NASA'S KEPLERS AND K2 MISSION

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https://goo.gl/images/1PgtwT

WHAT ARE WE GOING TO DISCUSS

- ❑ Overview
- ❑ Kepler's space telescope
- ❑ What was the actual mission
- ❑ What was found
- ❑ What is habitable zone
- ❑ Why did the mission fail
- ❑ What was the second light

OVERVIEW [2]

- In 2009 the telescope was launched
- In 2012 the mission was expected to extend until 2016
- But in July 2012 the first reaction took place that was the wheel used for pointing the spacecraft.
- Then on May 11,2013 a second reaction took place and the reaction wheel failed.
- On Nov 18 2013 the k2 mission was established.
- In 2016 NASA also verified 1,284 new exoplanet's were found.
- In Oct 2018 ran out of fuel NASA announced that telescope should be returned.

KEPLER SPACE TELESCOPE [1]

https://images.app.goo.gl/m4JPNLoMbX8ioteB8

- **Kepler space telescope** is a retired space telescope launched by NASA to discover Earth-size planets orbiting other stars.
- Named after astronomer Johannes Kepler who discovered the law of planetary motion.
- The spacecraft was launched on March 7, 2009, into an Earth-trailing heliocentric orbit.
- The principal investigator was William J. Borucki.
- After nine years of operation, the telescope's reaction control system fuel was depleted, and NASA announced its retirement on October 30, 2018.

Johannes Kepler [1]

https://en.wikipedia.org/wiki/Johannes_Kepler

William J. Borucki [1]

https://en.wikipedia.org/wiki/William_J._Borucki

WHAT IS THE KEPLERS MISSION? [7]

The mission was designed to survey our region of the milky way galaxy to discover hundreds of Earth size and smaller planets in or near the habitable zone and to determine the fraction of the hundreds of billions of stars in our galaxy that might have such planets.

Kepler had seen more than 4000 indication of existence of planets. Before Kepler we believed that there are more stars but after Kepler, we know that there are more planets than the stars, every sun like star is likely to have at least one planet.

SCIENCTIFIC METHOD [2]

It is to explore the structure and diversity of the planetary systems. This is achieved by surveying a large sample of stars to:

- Determine the distribution of sizes and shapes of the orbit of these planets
- Estimate how many planets these are in multiple-star systems
- Determine the percentage of habitable zone
- Identify additional members of each discovered planetary system using other techniques
- Determine the properties of those stars that harbor planetary system

HOW MANY EARTHS?

How common are Earth-size planets in the habitable zone of Sun-like stars?

NASA's Kepler Mission aims to get a more precise answer to this question!

