SPACE EXPLORATION

Jennifer F. Nemeth, Ph.D.
Pack 408, Troop 542
Merit Badge Counselor

Paul Schlosser
Troop 1
Merit Badge Counselor

Dates (Zoom Meetings)

Thursday, May 14 (7:00-8:30 PM)
Sunday, May 17 (10:00-11:30 AM)
Wednesday, May 27 (4:00-5:00),
attendance optional
Thursday, May 28 (7:00-8:30 PM)
Saturday, May 30 (10:00-11:30)

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

SPACE EXPLORATION

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Your Merit Badge Counselors:

Jennifer F. Nemeth-Seay, Ph.D.
jfnemeth1@Netscape.net

- Degrees in Chemistry and Mass Spectrometry
- Space Exploration Enthusiast for 40+ years
- Grew up during the Shuttle Program years
- First Year Space Exploration Merit Badge Counselor

Space Camp Contest….1988

“Where the IS will be in space exploration in the year 2000”

At the dawning of the year 2000, Liberty, the first manned spaceship to leave the confines of Earth’s gravity, is preparing to leave the docking bay of the U.S. space station “Taurus I” for its maiden voyage to Mars. The craft will fly at speeds close to that of speeds close to that of light. I hope to be on that ship with its elite crew from nations all over the world to explore the universe beyond Earth.

3rd Place Winner

Attended Space Academy

March 1989, 10th Grade

Physics, Rocketry, Astrophysics, Robotics

Your Merit Badge Counselors:

Paul Schlosser
pjs2164@verizon.net

- Degrees in Mechanical & Electrical Engineering
- FIRST FRC robotics mentor
- STEM/ Space Exploration Merit badge counselors for 15+ years
- Works for Lockheed Martin Space Company

How are we running this merit badge

1. Let your scoutmaster know that you are taking this merit badge.
2. Go into Scoutbook and assign yourself the Space Exploration merit badge under “Advancement”
3. Select Paul and/or Jennifer as your merit badge counselors for the merit badge.
4. We will be signing off on your requirements via Scoutbook.
5. There will be 4 required and 1 optional sessions to complete this badge
    1. History and Impact of Space Exploration
    2. Rocket Design
    3. Satellites and the International Space Station
    4. SpaceX Rocket Launch (optional)
    5. Manned Base Presentations

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.

*If local laws prohibit the launching of model rockets, do the following activity: Make a model of a NASA rocket. Explain the functions of the parts. Give the history of the rocket.

SESSION 1

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Green: Done on your own

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Poll: What year was NASA created?

Down to Earth

https://youtu.be/5L6eqgnmlPo

2 min video

REQUIREMENT #1: Why did we start exploring space and what has the impact been

1. Historical reasons that drove us to reach for the stars
2. What have we gained from our efforts to reach beyond our atmosphere
3. Benefits related to Earth resources, technology, and new products
4. How international relations, cooperation, and competition made our efforts successful

The *VISIONARIES* that inspired our fascination with space exploration

Father of modern science fiction

Jules Verne (1828-1905)

Imagined 7 Technologies before they were invented[1]:

- Electric Submarines
- **Space Flight and Lunar Modules**
- **Solar Sails**
- Video Conferencing
- Helicopter
- Hologram and Jukebox
- Video New Casts

"Earth is the cradle of mankind, but one does not stay in the cradle forever."

Konstantin Tsiolkovsky (1857-1935)

Russian teacher and scientist

- Credited for working out the math for the "rocket equation
- Wrote science fiction stories of interplanetary travel.
- Wrote about the use of liquid propellant to power rocket ships and the need for space suits

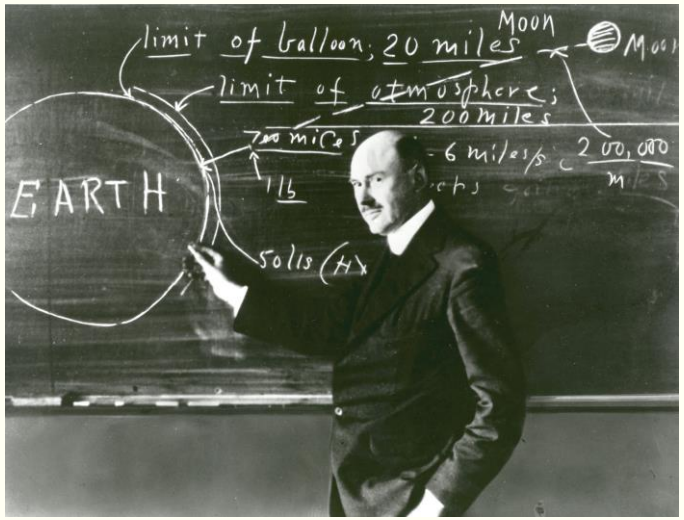
"The only way of finding the limits of the possible is by going beyond them into the impossible"

Arthur Clarke (1917-2008)

- Received degrees in physics and mathematics
- Published a paper on "Extraterrestrial Rays" that laid down the principles of modern communication satellites in geostationary orbit
- Wrote science fiction stories including *The Sentinel, Earthlight, Islands in the Sky, The Sands of Mars, and The Fountains of Paradise*
- Joined the British Interplanetary Society

[1]https://interestingengineering.com/prophet-or-futurist-7-technologies-jules-verne-predicted-leagues-ahead-of-his-time

The original *MAKERS* of our foundation for space flight



"Father of Modern Rocketry"

Dr. Robert Goddard (1882-1945)

- Published a paper on "A Method of Reaching Extreme Altitudes" postulating the use of rockets for carrying weather equipment
- Developed a rocket using liquid fuel, a rocket that went faster than the speed of sound, and the first automatic steering devise for rockets
- **Goddard Space Flight Center** (GSFC) is a major NASA space research laboratory in Greenbelt, Maryland

"There is no such thing as an unsolvable problem."

