GROUP 4:
CELINE HAMZE, SARA OSMAN, SULAGNA NANDI, SANIYAH FARZEEN, HEIDI WANG

PLANETARY EXPLORATION

McMaster University | School of Interdisciplinary Science

AGENDA

Hohmann Transfer Orbits

Solar System Analogue Mission

- Question & Experiment
- Liquid Water on Mars
- Landing Site

Mathematical Background

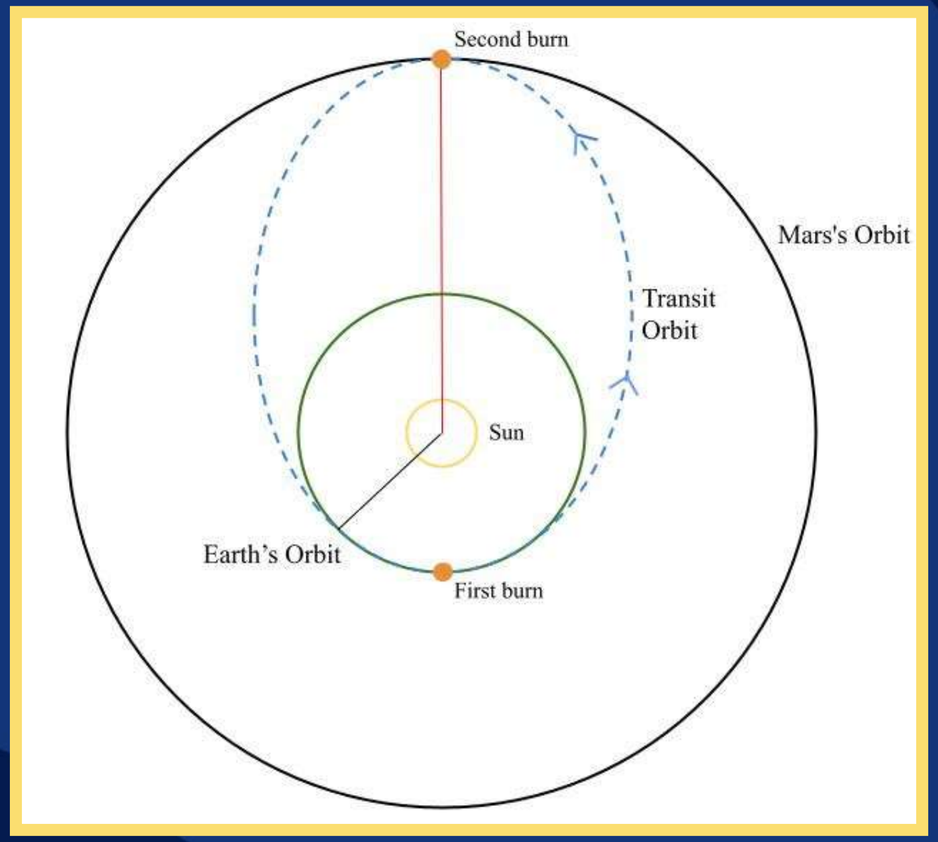
- Planetary Motion

Undergraduate Analogue Lab

Fun Fact!

HOHMANN TRANSFER ORBIT

- Most energy-efficient maneuvers for Interstellar transportation



(Wang 2024)

WINDOW OF OPPORTUNITY

- Mars must be 44° ahead of Earth in its orbit
- The satellite will take 0.715 Earth years In the transfer orbit
- SYNODIC PERIOD: 787 Days
- A full mission, including the return, will take 1039 days or 2.88 years

SOLAR SYSTEM ANALOGUE MISSION

MISSION OBJECTIVE AND EXPERIMENTS

Investigate Mars's Habitability

Objective: Assess if Mars could support microbial life by studying its environment and resources.

Focus on Extremophiles

Use Earth extremophiles, like halophiles that thrive in high-salinity conditions, as models for potential Martian organisms.

