SPACE EXPLORATION

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Merit Badge Counselor

https://blog.mendeley.com/2018/01/23/insights-into-the-national-aeronautics-and-space-administration-nasa-grant-research-funding/

SESSION 3

Blue: Covered F2F
Green: Done on your own

Requirements for the Space Exploration Merit Badge:

1.Tell the purpose of space exploration and include the following:
   a. Historical reasons,
   b. Immediate goals in terms of specific knowledge,
   c. Benefits related to Earth resources, technology, and new products,
   d. International relations and cooperation.

2.Design a collector's card, with a picture on the front and information on the back, about your favorite space pioneer. Share your card and discuss four other space pioneers with your counselor.

1.Build, launch, and recover a model rocket.* Make a second launch to accomplish a specific objective. (Rocket must be built to meet the safety code of the National Association of Rocketry. See the "Model Rocketry" chapter.)

Identify and explain the following rocket parts:
   a. Body tube
   b. Engine mount
   c. Fins
   d. Igniter
   e. Launch lug
   f. Nose cone
   g. Payload
   h. Recovery system
   i. Rocket engine

4.Discuss and demonstrate each of the following:
   b. The law of action-reaction
   c. How rocket engines work
   d. How satellites stay in orbit
   e. How satellite pictures of Earth and pictures of other planets are made and transmitted

5.Do TWO of the following:
   a. Discuss with your counselor a robotic space exploration mission and a historic crewed mission. Tell about each mission's major discoveries, its importance, and what was learned from it about the planets, moons, or regions of space explored.
   b. Using magazine photographs, news clippings, and electronic articles (such as from the Internet), make a scrapbook about a current planetary mission.
   c. Design a robotic mission to another planet, moon, comet, or asteroid that will return samples of its surface to Earth. Name the planet, moon, comet, or asteroid your spacecraft will visit. Show how your design will cope with the conditions of the environments of the planet, moon, comet, or asteroid.

6.Describe the purpose and operation of ONE of the following:
   a. Space shuttle or any other crewed orbital vehicle, whether government owned (U.S. or foreign) or commercial
   b. International Space Station

7.Design an inhabited base within our solar system, such as Titan, asteroids, or other locations that humans might want to explore in person. Make drawings or a model of your base. In your design, consider and plan for the following:
   a. Source of energy
   b. How it will be constructed
   c. Life-support system
   d. Purpose and function.

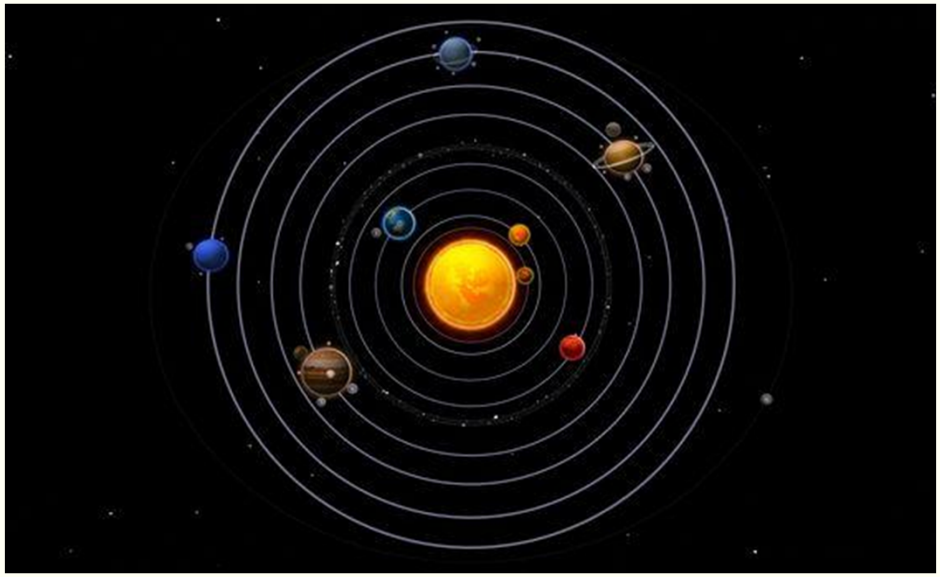
8.Discuss with your counselor two possible careers in space exploration that interest you. Find out the qualifications, education, and preparation required and discuss the major responsibilities of those positions.

REQUIREMENT #4: Physics of Space Exploration

4. Discuss and demonstrate each of the following:
   a. Newton's Laws of Motion
   b. How rocket engines work
   c. How satellites stay in orbit
   d. How satellite pictures of Earth and pictures of other planets are made and transmitted

Satellites

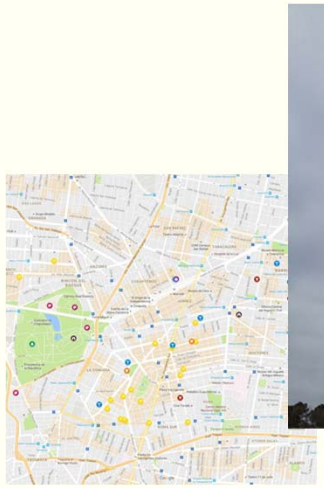
- A satellite is a moon, planet or machine that orbits a planet or star.
  - Earth is a satellite because it orbits the sun.
  - The moon is a satellite because it orbits Earth.
- Types of satellites
  - Earth and the moon are examples of **natural satellites**.
  - There are thousands of **man-made satellites** orbiting Earth
    - Meteorology satellites for predicting weather
    - Telescopes
    - Telecommunications, TV, radio satellites
    - Military intelligence satellites
    - 20+ satellites make up the Global Positioning System, or GPS.
- Sputnik 1 was the first satellite in space. The Soviet Union launched it in 1957.