Sergei Korolev (1907-1966)

- Studied Engineering
- Oversaw a range of Russian space programs including rocket launches, space craft, and space probes into orbit
  - Directed the first rocket launch into orbit
  - Vostok, Voskhod, Molniya (Soyuz), and Zond spacecraft
  - Directed the programs for probes to the Moon, Mars, and Venus

Dr. Wernher von Braun (1912-1977)

- Doctorate in aerospace engineering
- Build Germany's V2 missile
- Led the US Army missile development program
- Launched the first US satellite, Explorer I
- Developed the Saturn class rockets used in the Apollo missions and the moon landing

*"I have learned to use the word Impo**ssible** with the greatest caution."*

Clips of early rocket failures

Video Times
0:00-1:00
3:30-6:30
13:40-16:20

https://youtu.be/McbCwSW2moo

The DOERS: Pilots who became our first astronauts

U.S. Sen. John Glenn (1921-2016)

- Eagle Scout
- Aerospace engineering degree
- Navy Marine aviator
- Mercury astronaut
- 1st American to orbit Earth
- Oldest person to go into space (age 77) on a shuttle mission

Alan Shepard (1923-1998)

- First Class Scout
- Navel Academy Grad
- Flew aircraft carriers in WWII
- Mercury 7 astronaut
- 1st American to fly in space
- Led the Apollo 14 lunar-landing mission
- Hit a golf ball on the moon that traveled 900 yards (a standing record)

Neil Armstrong (1930-2012)

- Eagle Scout
- Aerospace engineering degree
- Navel aviator
- Gemini astronaut
- Commanded Gemini 8
- Commander for Apollo 11
- First man to set foot on the moon

John Young (1930-2018)

- Second Class Scout
- Aeronautical engineering degree
- Navy pilot
- Only astronaut to fly Gemini, Apollo, and Space shuttle missions
- Commanded Gemini 10
- Command pilot for Apollo 10
- Drove the Apollo 16 rover
- Commanded the first space shuttle flight

US Space Exploration Fallen Heroes

Apollo 1 – 1967
The first fatal accident in the history of U.S. space flight occurred on January 27, 1967, during preparations for the first manned mission of the Apollo space program. A flash fire broke out in the Apollo command module during a simulated launch, killing astronauts Virgil “Gus” Grissom, Edward White and Roger Chaffee of asphyxiation. A design flaw in the hatch door prevented getting it open in time to save the astronauts. After the accident, NASA officially designated the mission as Apollo 1.

Challenger – 1986
On the bitterly cold morning of January 28, 1986, the space shuttle Challenger broke apart 73 seconds after its launch from Cape Canaveral. All seven astronauts aboard were killed including Francis "Dick" Scobee, Michael Smith, Judith Resnik, Ellison Onizuka, Ronald McNair, Gregory Jarvis, S. Christa McAuliffe. An investigation later found that extreme cold temperatures could result in damage to the spacecraft’s rubber O-rings—which separated its rocket boosters and prevented fuel leaks.

https://www.history.com/news/the-5-deadliest-disasters-of-the-space-race

Columbia – 2003
After a 16-day mission, Columbia was reentering the Earth’s atmosphere for landing when the shuttle’s orbiter broke into pieces, killing all seven astronauts aboard: Rick Husband, Michael Anderson, David Brown, Kalpana Chawla, Laurel Clark, William McCool, and Ilan Ramon. A small piece of insulating foam had broken loose from a fuel tank during launch and pierced Columbia’s left wing, Upon reentry, hot gases and smoke penetrated the damaged wing, causing it to break off and the shuttle to disintegrate.

A Local Philadelphia Connection

- **Guion Stewart Bluford Jr.** (born November 22, 1942)
  - American aerospace engineer, retired U.S. Air Force officer and fighter pilot
  - Former NASA astronaut
  - First African American and the second person of African descent to go to space
  - Before becoming an astronaut, he was an officer in the U.S. Air Force, where he remained while assigned to NASA, rising to the rank of colonel
  - Participated in four Space Shuttle flights between 1983 and 1992

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

The ENTREPRENEURS who are driving the next generation into space

"Bigelow Aerospace: Colonizing space one module at a time"

Robert Bigelow (1945-)

- Applied the concept to orbital facilities
- Bigelow Aerospace launched its first spacecraft, Genesis I, in 2006 followed by Genesis II in 2007
- **The Bigelow Expandable Activity Module (BEAM) is an experimental expandable space station module developed by Bigelow Aerospace, under contract to NASA, for testing as a temporary module on the International Space Station (ISS) from 2016 to at least 2020.**

"The day before something is a breakthrough, it's a crazy idea."

Peter Diamandis (1961-)

- **Serial entrepreneur involved in the creation of elements for the broader space community:**
  - International Space University
  - Students for the Exploration and Development of Space
  - Zero-G Corp: provides micro-, lunar, and Martian gravity parabolas
  - Z-Prize Foundation: offers monetary awards to spur innovation in space exploration

"Failure IS an option here. If things are not failing, you are not innovating."

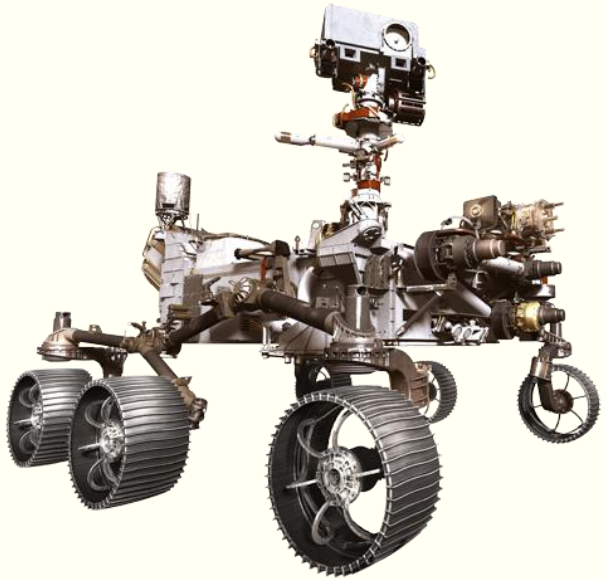
Elan Musk (1971-)

