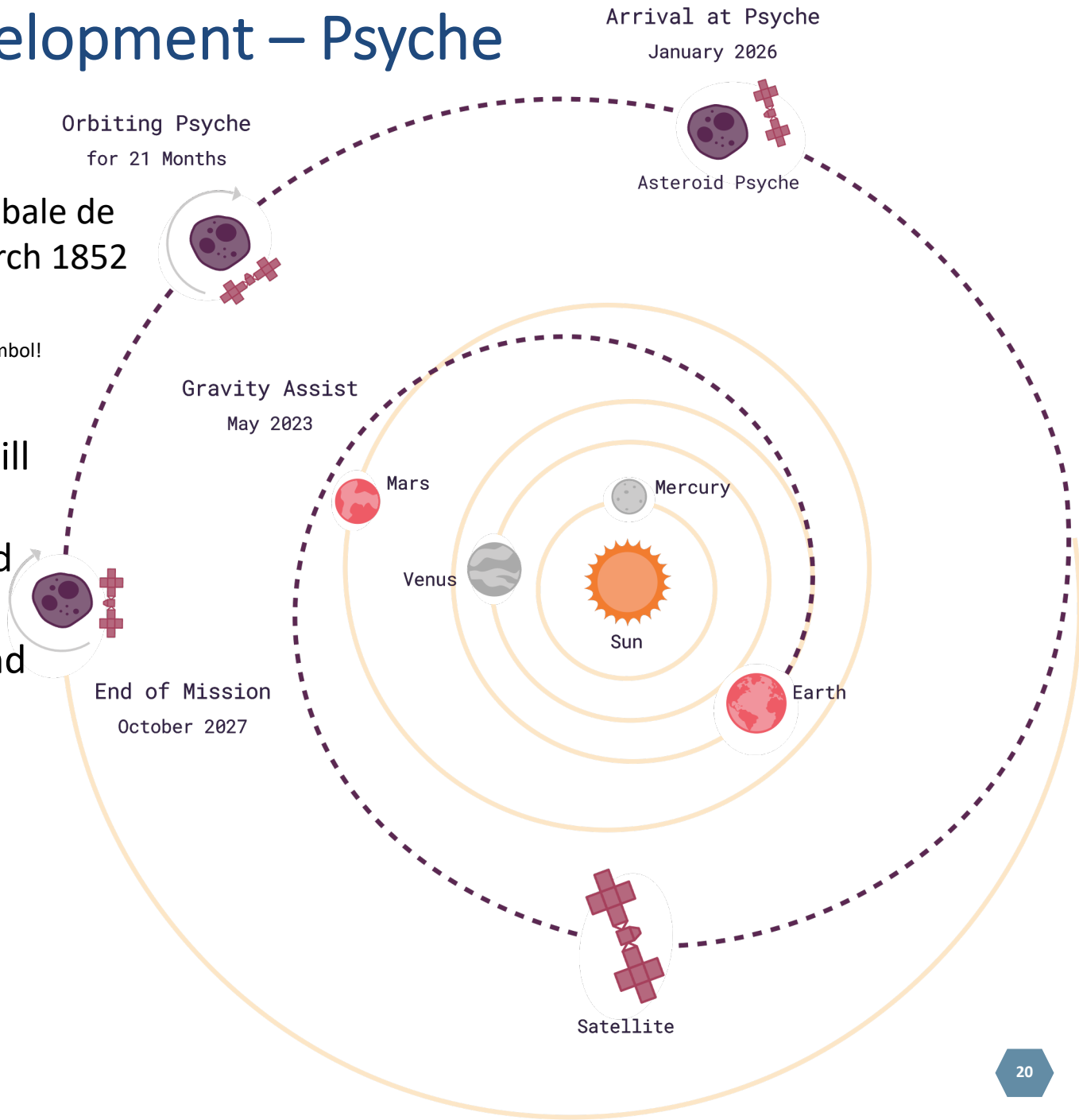


Discovered by Annibale de Gasparis on 17 March 1852

Psyche has its own astrological symbol!

The Psyche spacecraft will carry a multispectral imager, a gamma ray and neutron spectrometer, and a magnetometer, and will conduct radio science.