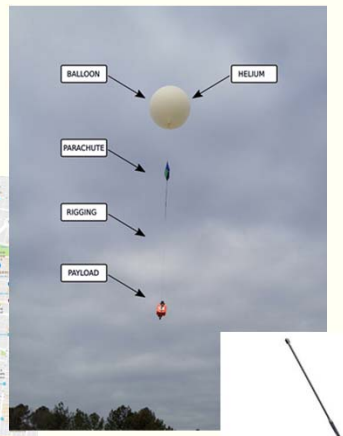


https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-a-satellite-58.html

Why are satellites so important?

- Satellites can see into space better than telescopes at Earth's surface.
  - No clouds, dust and molecules in the atmosphere that can block the view from ground level.
  - No human light contamination
- Life before satellites
  - There was no GPS
  - Used weather balloons, not weather radar
  - No satellite TV, satellite radio, satellite internet
- With satellites, TV signals and phone calls are sent upward to a satellite. Then, almost instantly, the satellite can send them back down to different locations on Earth.



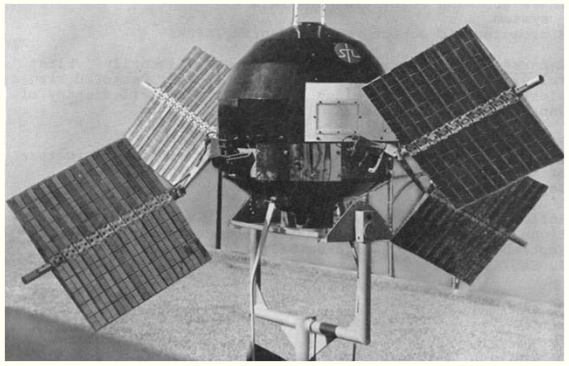


https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-a-satellite-58.html

NASA’s first satellites

- NASA has launched dozens of satellites into space, starting with the Explorer 1 satellite in 1958.
  - Explorer 1 was America's first man-made satellite.
  - The main instrument aboard was a sensor that measured high-energy particles in space called cosmic rays.
- The first satellite picture of Earth came from NASA's Explorer 6 in 1959.
  - The pictures did not show much detail, but they did show the potential satellites had to change how people view Earth and space.