- **Founder of SpaceX (Space Exploration Technologies)**
- Builds rockets for transport of payloads into low-Earth orbit
- SpaceX is suppling the ISS using its Dragon spacecraft
- Plans to launch Starlink internet service in 2020
- **SpaceX aims to launch astronauts this spring 2020 after Crew Dragon escape test success…*This would return the US to manned space flight since the retirement of the shuttle program***

Get involved with Space Exploration

- **Mars 2020 rover is officially named 'Perseverance'**

Alexander Mather, 13



Perseverance

https://www.cnn.com/2020/03/05/us/mars-rover-2020-name-perseverance-scn-trnd/index.html

- **The NASA chopper 'Ingenuity' set to be first aircraft to fly on Mars now has a name**

Vaneeza Rupani, 17

Ingenuity

https://www.cnn.com/2020/04/29/us/nasa-ingenuity-mars-helicopter-rupani-scn-trnd/index.html

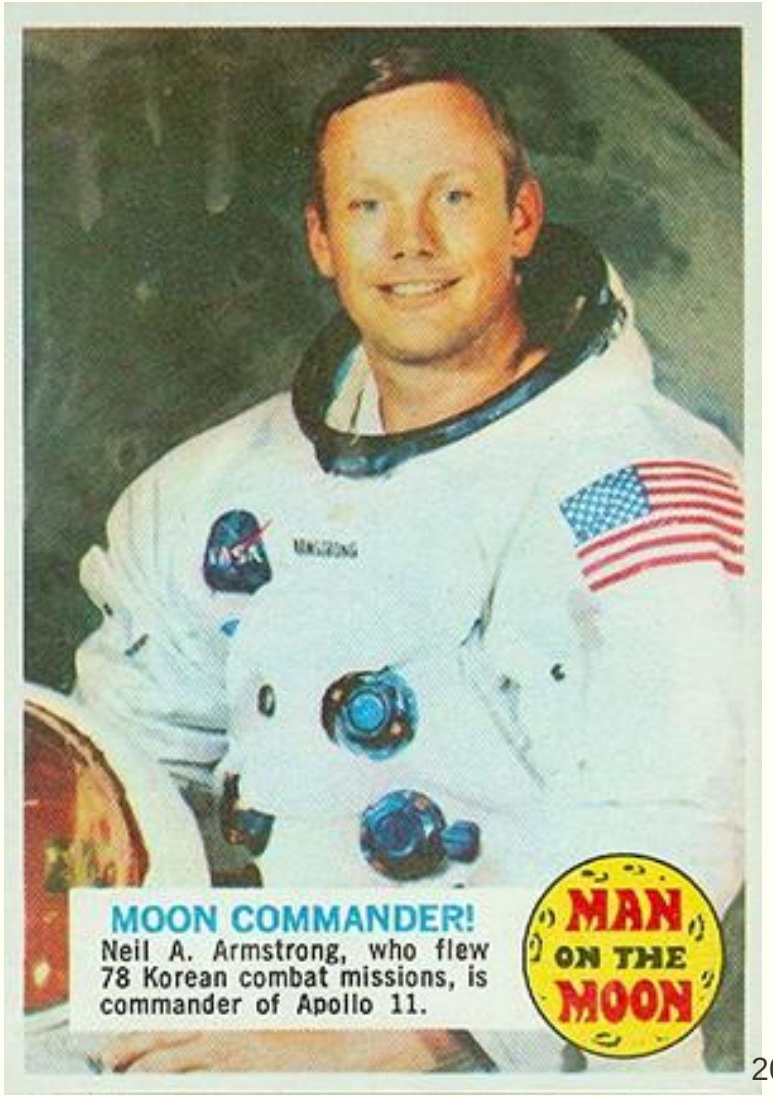
REQUIREMENT #2: Design an astronaut collector's card

- Picture on the front
- Information on the back, about your favorite space pioneer.
- Share your card with your counselor
  - There is a place in the merit badge workbook to design your card

This is to be done on your own in your handbook

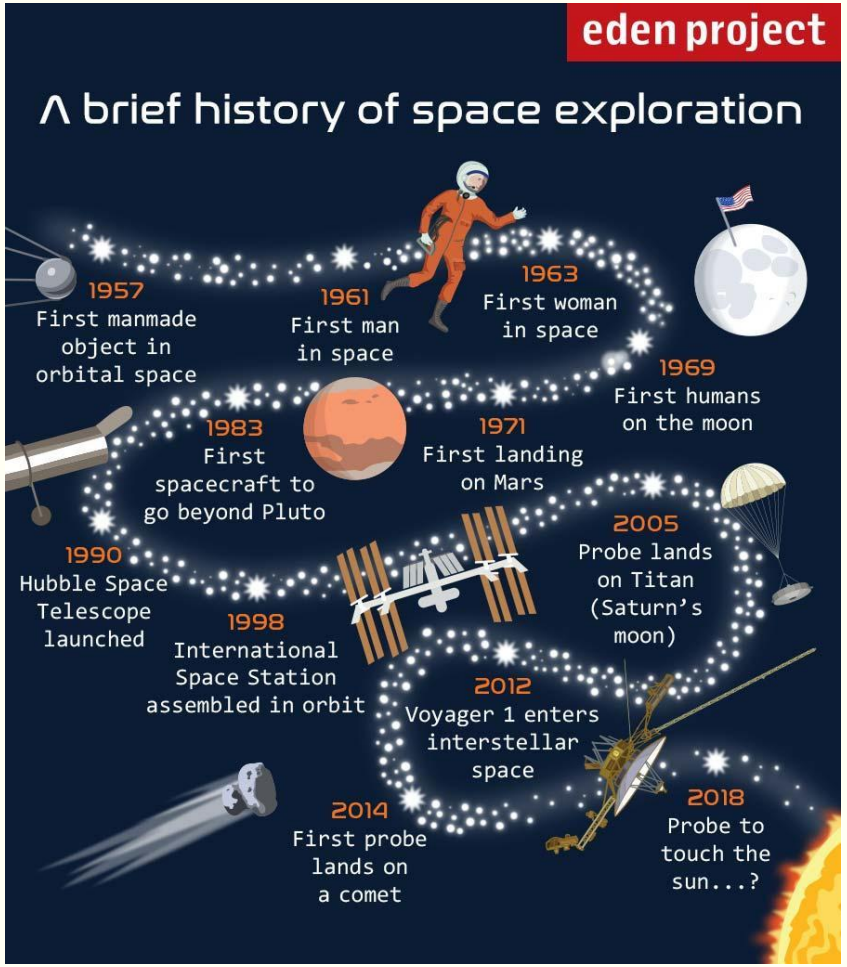
- Discuss four additional space pioneers (Visionaries, Makers, Doers, Entrepreneurs) with your counselor
  - In lieu of a discussion, you can submit write-ups (at least 1 paragraph each) on 4 pioneers