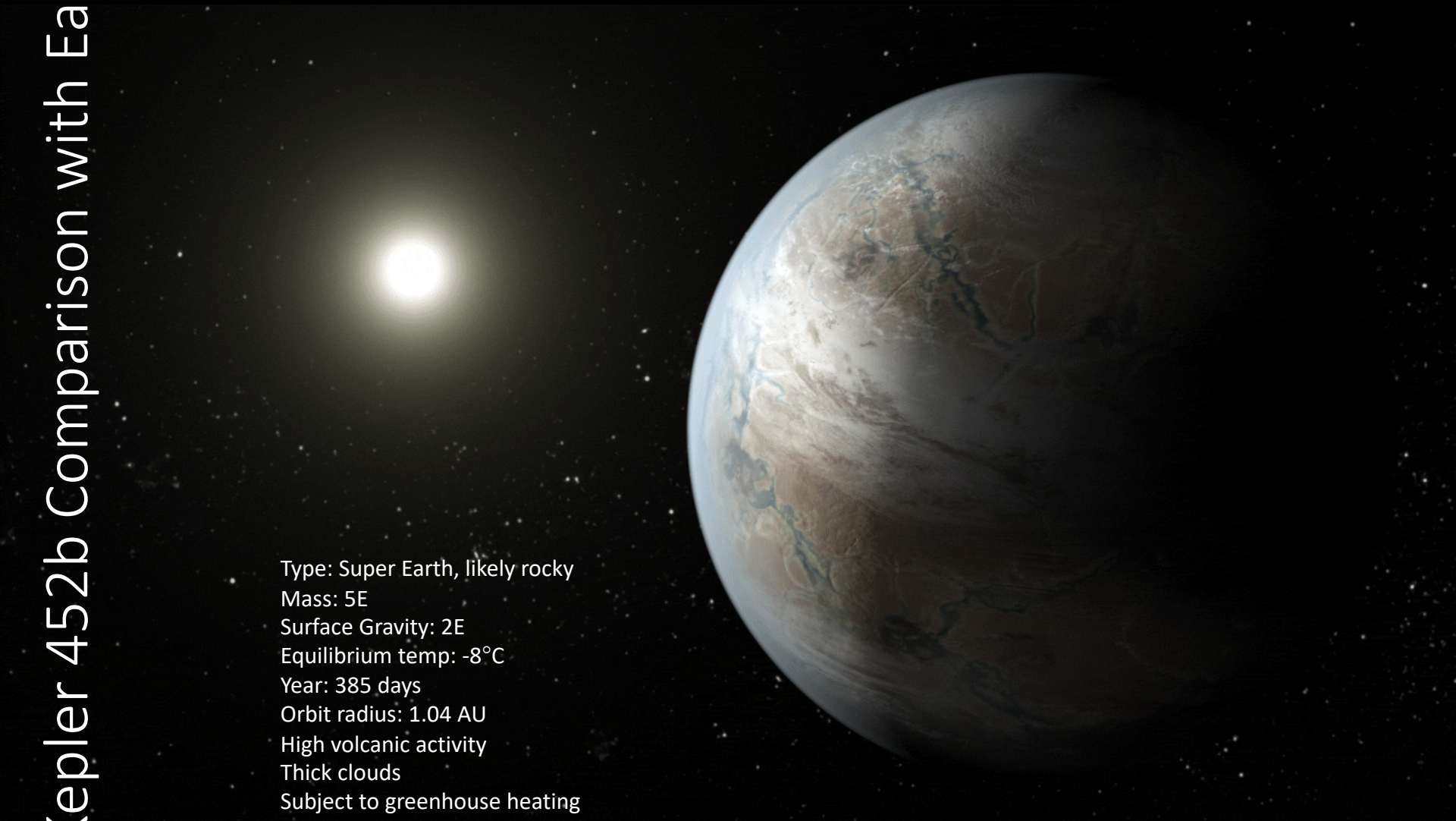
Goals are asteroid characterization, elemental mapping, topography, and gravity science.



https://psyche.asu.edu/mission/

Questions?