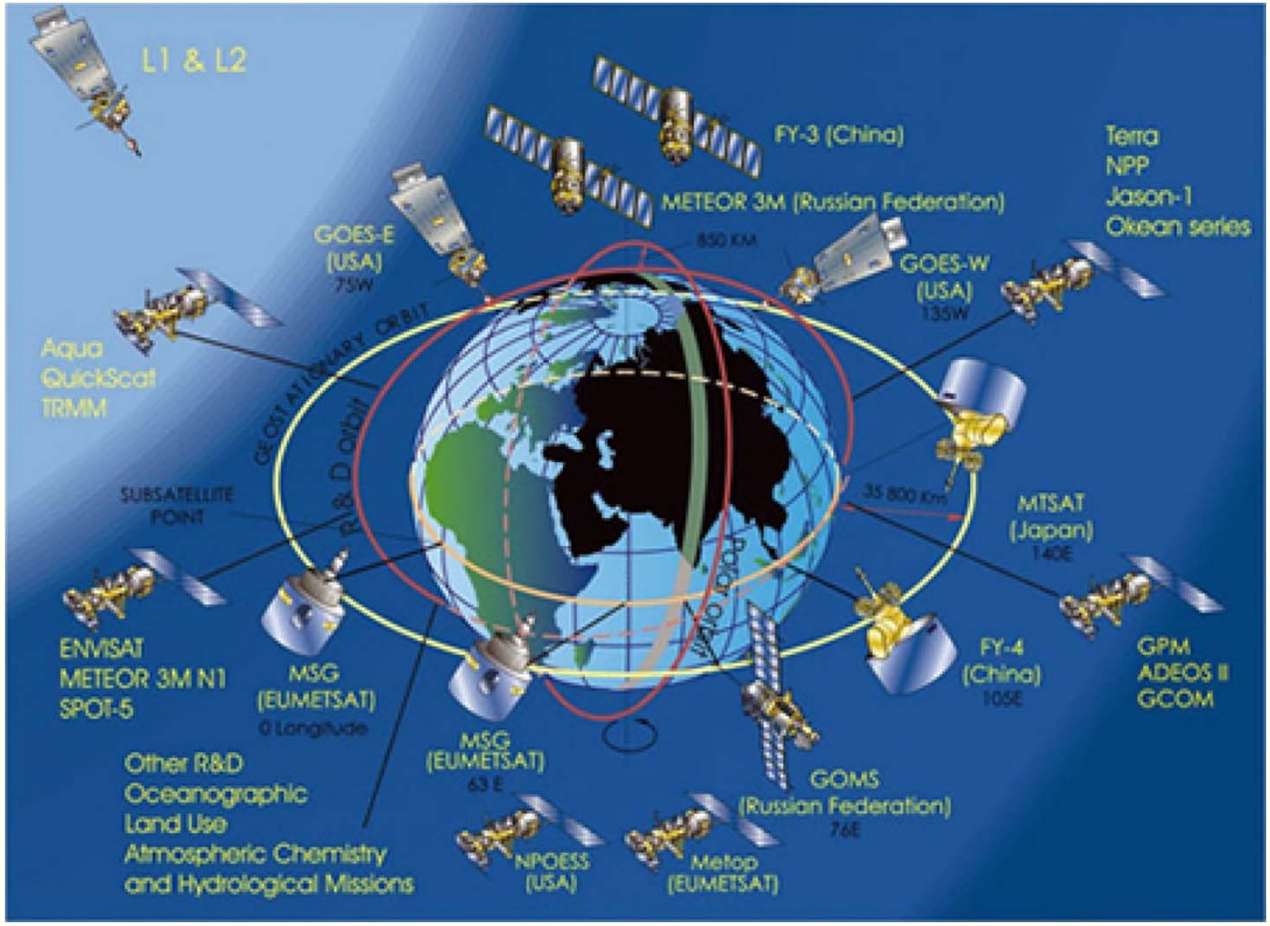
NASA's Explorer 1



NASA's Explorer 6

First Picture of Earth

Weather Monitoring Satellites

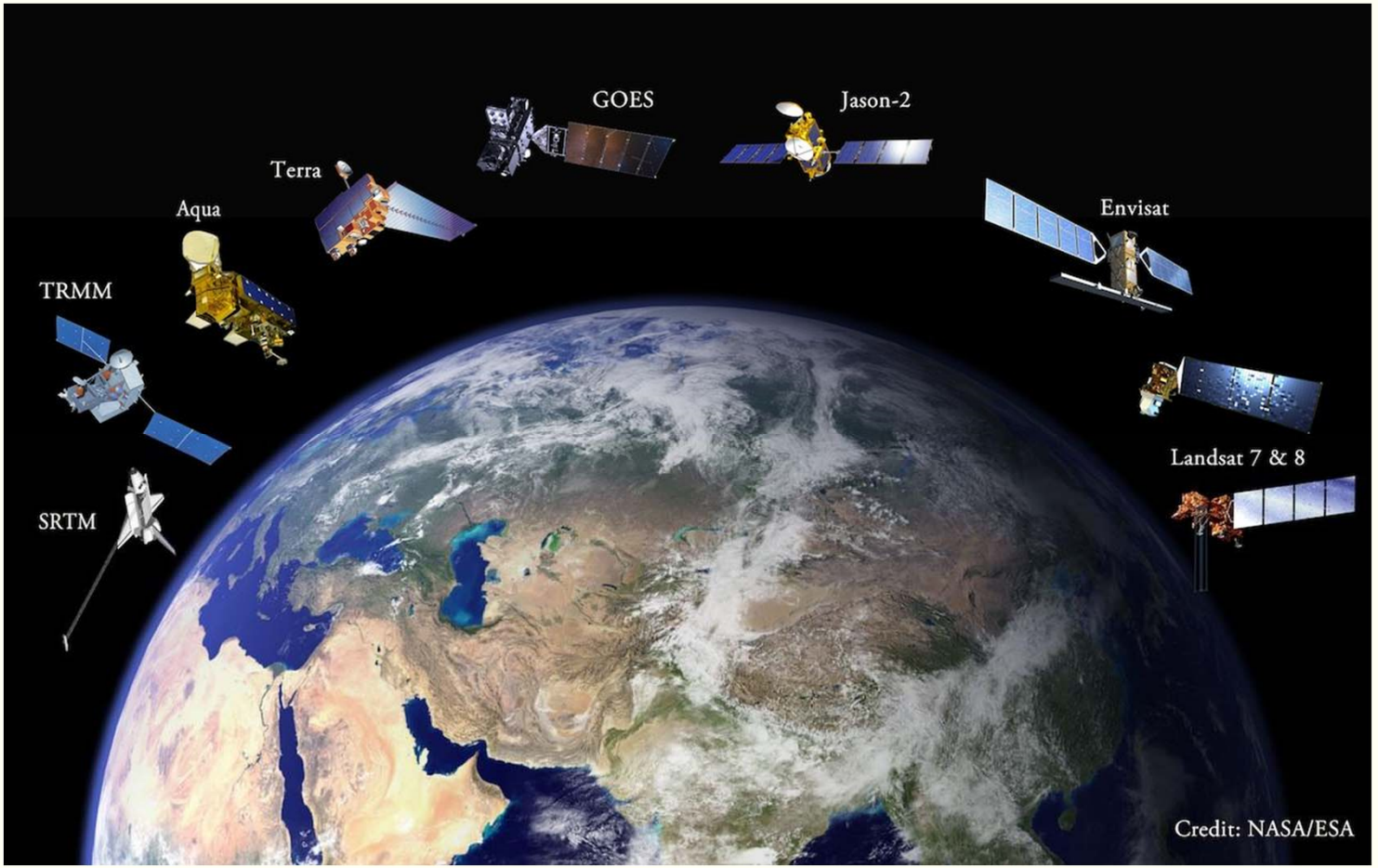


http://bruce.maulden.us/2013/02/27/weather-satellite-surveillance-not-going-to-be-pretty/

The Global Climate Observation System (GCOS) is used for global climate monitoring

http://kejian1.cmatc.cn/vod/comet/climate/climate_monitoring/navmenu.php_tab_1_page_6.4.0_type_text.htm

A set of satellites is collecting data for predicting river behavior when ground data is unavailable.



https://servirglobal.net/Global/Articles/article/1375/satellites-hold-secrets-to-understanding-remote-rivers

Global Positioning System (GPS)

https://youtu.be/5VJscsBUWm0

0.22 min

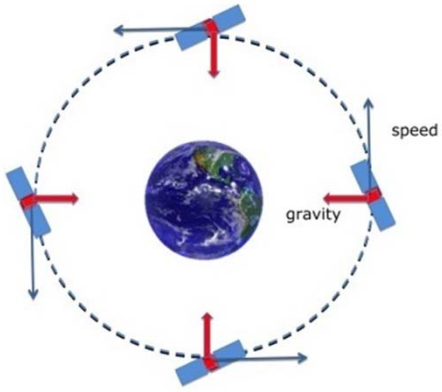
Global Positioning System (GPS)