https://www.nasa.gov/astronauts
http://www.rocketmime.com/space/history.html



Purpose of Space Exploration

- Explore the unknown
- We have observed and cataloged the movement of the sun, planets, moons, and stars for over 6000 years
- Advances in science and technology in the 20th century, made it possible to do more than just “watch” the sky
- The **“space race”** was launched in the late 1950’s, a Cold War competition between the United States and the Soviet Union to develop aerospace capabilities, including artificial satellites, unmanned space probes, and human spaceflight.
- This resulted in an age of technological advancement as it was never seen before

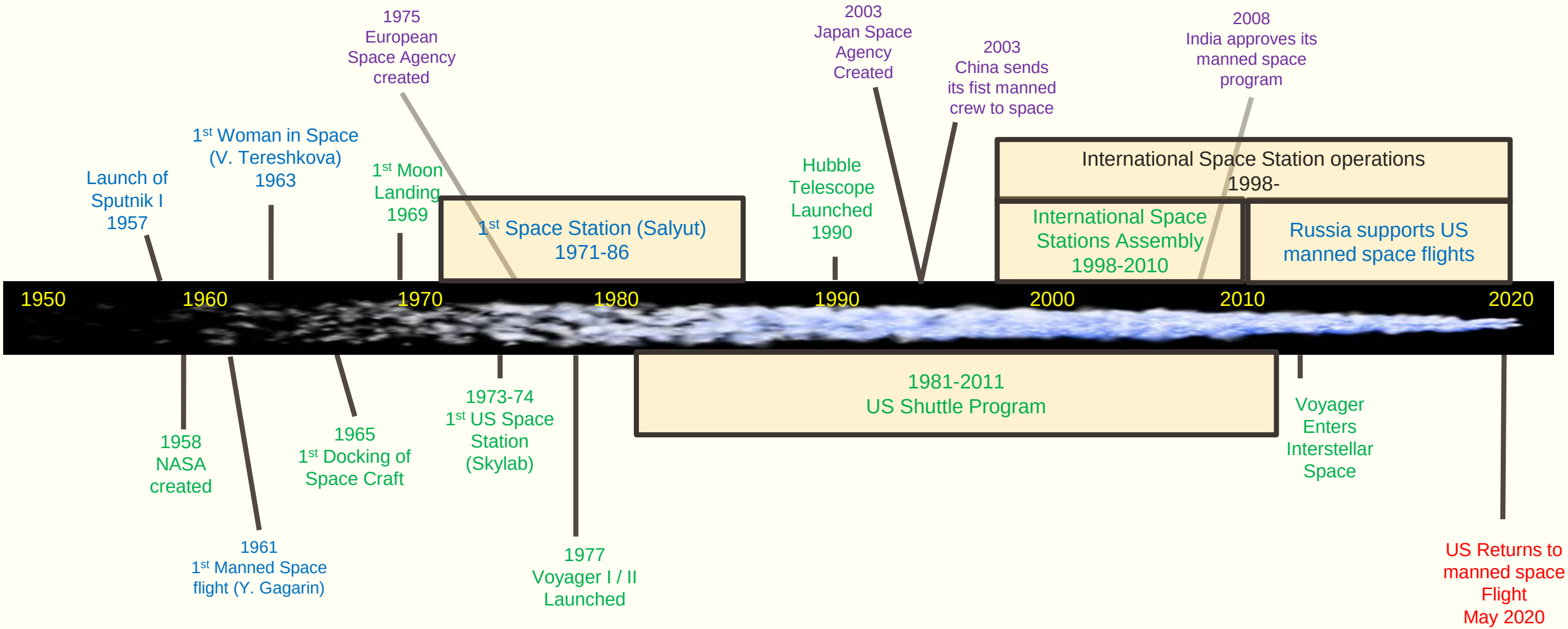


https://www.edenproject.com/learn/for-everyone/a-brief-history-of-space-exploration

The launching into Space…

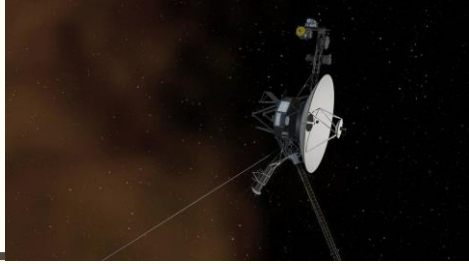
- The USSR launched the world's first artificial satellite, ***Sputnik I,*** in October 1957, followed the next month with Sputnik II.
- These successes set of alarm bells in America that the Soviet Union had surpassed the technological achievements of the United States.
- Early Soviet successes in the space race had a major impact on US society and culture, altering strategic defense doctrines and leading to new educational initiatives.
- The **National Aeronautics and Space Administration** (**NASA**) was created in October 1958 with primary responsibility for the **development of civilian aerospace research**.
- NASA's **earliest objective** was to launch a manned vehicle into Earth's orbit as soon as possible
- In April 1961, the Soviets won this race when cosmonaut Yuri Gagarin became the first man to enter Earth's orbit, in a single-pilot spacecraft called Vostok I.
- American was not far behind as a month later Alan Shepard became the first American in space, piloting a 15-minute suborbital flight.
- In February 1962, **John Glenn** became the first American to enter Earth's orbit.
- Early Soviet successes in the space race led US President John F. Kennedy to announce the inauguration of the **Apollo program in 1961**, which pledged to put a man on the moon by the end of the decade.