Kepler 452b Comparison with Earth

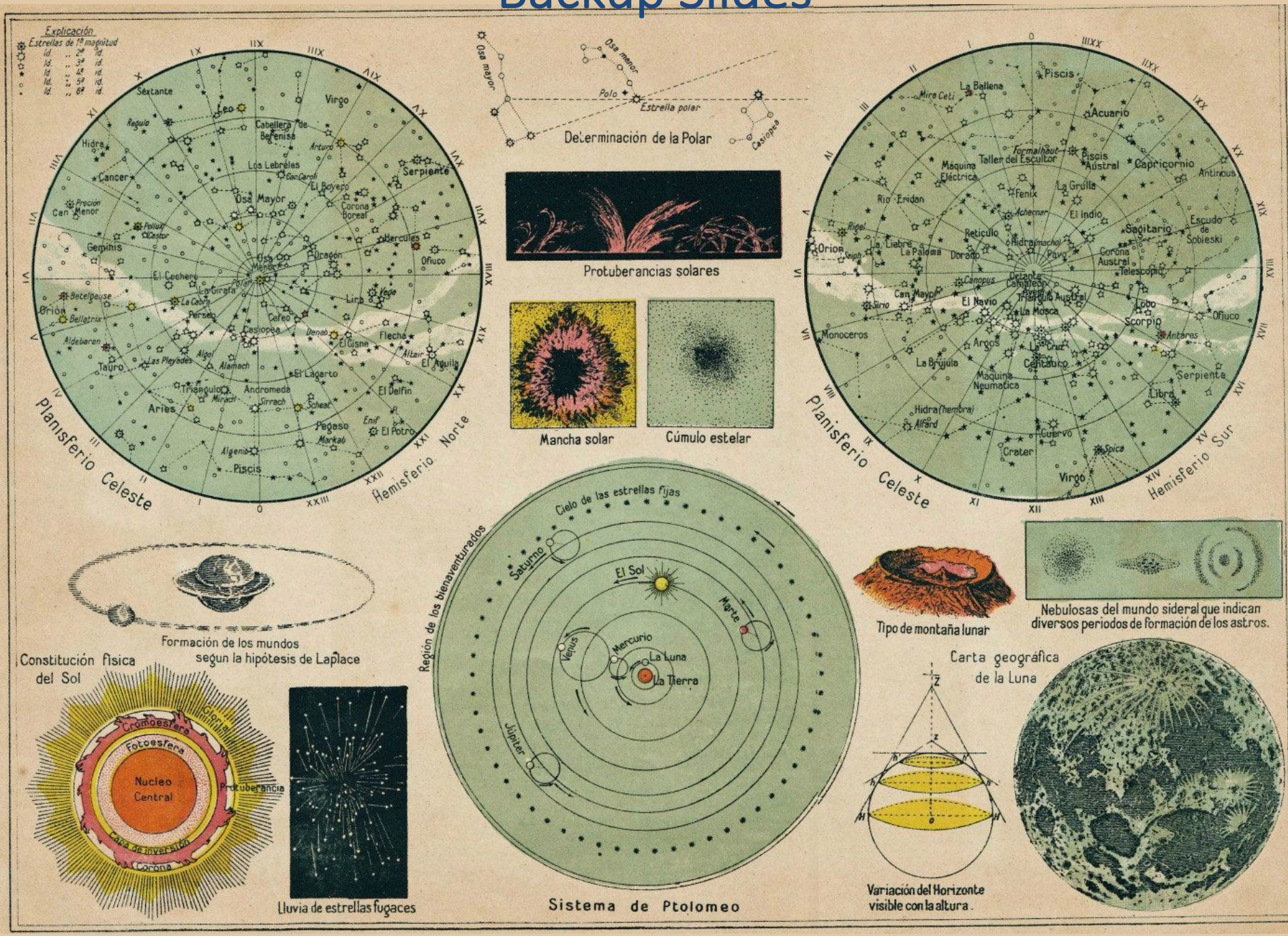


Type: Super Earth, likely rocky
Mass: 5E
Surface Gravity: 2E
Equilibrium temp: -8°C
Year: 385 days
Orbit radius: 1.04 AU
High volcanic activity
Thick clouds
Subject to greenhouse heating

https://www.nasa.gov/mission_pages/kepler/main/index.html

This is an artist's impression, not an image.