https://youtu.be/RSA3feQ9gKk

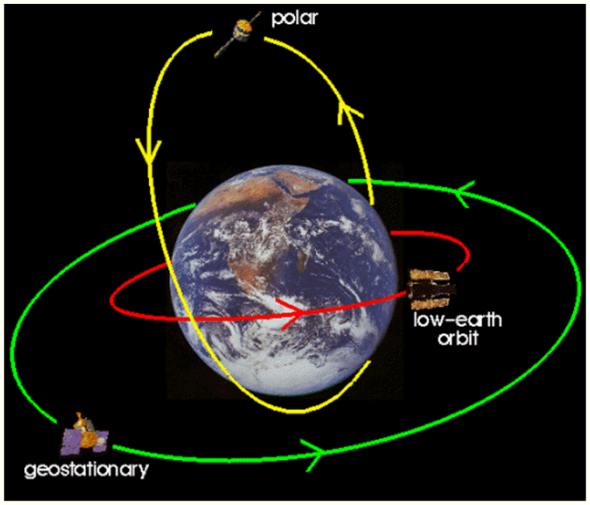
2.43 min

How satellites stay in orbit

- How do satellites get positioned in space
  - Most satellites are launched into space on rockets.
  - On-board thrusters are used to direct the satellite into its orbit
  - A satellite orbits Earth when its speed is balanced by the pull of Earth's gravity.
- The three most common types of orbit are:
  - Geostationary
    - Travels from west to east over the equator.
    - It moves in the same direction and at the same rate Earth is spinning.
    - From Earth, a geostationary satellite looks like it is standing still since it is always above the same location.
  - Polar-orbiting satellite
    - Travel in a north-south direction from pole to pole.
    - As Earth spins underneath, these satellites can scan the entire globe, one strip at a time.
  - Low-Earth Orbit



https://www.sciencelearn.org.nz/images/261-satellite-speed-and-force-directions



https://sites.google.com/site/satellitecsap/present/types-of-satellites

Location of orbiting satellites

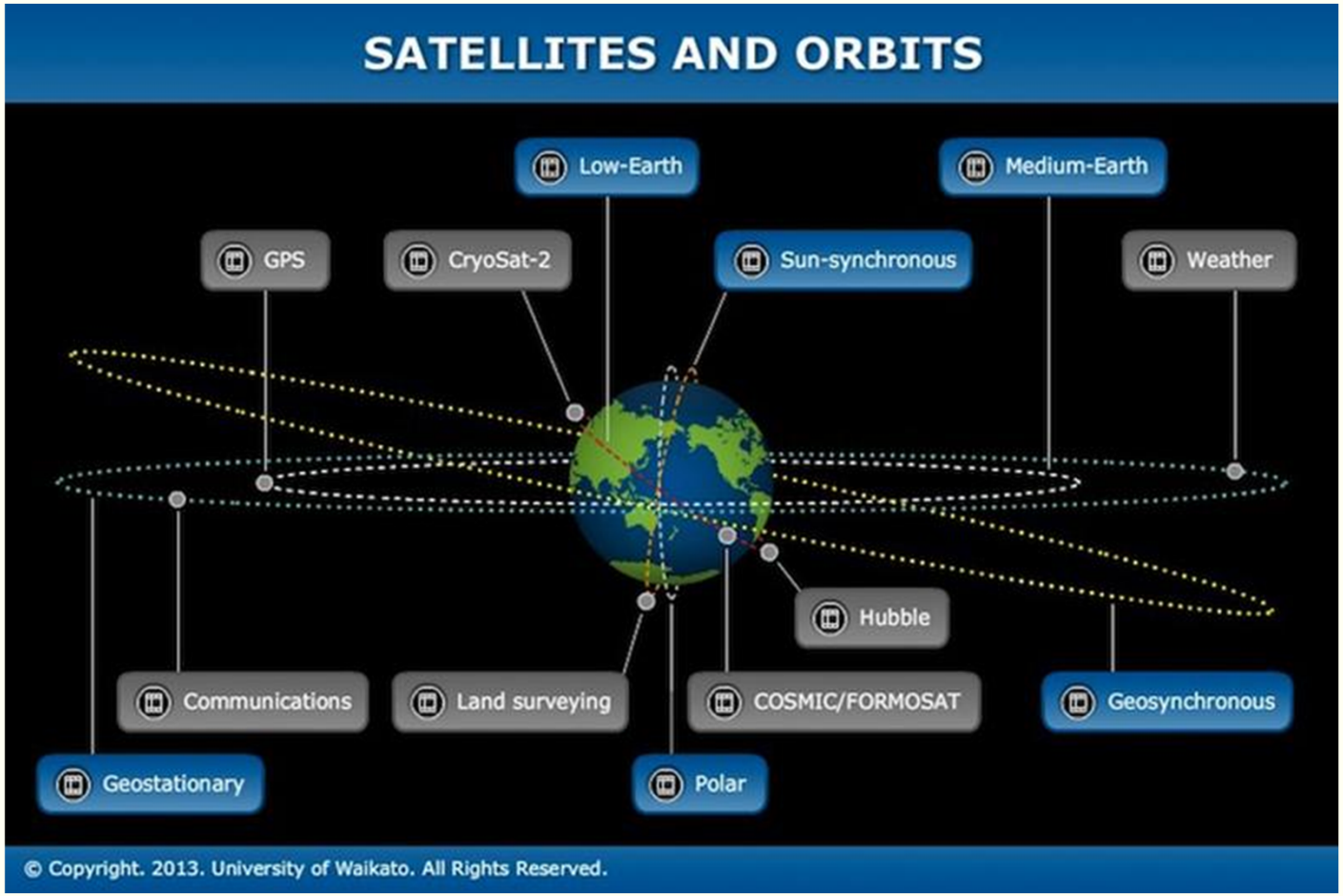
Satellites in geostationary orbit
- Land surveying