Highlights of Manned Space Exploration

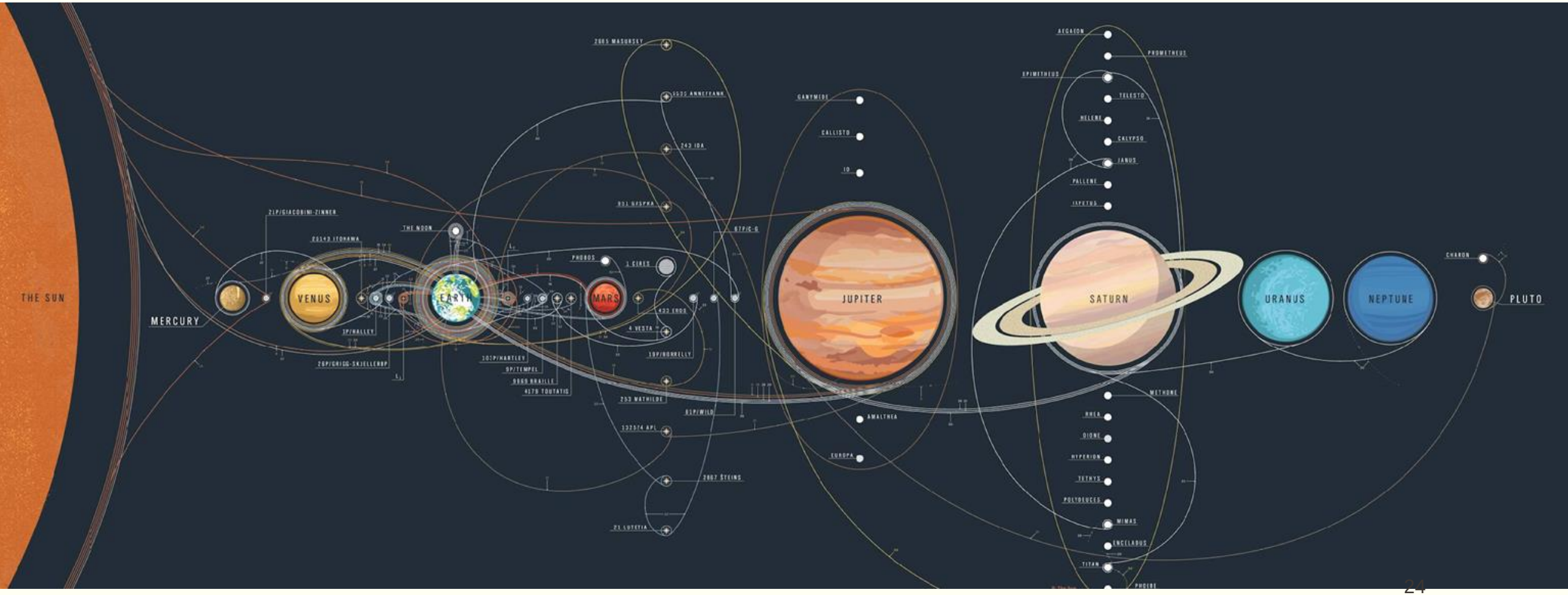


USSR (Russia), US, Other Countries

Where have we explored…

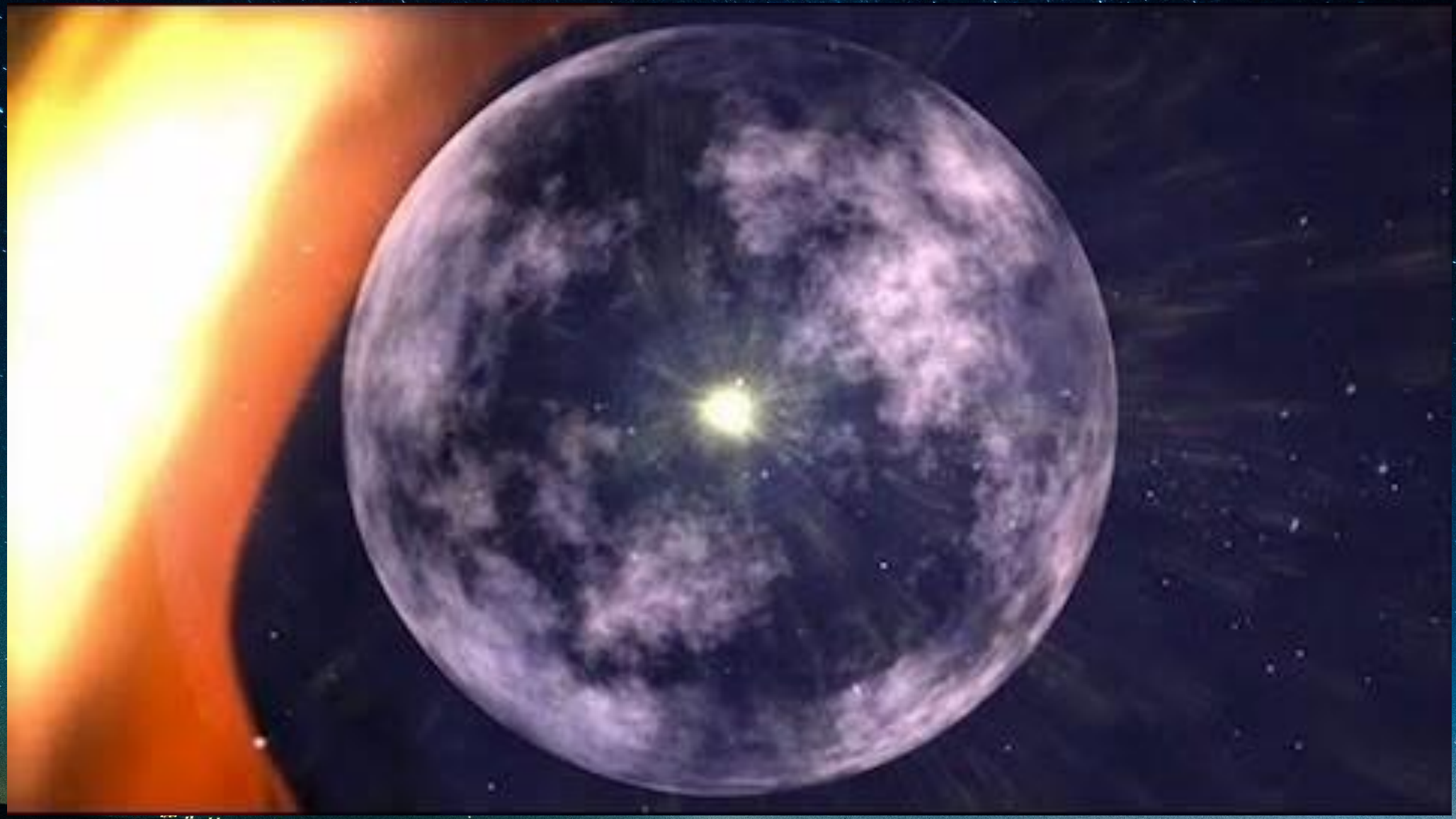


Voyagers I and II ir interstellar space



https://www.sciencealert.com/this-glorious-map-helps-you-keep-track-of-every-space-mission-in-the-solar-system.

The missions for Voyagers I and II



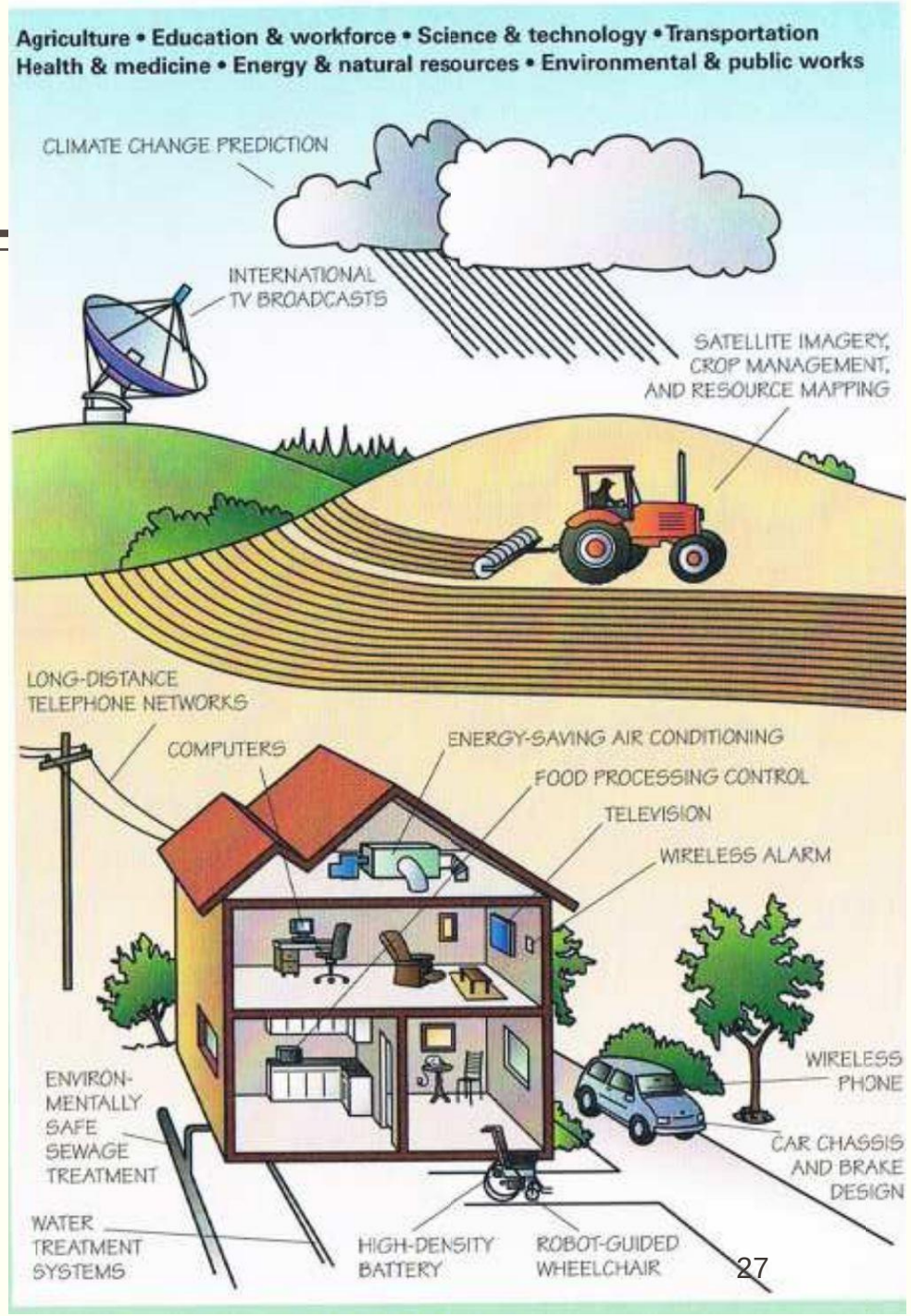
https://youtu.be/MGPM58S5Njg

2:50 min

POLL: WHAT ITEMS WERE INVENTED AS A RESULT OF SPACE EXPLORATION

New technologies that we have today as a result of space exploration