Backup Slides



Kepler 186f Comparison with Earth

Type: Terrestrial
Mass: 1E
Surface Gravity: 1E
Equilibrium temp: 0°C
Year: 365 days
Orbit radius: 1.0 AU

Type: Likely rocky
Mass: ~1.44 E?
Equilibrium temp: -85°C
Year: 130 days
Orbit radius: 0.4 AU

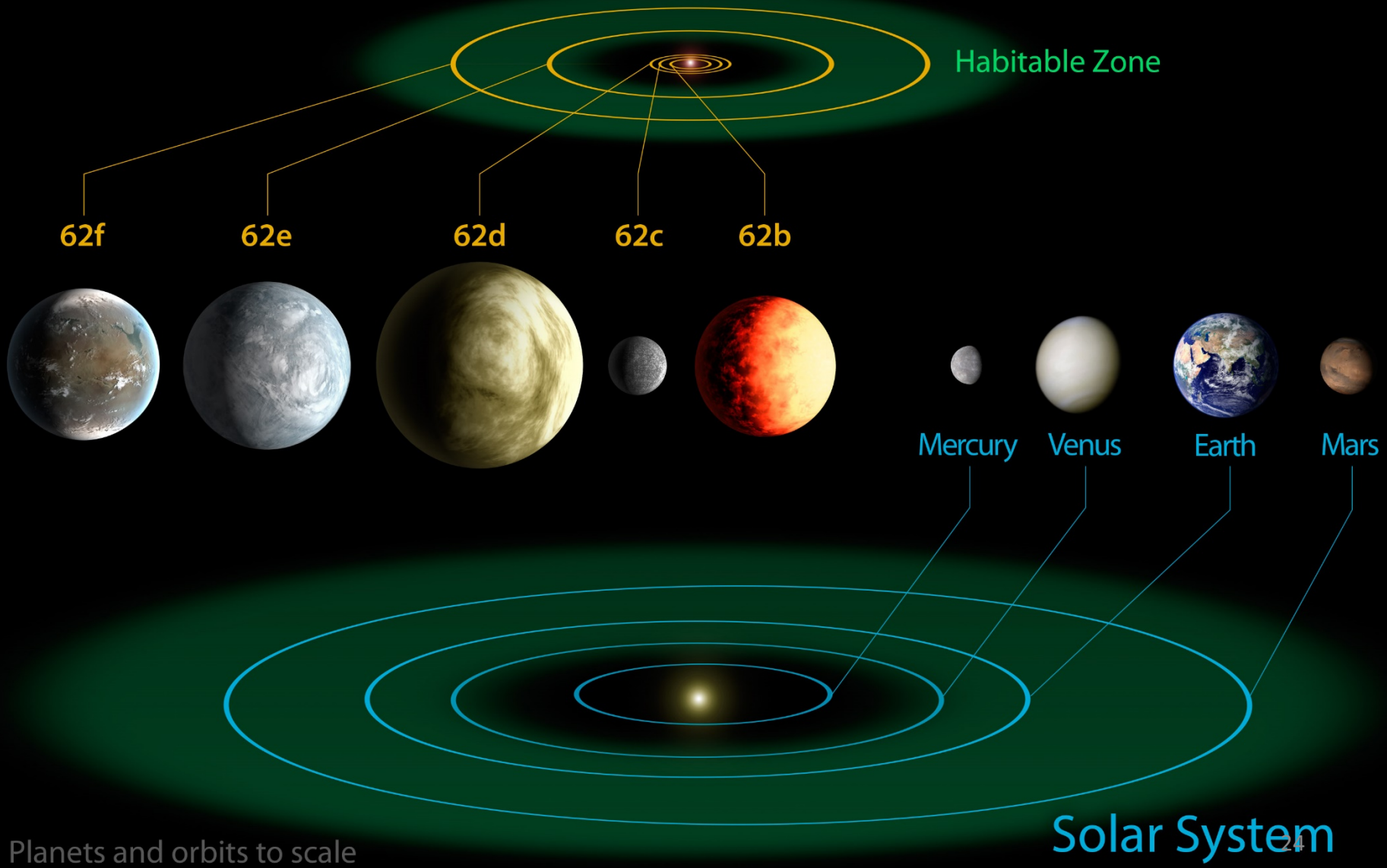
- Star is ½ mass and size of the Sun
- Gets 30% of energy Earth does
- 500 light-years from Earth
- The system has four inner planets

https://www.nasa.gov/mission_pages/kepler/main/index.html

This is an artist's impression, not an image.