https://goo.gl/images/kLqhAR

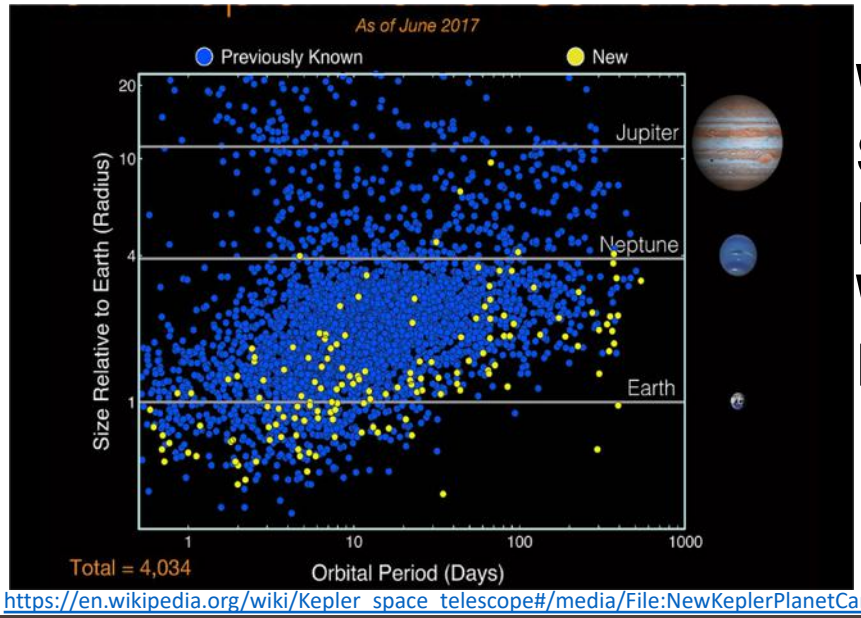
https://goo.gl/images/vPQXNn

WHAT WAS ACTUALLY FOUND! 2

Most of the planets previously discovered around other stars were closer in mass to Neptune or Jupiter. This is what we found from ground-based telescopes. Most of the planets that have been found are those similar in size and mass to Neptune or even larger. In fact, most of the first exoplanets discovered from ground-based observing were the size of Jupiter or bigger! It was not possible to find small planets from ground-based telescopes. The Kepler Mission was designed to find the smaller Earth-size planets

This is what we found from ground-based telescopes.

This is what Kepler Mission looked for



https://en.wikipedia.org/wiki/Kepler_space_telescope#/media/File:NewKeplerPlanetCandidates-20170619.jpg

WHAT SIZE PLANETS WERE FOUND ?

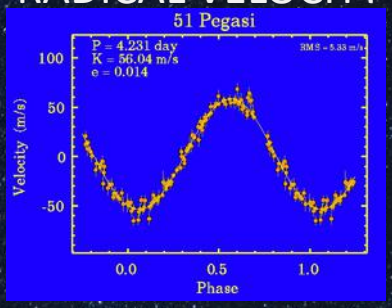
HOW TO SEARCH FOR EXOPLANET [3]

How does one detect a planet-sized object orbiting a star dozens of lightyears away?

(1) Direct imaging
(2) Radial velocity → velocity

Astrometry → position
(1) Transits
(2) Gravitational microlensing

RADICAL VELOCITY



- Most successful method: >300 planets detected
- The first planet around a normal star, 51 Peg, was detected by doppler wobbles in 1995.
- Doppler shift of starlight caused by the star orbiting the center of mass with 1 or more orbiting planets

http://www.planetary.org/multimedia/space-images/charts/radial-velocity-graph-51-pegasi.html

TRANSIT METHOD [6]

- This method detects distant planets by measuring the minute dimming of a star as an orbiting planet passes between it and the Earth.
- The passage of a planet between a star and the Earth is called a "transit."
- If such a dimming is detected at regular intervals and lasts a fixed length of time, then it is very probable that a planet is orbiting the star and passing in front of it once every orbital period.

http://www.planetary.org/multimedia/space-images/universe/a-planetary-transit.html

WHY EARTH-SIZE PLANETS?

If a planet is:

•Too small—less than 1/2 the mass of Earth— like Mercury or Mars:

Not enough gravity to hold onto a life-sustaining atmosphere

•Too big—more than about 10 times the mass of Earth—like Jupiter and Neptune:

Enough gravity to hold onto light gases—hydrogen and helium—and turn into a gas giant planet.

WHATS NEXT?

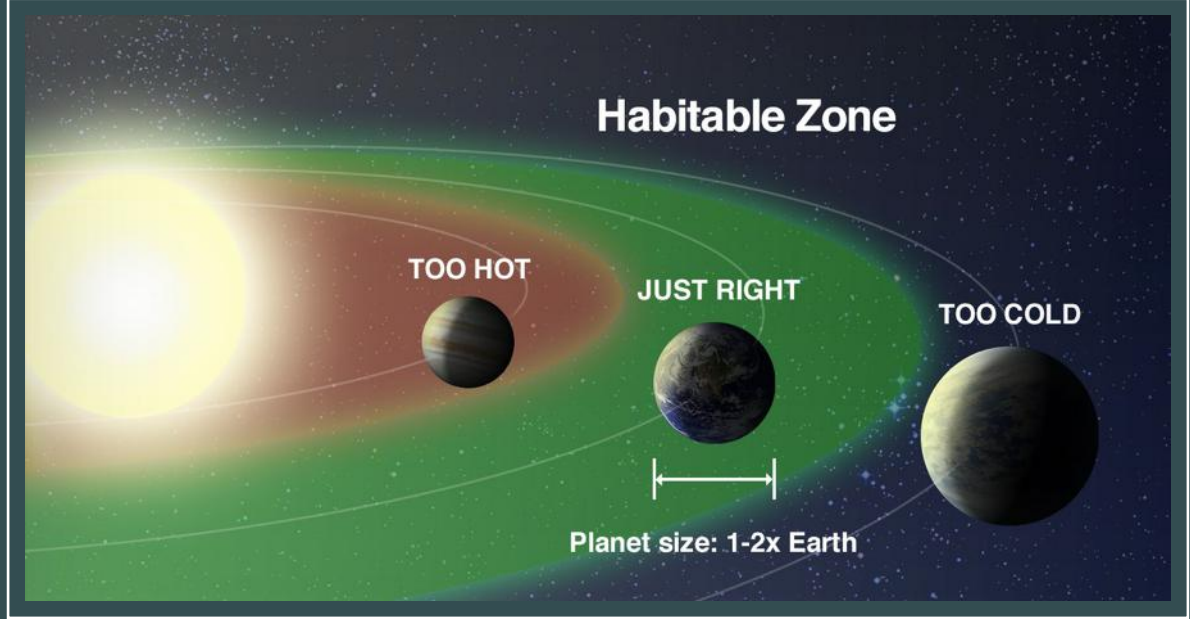
Follow-up work is done by other methods to make sure its really a planet . . . and other observations try to detect evidence of life!