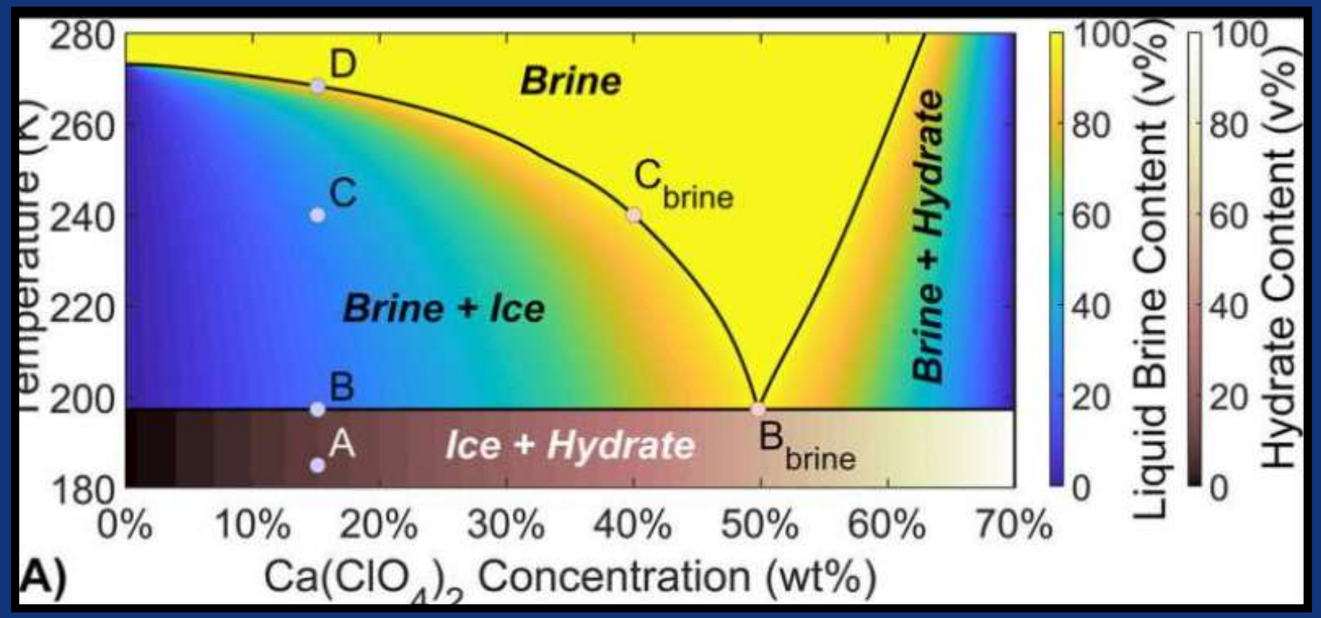
Key Experiments

Conduct brine detection, mineral analysis, and monitor temperature and radiation at chosen landing sites to explore conditions for life.