https://www.nasa.gov/mission_pages/kepler/main/index.html

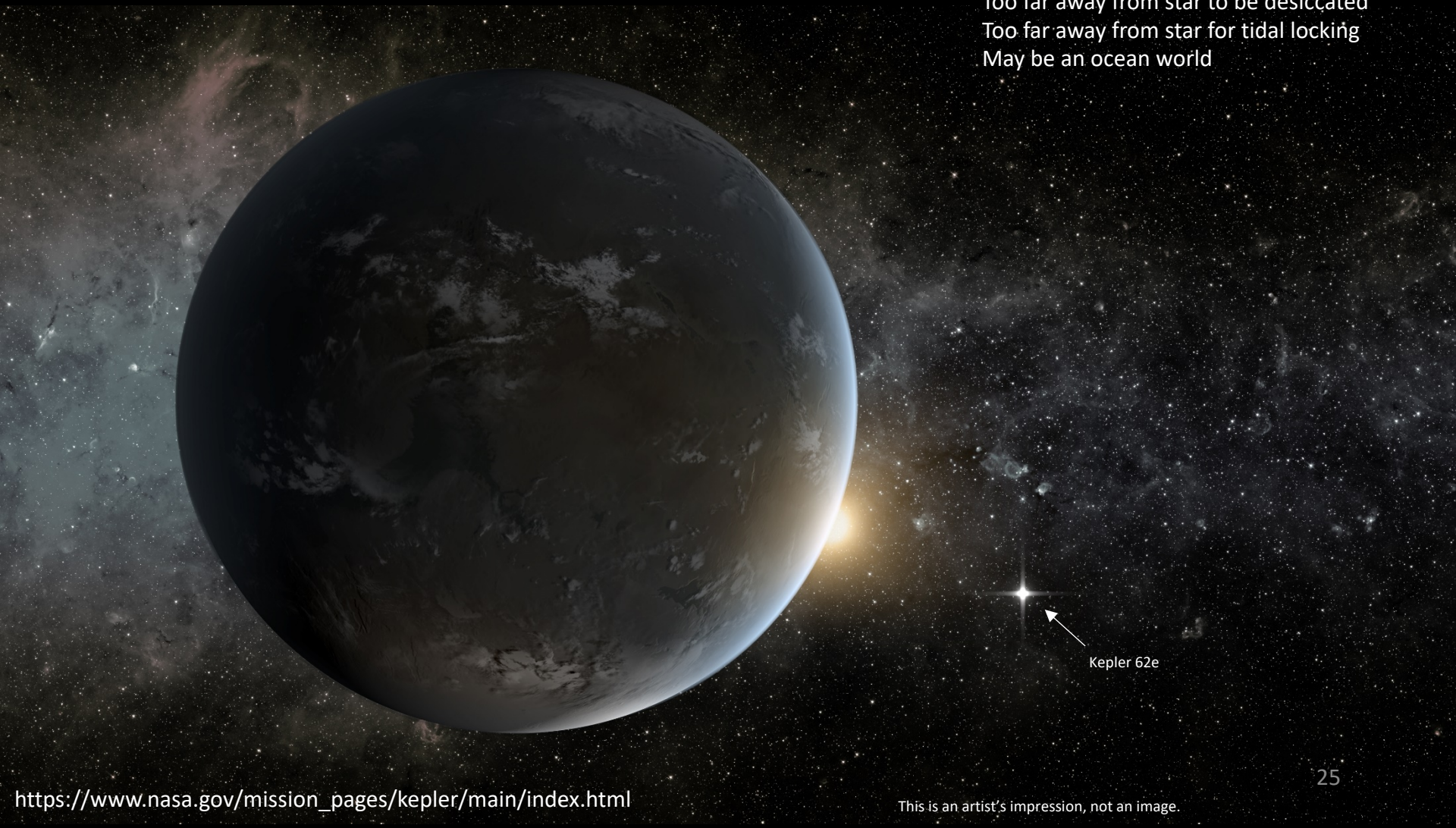
Kepler-62 System



These are artists' impressions, not images.