Satellites in polar orbit
- GPS
- Communications
- Weather

Low-Earth orbit
- CryoSat-2**
- Hubble space telescope
- Cosmic/Formosat*

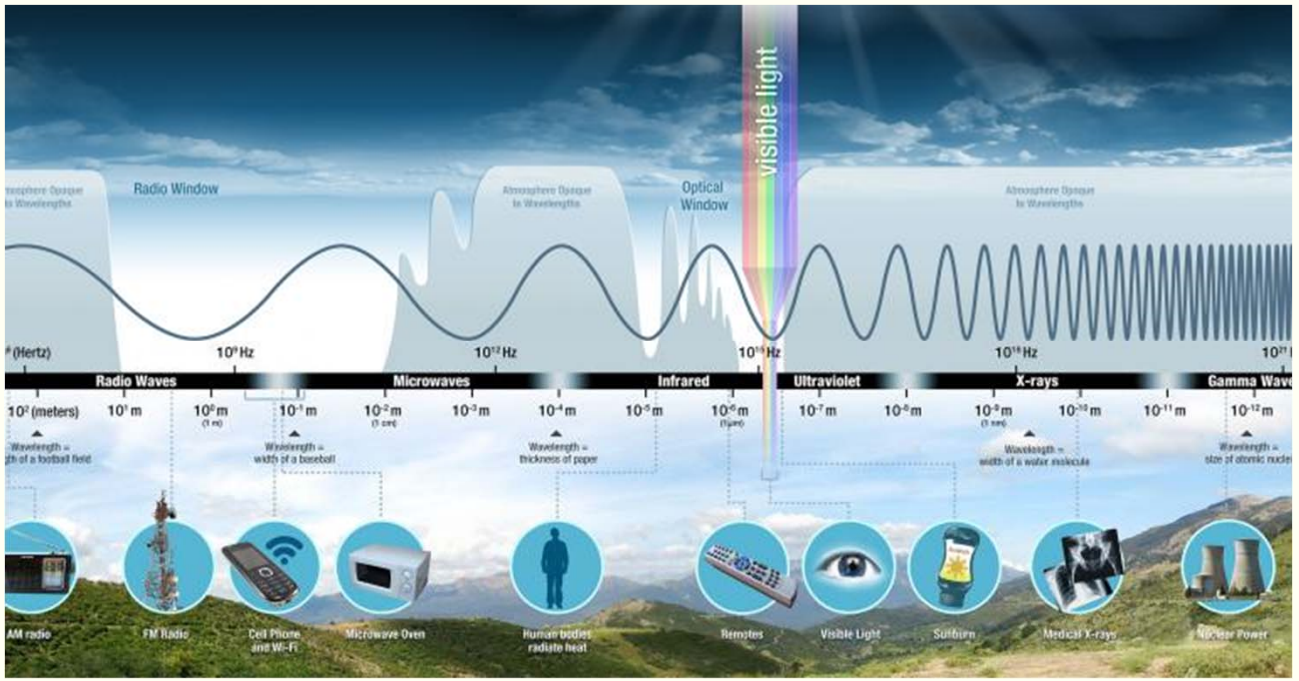
*System of satellites for studying meteorology, ionospheric research, climatology, and space weather by using GPS satellites in conjunction with low Earth orbiting (LEO) satellites.
**Monitors polar ice sheets

https://www.sciencelearn.org.nz/image_maps/13-satellites-and-orbits



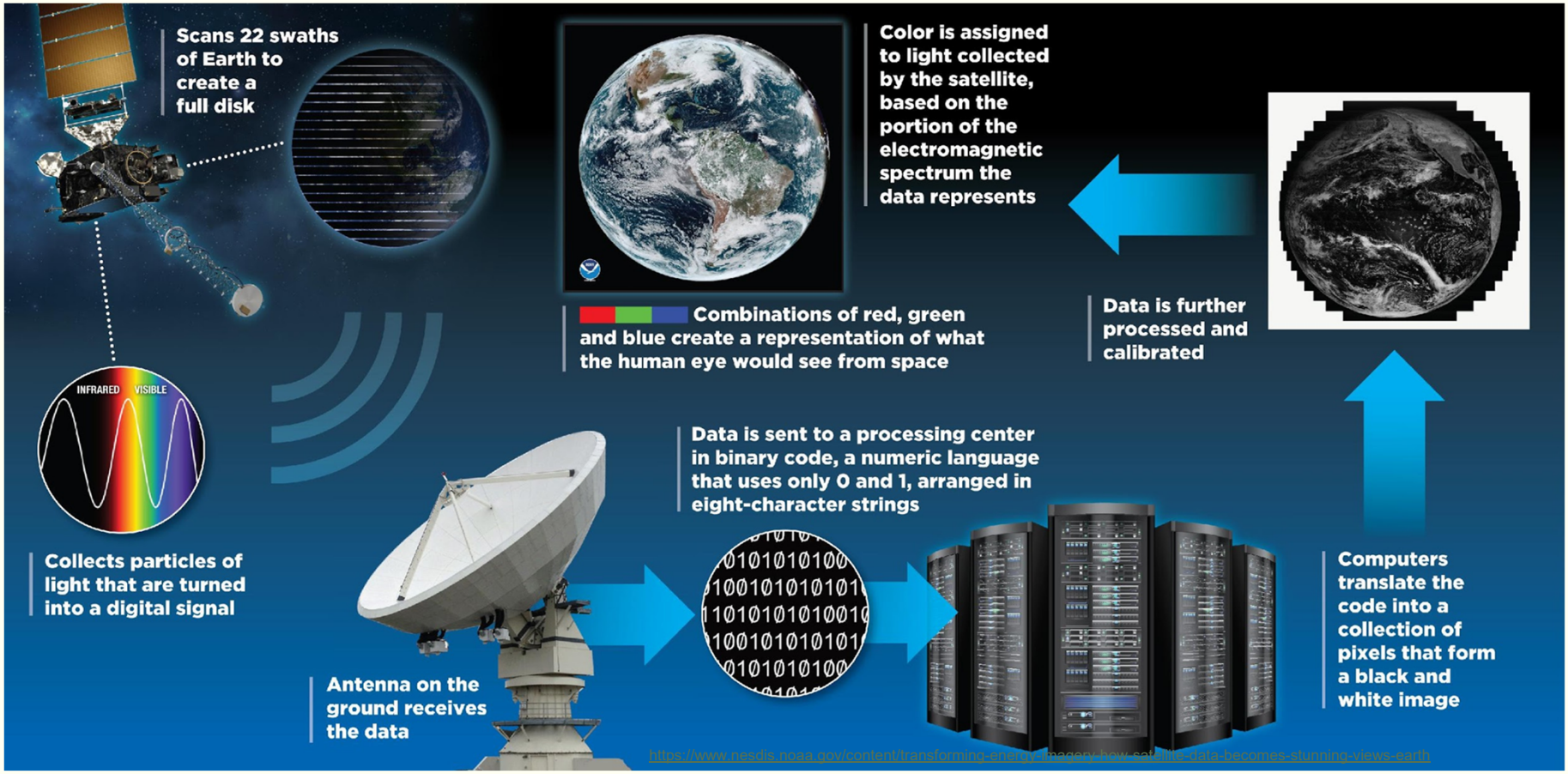
How satellite pictures of Earth and pictures of other planets are made and transmitted