- New materials, products, and technologies coming from the space program are called “spinoffs”
- Spinoffs from NASA include:
  - Portable coolers
  - Scratch-resistant lenses
  - Self-righting life rafts
  - Water treatment systems
  - Virtual reality simulators
  - Smoke detectors
  - Cordless tools
  - Flame-retardant materials for firefighting
  - Programable pacemakers
  - Voice-controlled wheelchairs
  - Tang juice drink, Freeze-dried ice cream

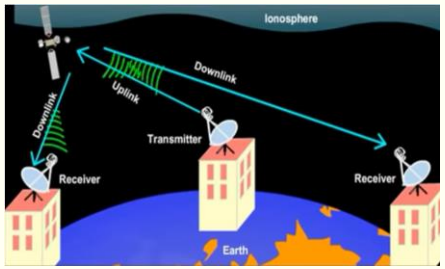


Spinoff.nasa.gov

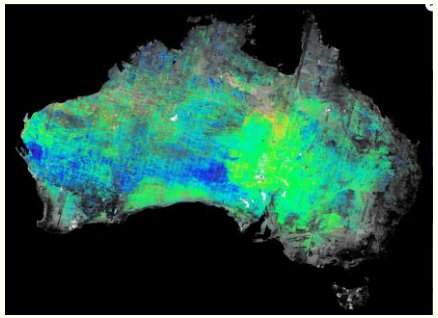
The impact of satellites on everyday life