SOLAR SYSTEM ANALOGUE MISSION

LIQUID WATER ON MARS

Phoenix Lander (2008),
Martian Arctic:
Perchlorate salts

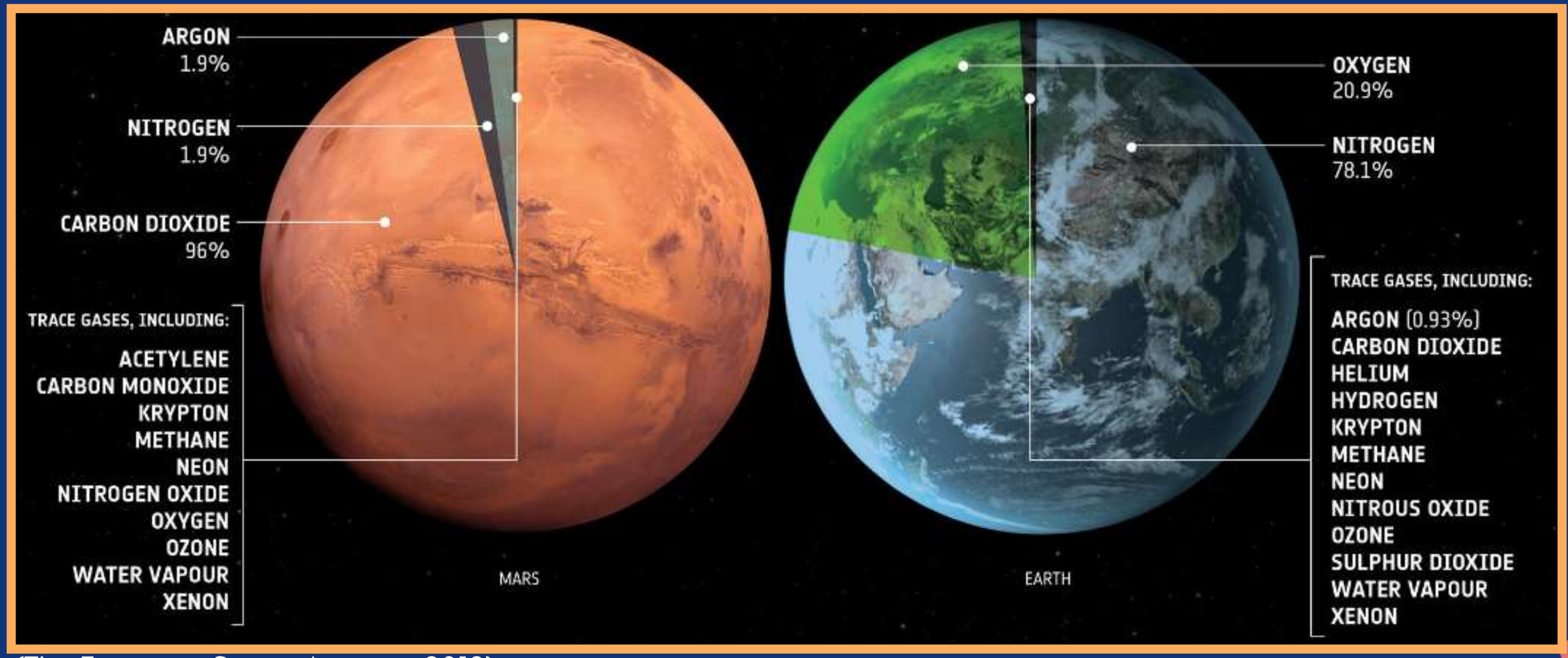


(University of Southern Queensland, 2022)

(Hess, 2018)