- Satellite imagers collect information
  - Remote sensing is the **science of obtaining information** about objects or areas from a distance
- Satellites carry instruments to measures energy at different wavelengths along the electromagnetic spectrum.
- The signals are sent back to Earth for processing
- The signals are converted into digital code and then converted into pixels to make a picture
- This is a similar process for creating a picture with a digital camera



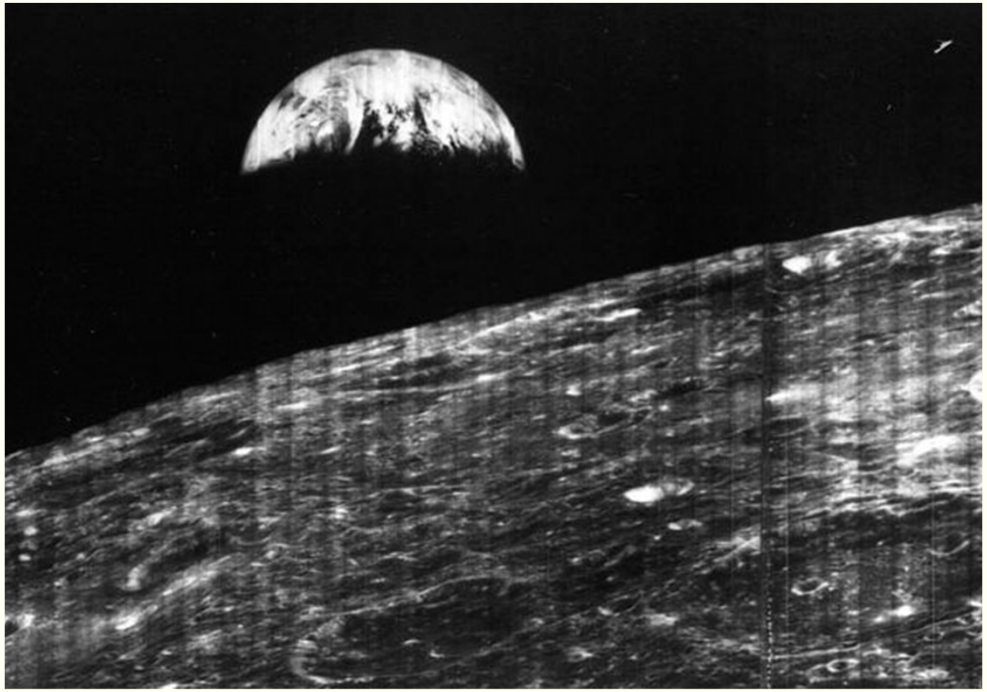
https://www.nesdis.noaa.gov/content/transforming-energy-imagery-how-satellite-data-becomes-stunning-views-earth

Transforming Energy Into Imagery



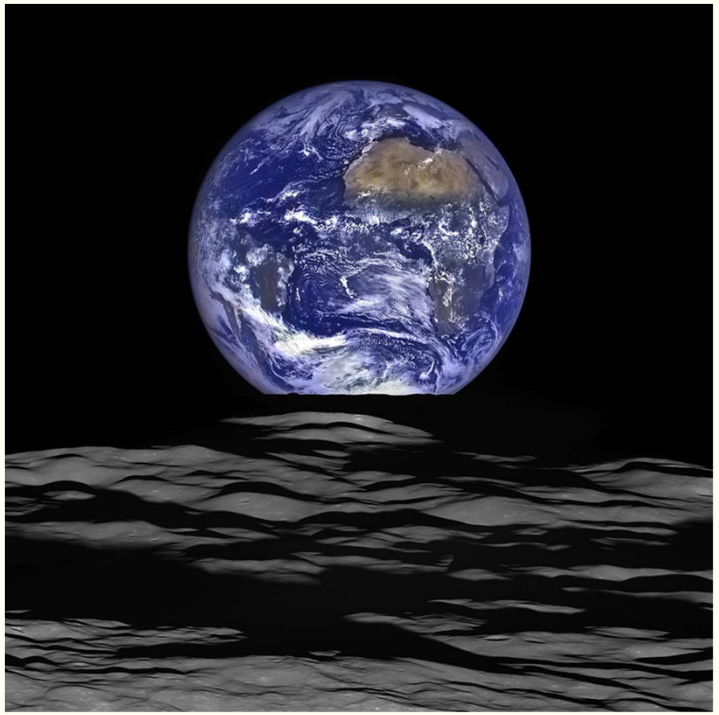
First picture of Earth from the moon's orbit

- *The first image of the Earth from the Moon, taken on August 23, 1966*
- The photo was sent to Earth by the unmanned robotic spacecraft and was received at the tracking station at Robledo De Chavela near Madrid, Spain.



https://www.indiatvnews.com/news/world-see-pic-50-years-ago-nasa-spacecraft-captured-this-first-ever-image-of-earth-from-the-moon-345240

- Image of Earth from the NASA's Lunar Reconnaissance Orbiter (LRO) vantage point in orbit around the moon:



https://www.nasa.gov/image-feature/goddard/lro-earthrise-2015

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Welcome to the International Space Station

8:43 min

International Space Station

The International Space Station (ISS) is a multi-nation Endeavor for scientific exploration.