DO THESE PLANETS HAVE ATMOSPHERE???

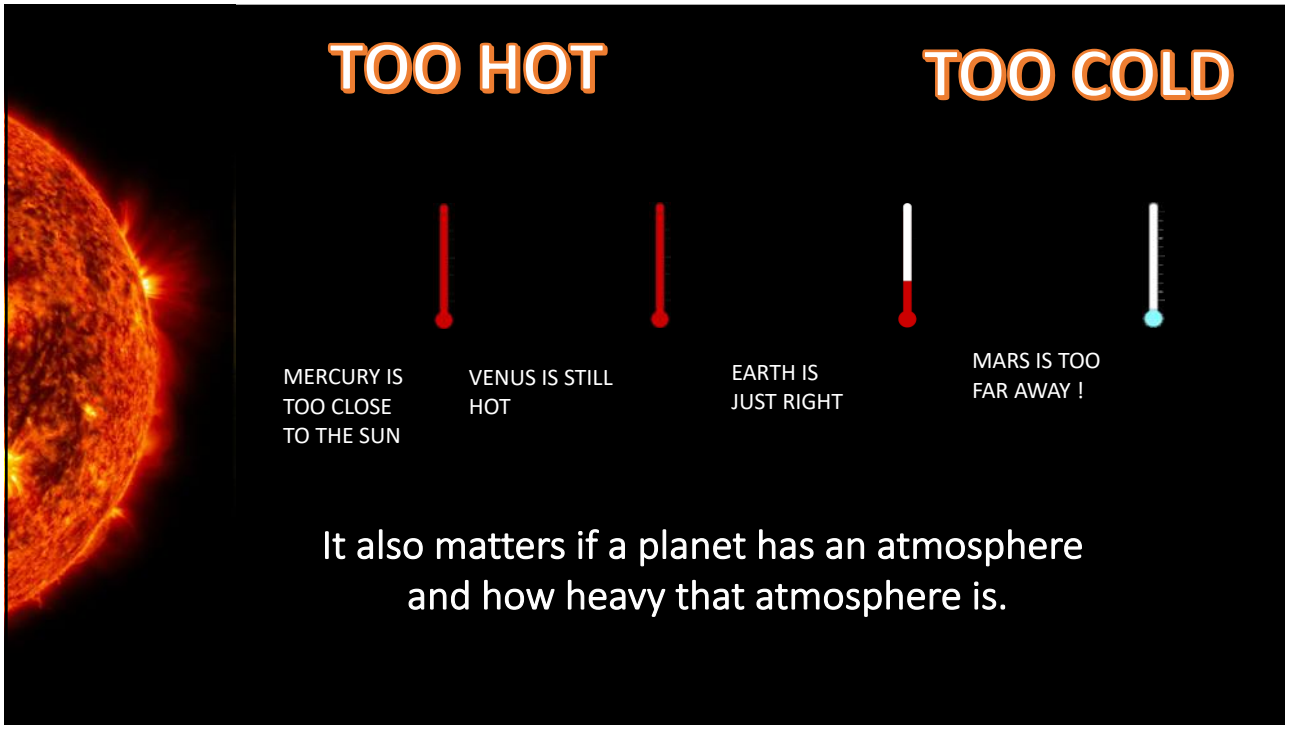
IS THERE LIFE ON THESE PLANETS????