SOLAR SYSTEM ANALOGUE MISSION

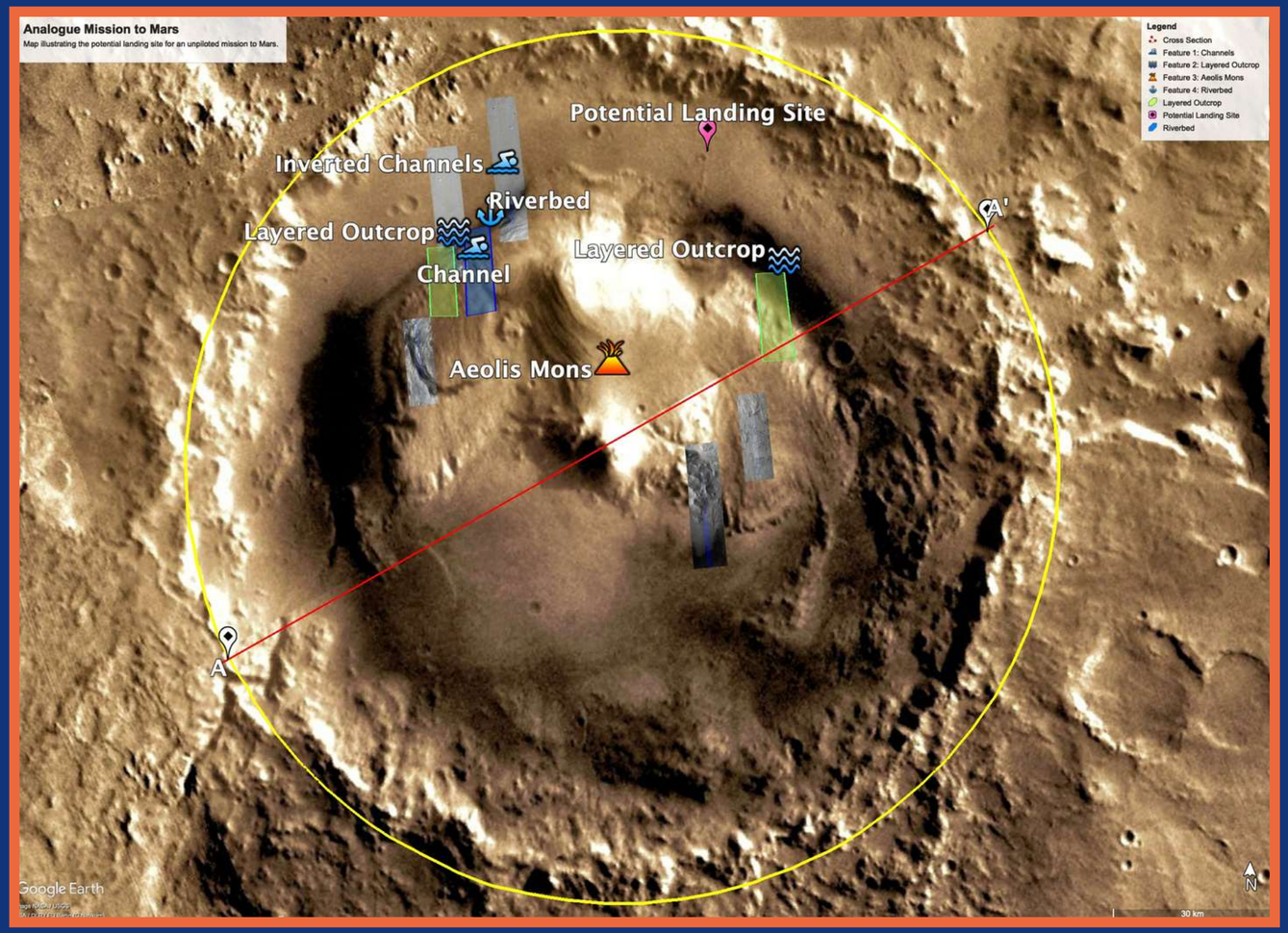
LIQUID WATER ON MARS



(The European Space Agency, 2018)

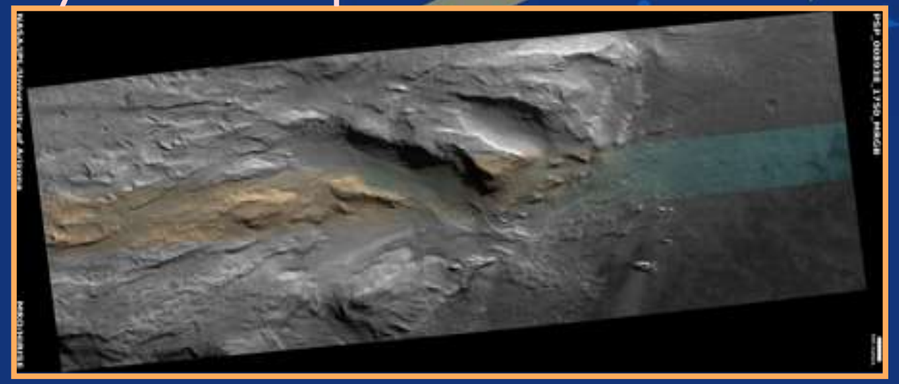
SOLAR SYSTEM ANALOGUE MISSION

LANDING SITE: THE GALE CRATER



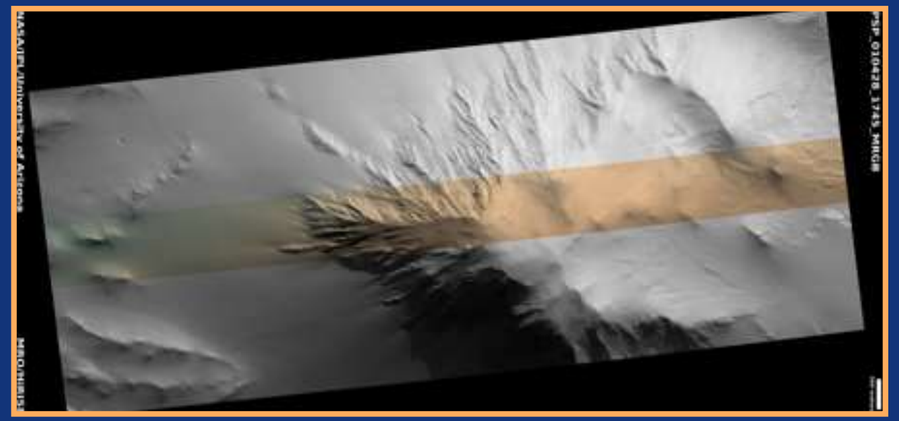
(Google Earth Pro 2024)

Layered Outcrops



(HiRISE 2008)