Travels at 5 miles / sec

Circles the Earth every 90 min

16 Countries built the ISS

240 Astronauts

https://images.app.goo.gl/yYUdFy5BjyahjFcc

Most expensive item at $120 B

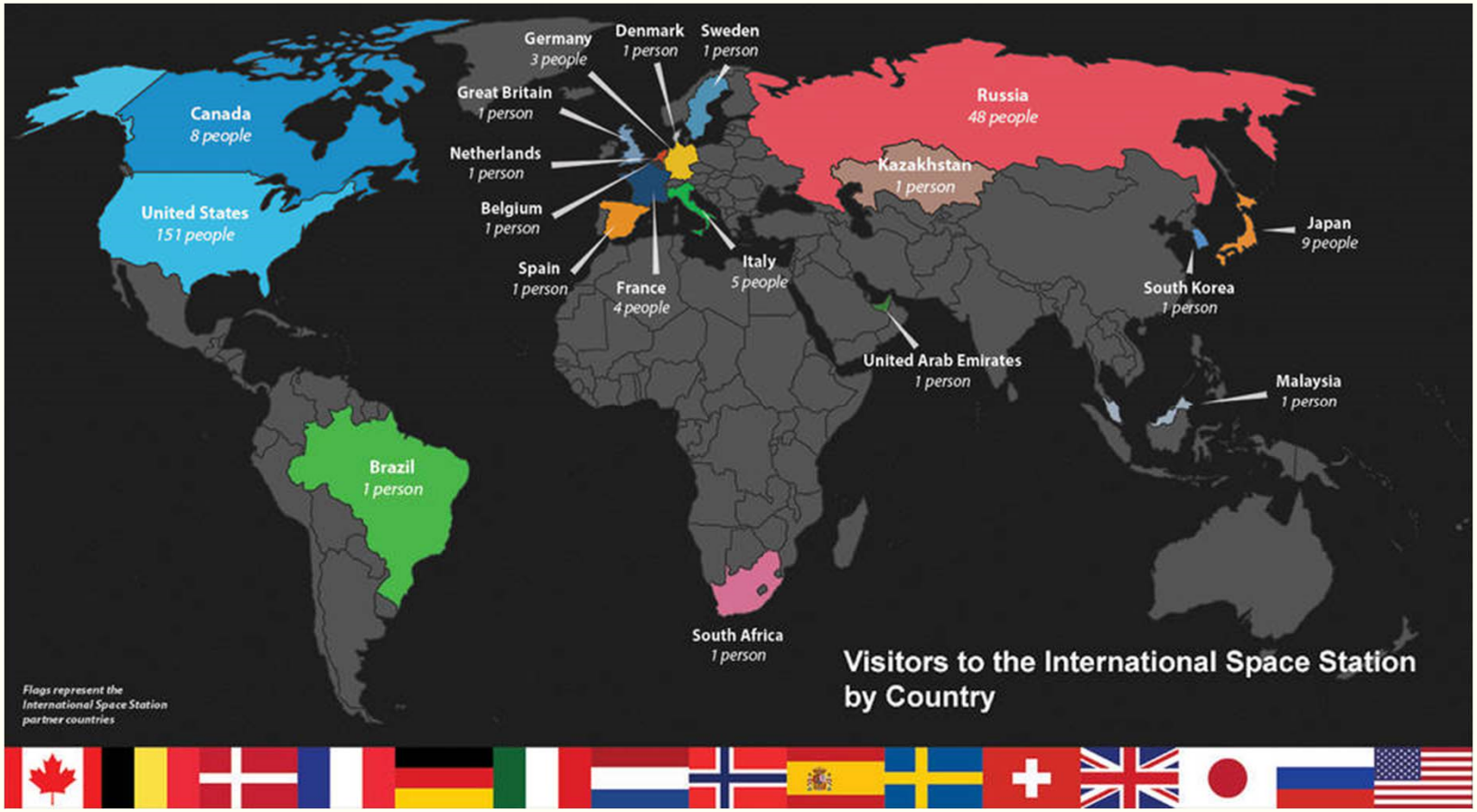
Third brightest object in the night sky

Largest manmade object in space

Astronauts must work out at least two hours a day

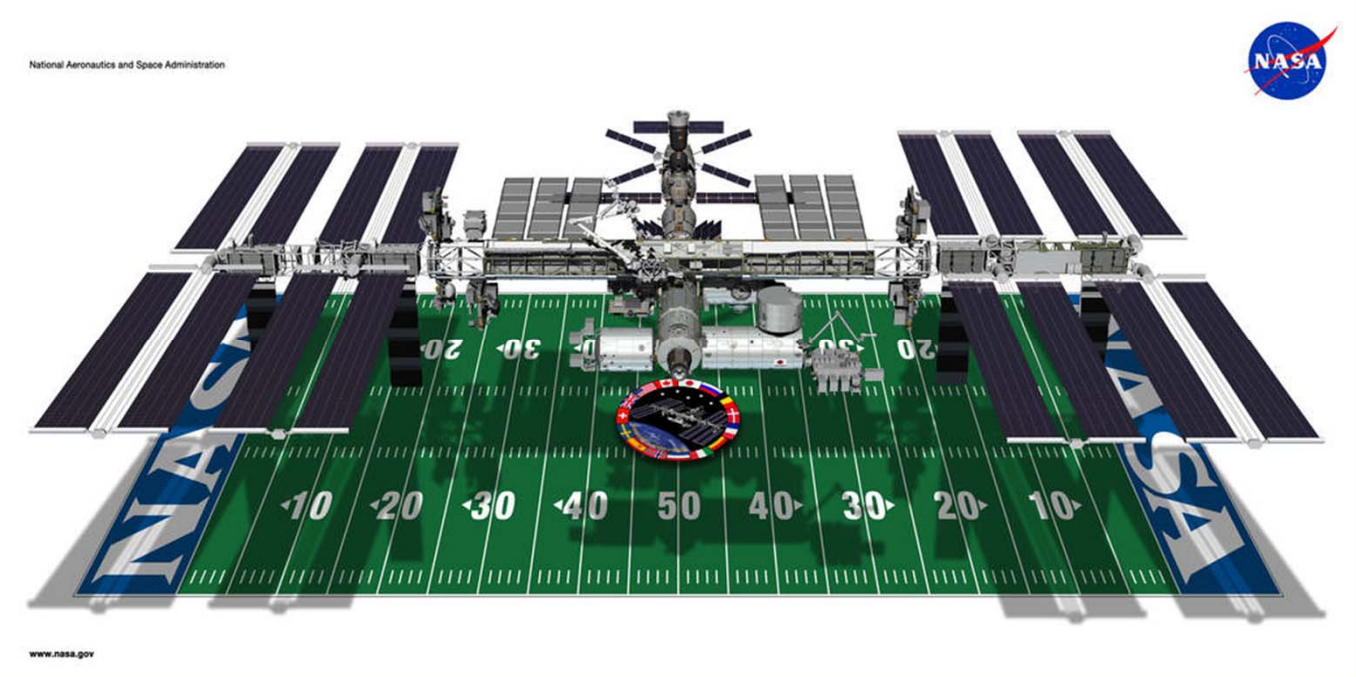
Oxygen is generated via electrolysis

19 Countries have sent astronauts to the ISS as of April 2020



Construction of the International Space Station

- Main construction was completed between 1998 and 2011
- It is continually evolving to include new missions and experiments.
- It has been continuously occupied since Nov. 2, 2000.



ISS Construction Simulation

https://videos.space.com/m/SR62rlwb/building-the-international-space-station-animation?list=9wzCTV4g

2:30 min

Detailed List of Construction

https://www.nasa.gov/mission_pages/station/structure/elements/space-station-assembly

Research being conducted on the ISS in 2020

https://youtu.be/Je0I0ukpims

2:21 min

Astronaut and Mission Commander Suni Williams

- Sunita L. Williams (Suni) was selected as an astronaut by NASA in 1998 and is a veteran of two space missions:
- Expeditions 14/15… December 9, 2006 to June 22, 2007. Williams launched with the crew of STS-116 on December 9, 2006, docking with the International Space Station on December 11, 2006. As a member of the Expedition 14 crew, Williams served as Flight Engineer.
- Expeditions 32/33… Williams spent four months conducting research and exploration aboard the orbiting laboratory including being the Space Station commander for Expedition 33. She landed in Kazakhstan on November 18, 2012, after spending 127 days in space. During their Expedition, Williams and Hoshide performed three spacewalks to replace a component that relays power from the space station's solar arrays to its systems and repair an ammonia leak on a station radiator.
- She is currently training for the first post-certification mission of Boeing's Starliner spacecraft – the second crewed flight for that vehicle – and her third long duration mission aboard the International Space Station. Williams and her crewmates are working closely with Boeing to develop their new spacecraft systems, which will provide roundtrip crew transportation services to the International Space Station and, along with SpaceX's CrewDragon, return the ability to launch humans into space from United States soil.