Kepler 62f

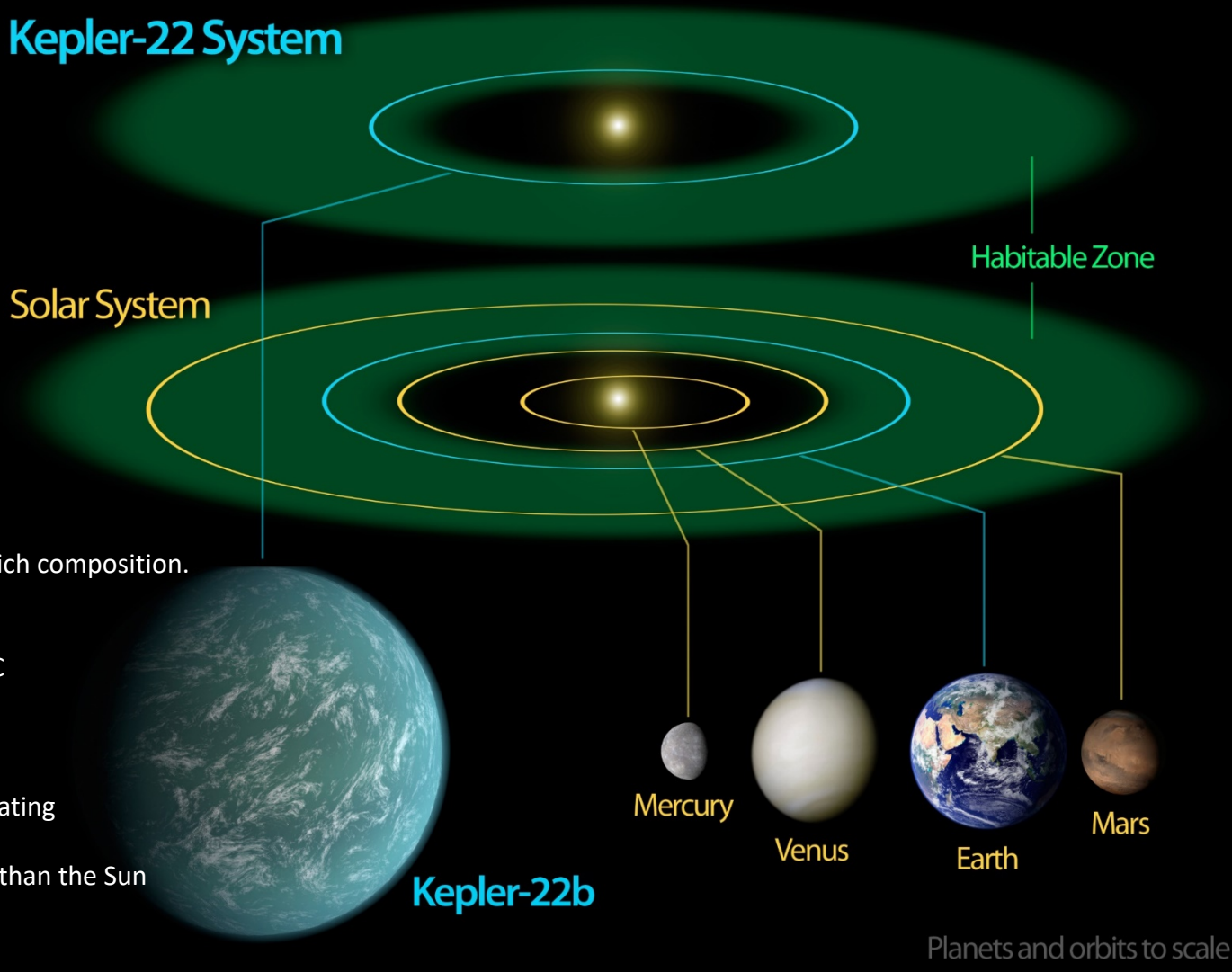
Type: Super Earth, likely rocky
Mass: ~2.8E
Surface Gravity: ~2E
Equilibrium temp: -65°C
Year: 267 days
Orbit radius: 0.718 AU
Too far away from star to be desiccated
Too far away from star for tidal locking
May be an ocean world



https://www.nasa.gov/mission_pages/kepler/main/index.html

This is an artist's impression, not an image.

Kepler 22b



Type: Not Earth-like. Volatile-rich composition.
Size: ~2.4E
Surface Gravity: ?
Equilibrium temp: -11°C / 22°C
Year: 289 days
Orbit inclination: ~90°

- 600 light years from Earth
- No extreme greenhouse heating
- Could be a 'water world'
- Kepler-22: 25% less output than the Sun

https://www.nasa.gov/mission_pages/kepler/main/index.html

These are artists' impressions, not images.