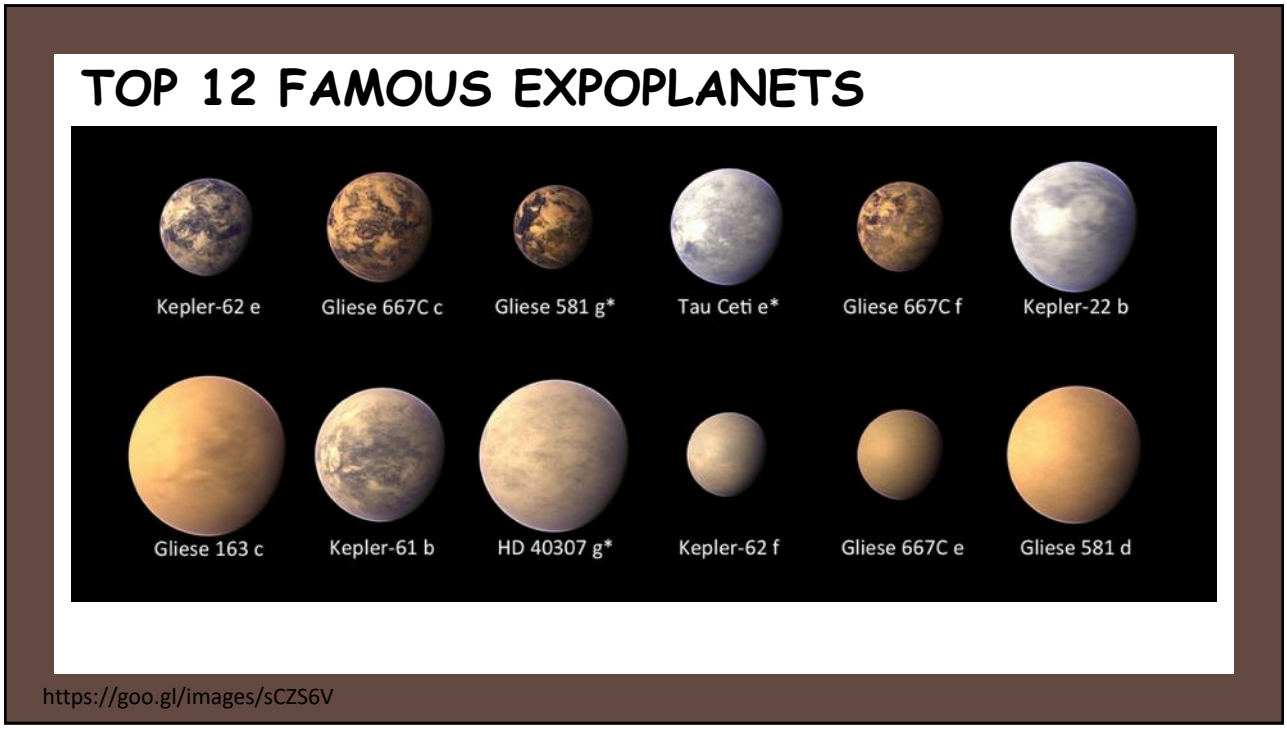
WHAT IS HABITABLE-ZONE? [5]

- Liquid water on planet surface--determined by size and temperature of the star and orbit of the planet
- Size and mass of planet--small planets don't have enough surface gravity to hold onto a life-sustaining atmosphere
- Amount and composition of atmosphere
- Affects of moons and giant planets in the system