- Meteorology
  - Provide accurate daily weather forecasting
  - Tracking of large, impact for storms
- Communications
  - Satellite Radio (Sirius/XM)
  - Satellite Phones (critical for military operations)
  - Satellite internet
  - GPS
- Environmental Scanning
  - Scanning land and sea allows for the location of natural resources
  - Scanning land and sea allows for the identification of areas under destruction
- Military Uses
  - Intelligence
  - Communications
  - Defense

Weather Radar – April 15, 2020



2-Way data transmission


Mineral Map of Australia

Space exploration is humanity's future

- People who work on space-related projects are seeking to improve the future of humanity
- Once we can cheaply transport people and cargo into space, the opportunities are vast:

Moon Colonies

https://www.nextbigfuture.com/2017/10/moon-colonization-many-lava-tube-caves-water-and-high-amounts-of-titanium.html

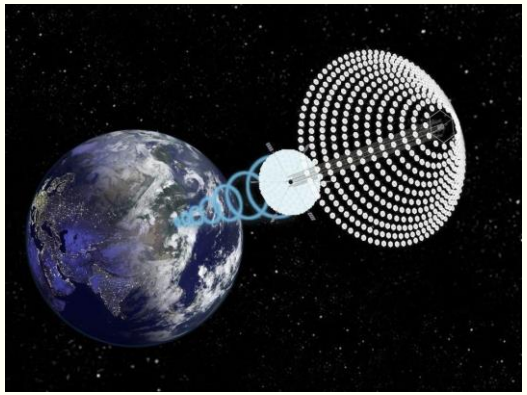
Space Colonies

https://lifeboat.com/ex/spacehabitats

Martian Colonies

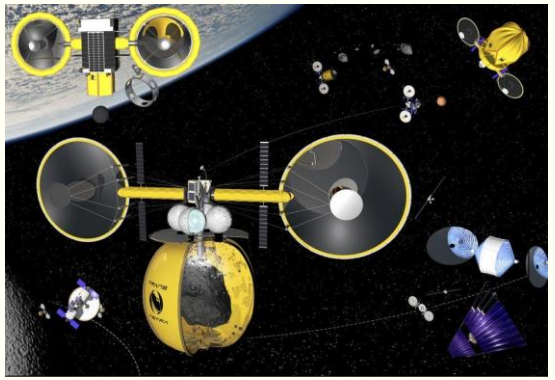
https://www.nasaspaceflight.com/2019/12/mars-colonization-new-water-map-hold-key-land/

Space Solar Arrays

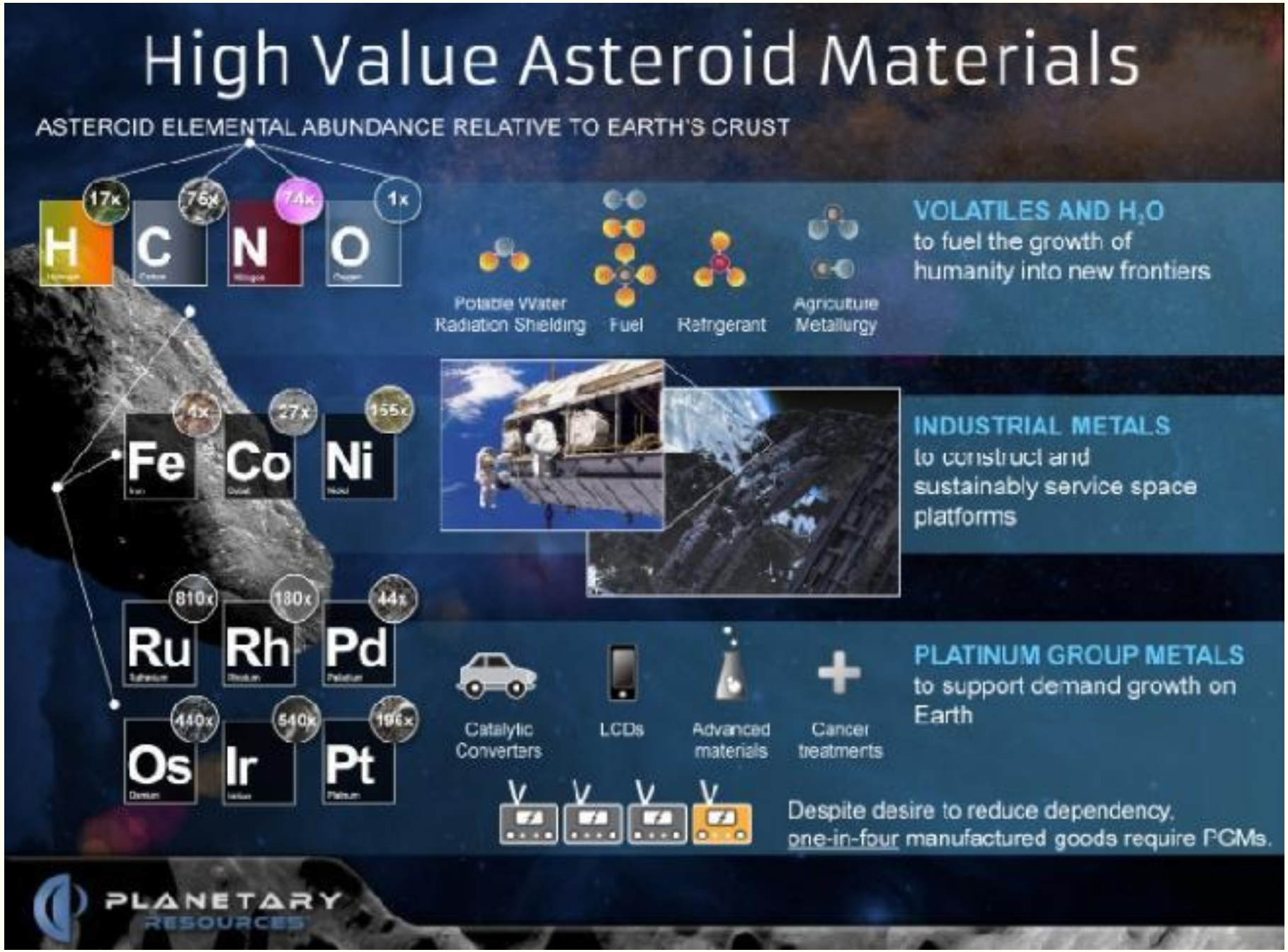


https://www.forbes.com/sites/scottsnowden/2019/03/12/solar-power-stations-in-space-could-supply-the-world-with-limitless-energy/#4bace6194386