https://www.nasa.gov/sites/default/files/thumbnails/image/jsc2012e096604.jpg8

Take a Tour of the International Space Station with Suni Williams

This is to be done on your own; Document the role of ISS modules in Req #6 in your workbook

Suni takes viewers on a tour of the space hours before she is scheduled to return to Earth in a Russian Soyuz capsule.

You will see modules for working, living, storage, and relaxation. Note that all surfaces are utilized…there is no real “up” or “down” in space.

Note that the Soyuz capsule that brought Suni to the station remains docked until her and her follow crewmates return home (four-month duration).

You will see the capsule while visiting the Copula and at the end of the video when she takes viewers inside.

https://youtu.be/FXv9AZl3fw4

30:00 min

Careers in Space Exploration

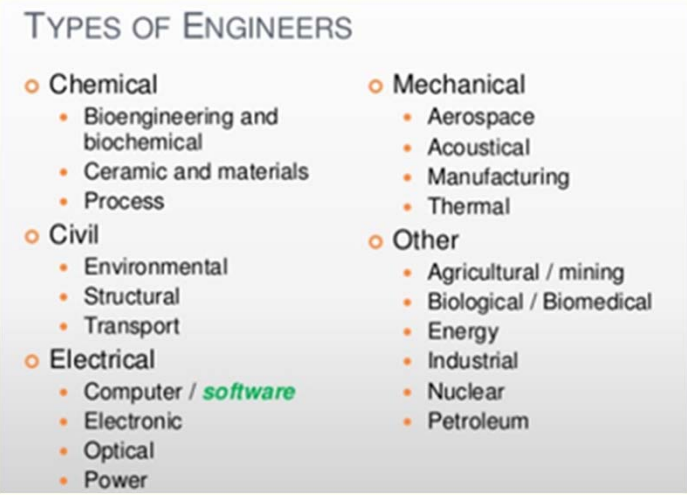
8. Provide a write-up (word doc or PPT) on two possible careers in space exploration that interest you. Find out the qualifications, education, and preparation required and discuss the major responsibilities of those positions.

Companies / Organizations Involved in Space Exploration

- NASA
- SpaceX
- Virgin Galactic
- Bigelow Aerospace
- Blue Origin
- Orion Span
- Boeing
- Lockheed Martin
- Northrup Grumman
- Raytheon

Potential Careers in Space Exploration

- Astronomers
- Aerospace engineers
- Research associates
- Space scientists
- Systems programmer
- Systems analyst
- Botanist
- Chemist
- Physicists
- Pilots



DESIGN YOUR MANNED BASE

Break-out sessions

Design Teams & Objectives

Eagle 14
- Joseph R
- Charlie M
- Henry H
- Lance Y
- Caleb M
- Liam M

Moderators
Schlosser
Gregg

Spatius Explorationis
- Robert R
- Michael C
- Jonah G
- Kiran M

Moderators
Myers
Cooper

Project Supernova
- Austin G
- Kevin D
- Gavin F
- Colin P
- Tyler P

Moderators
Fountain
Pennington

Space Scouts
- Jacob C
- Connor S
- Joshua S
- Gabriel E
- Dylan N

Moderators
Nemeth-Seay
Christ

Goals for today's Break-Out

- Finish your manned base design in the PPT file