https://exoplanets.nasa.gov/the-search-for-life/habitable-zones/





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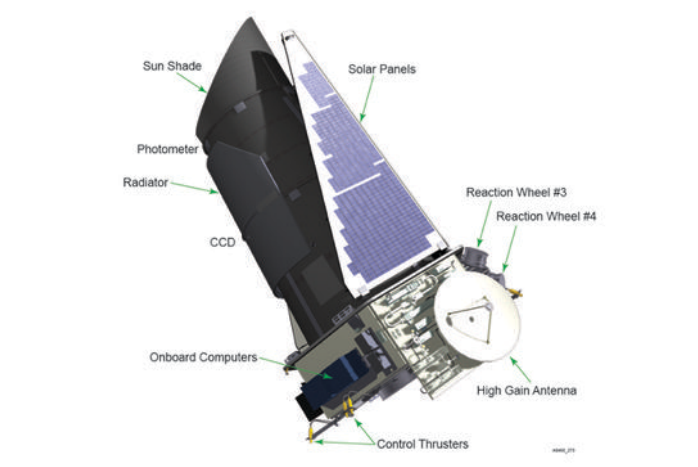
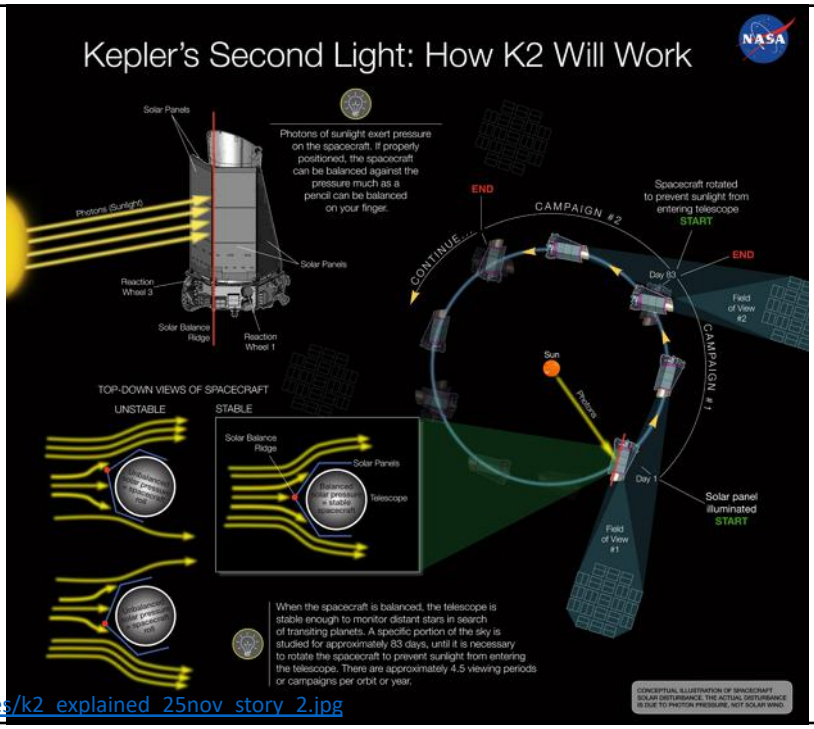
WHY WAS THIS MISSION FAILED? 4



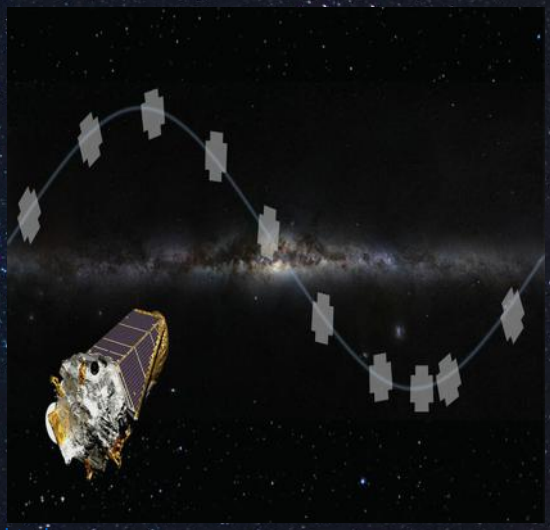
In July 2012, one of Kepler's four reaction wheels (wheel 2) failed. On May 11, 2013, a second wheel (wheel 4) failed, jeopardizing the continuation of the mission, as three wheels are necessary for its planet hunting

KEPLERS SECOND LIGHT: K2



https://www.nasa.gov/sites/default/files/k2_explained_25nov_story_2.jpg

- A new mission concept, dubbed K2.
- Using the sun and the two remaining reaction wheels, engineers have devised an innovative technique to stabilize and control the spacecraft in all three directions of motion.
- To achieve the necessary stability, the orientation of the spacecraft must be nearly parallel to its orbital path around the sun.
- K2 would study a specific portion of the sky for up to 83 days.
- The K2 mission concept has been presented to NASA Headquarters.



ttps://www.space.com/25913-nasa-kepler-telescope-new-mission.html

THANK YOU !

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