Asteroid Mining



https://www.transastracorp.com/home.html



https://africanews.space/the-effect-of-asteroid-mining-on-mining-activities-in-africa/

Requirement #5: Exploring Space Exploration

5. Do TWO of the following:

   a. Discuss with your counselor 1) **a robotic space exploration mission** and 2) **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.

   List of NASA Space Missions: https://www.nasa.gov/missions

   b. Using magazine photographs, news clippings, and electronic articles (such as from the Internet), make a PPT presentation about a **current** planetary mission.

   List of Current planetary missions: https://www.planetary.org/explore/space-topics/space-missions/

   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.

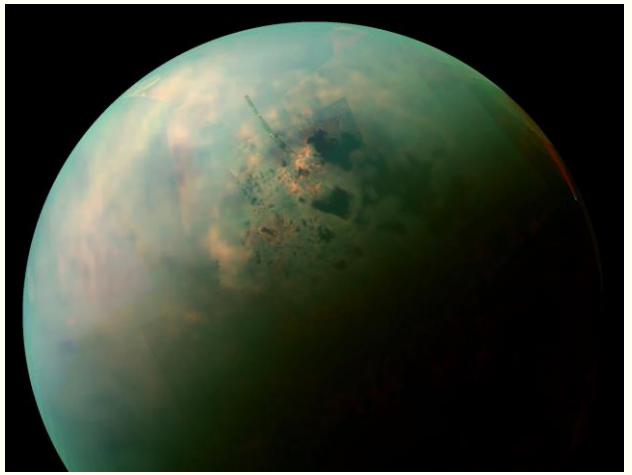
Requirement #7: Design an inhabited base **within** our solar system

Watch “The Martian”

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 (Environmental conditions, temperature, radiation, atmosphere)
    d. Purpose and function (Colonization, Mining, Scientific Study)

Our Moon

Mars



Titan (moon of Saturn)

Callisto (moon of Jupiter)

Destination: The Moon

Destination Specifications	Details
Distance from Earth:	238,900 miles
Length of a Day:	29.5 Earth days
Atmosphere:	None
Gravity:	0 g
Radiation conditions:	High
Temperature:	-280 °F (night side) to 260 °F (day side)
Precipitation:	Meteors showers
Weather:	None
Resources:	• Frozen water, regolith, solar power • Base metals: hydrogen (H), oxygen (O), silicon (Si), iron (Fe), magnesium (Mg), calcium (Ca), aluminium (Al), manganese (Mn) and titanium (Ti)

Destination: Mars

Destination Specifications	Details
Distance from Earth:	113.43 million miles
Length of a Day:	Similiar to Earth (24.6 hours)
Atmosphere:	95.32% carbon dioxide (CO_2), 2.7% nitrogen (N_2), 1.6% argon (Ar), 0.13% oxygen (O_2), 0.08% carbon monoxide (CO)
Gravity:	38% that of Earth
Radiation conditions:	Radiation is present; colony will need shielding
Temperature:	Ranges from -195 ˚F to ˚70 F depending on your location
Precipitation:	Snow made of carbon dioxide rather than water that create a fog effect
Other Weather:	Dust storms capable of blanketing the entire planet and lasting for months.
Resources:	Regolith, frozen carbon dioxide, frozen water

Destination: Titan (moon of Saturn, 2nd largest in our solar system)

Destination Specifications	Details
Distance from Earth:	907.12-1037 million miles
Length of a Day:	15.9 Earth days
Atmosphere:	Titan's lower atmosphere is primarily composed of 94.2% **nitrogen** (N_2), 5.65% **methane (CH_4)**, and 0.099% hydrogen (H_2)
Gravity:	14% that of Earth
Radiation conditions:	Radiation; safe for long-term occupancy
Temperature	-290 ˚F
Precipitation:	Rain of methane (rare)
Other Weather:	Clouds
Resources:	• Liquid rivers, lakes and seas of methane (CH_4) and ethane (C_2H_6) • Frozen water, liquid water under the water ice • Sand dunes • Nitrogen (N_2), methane **(CH_4)** and ammonia (NH_3) (can be used to produce fertilizer for growing food)

Destination: Callisto (moon of Jupiter)

Destination Specifications	Details
Distance from Earth:	447.61-928 million miles
Length of a Day:	16.7 Earth days
Atmosphere:	**Carbon dioxide (CO_2)** and probably molecular **oxygen** (O_2) as well as by a rather intense **ionosphere**
Gravity:	12% that of Earth
Radiation conditions:	Radiation; safe for long-term occupancy
Temperature:	-220 ˚F
Precipitation:	No known events
Weather:	No reported weather
Resources:	• Rocks, water ice, carbon dioxide, silicates, and organic compounds • Possible sub-surface ocean(s) 155 miles below the surface

DESIGN YOUR MANNED BASE

Break-out sessions

Design Teams & Objectives

Team 1

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

Moderators
Schlosser
Gregg

Team 2

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

Moderators
Myers
Cooper

Team 3

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

Moderators
Fountain
Pennington

Team 4

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

Moderators
Nemeth-Seay
Christ

Goals for today's Break-Out

- Create a **code name** for your design initiative
- Select one of the four **destinations** for your manned base
- **Review** the destination info sheet for your selected destination
- Determine the **purpose** of your manned base