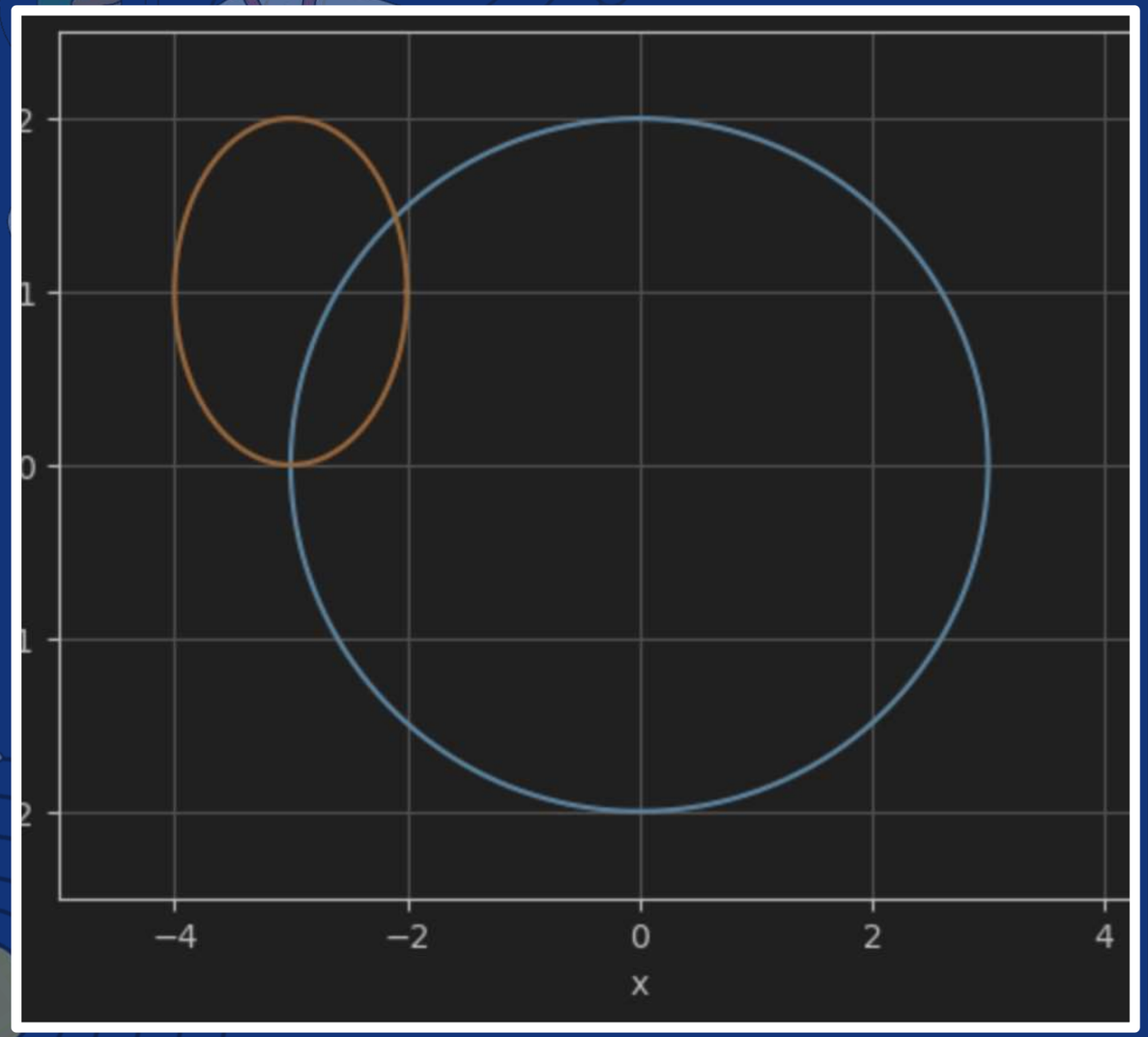
Aeolis Mons



(HiRISE 2008)

MATHEMATICAL BACKGROUND:

EXPLORING PLANETARY MOTION WITH PYTHON



Programming allows:

- automating large-scale calculations
- minimizing human error
- enabling the efficient analysis of vast datasets

Collisions

- Two particles: same place, same time
- Found time where distance was close to zero

Parametric Functions

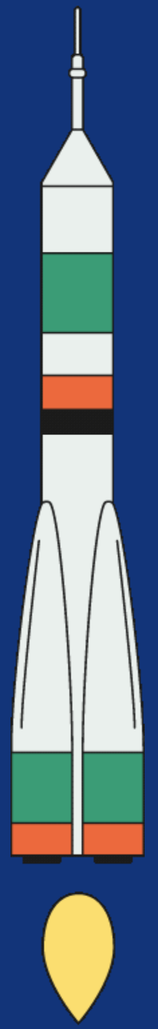
- Input is a parameter, usually time
- Output is a position

Polar Coordinates

- Input is an angle
- Output is a distance from the origin at that angle

UNDERGRADUATE ANALOGUE LAB

SUMMARY OF THE LAB EXPERIMENT

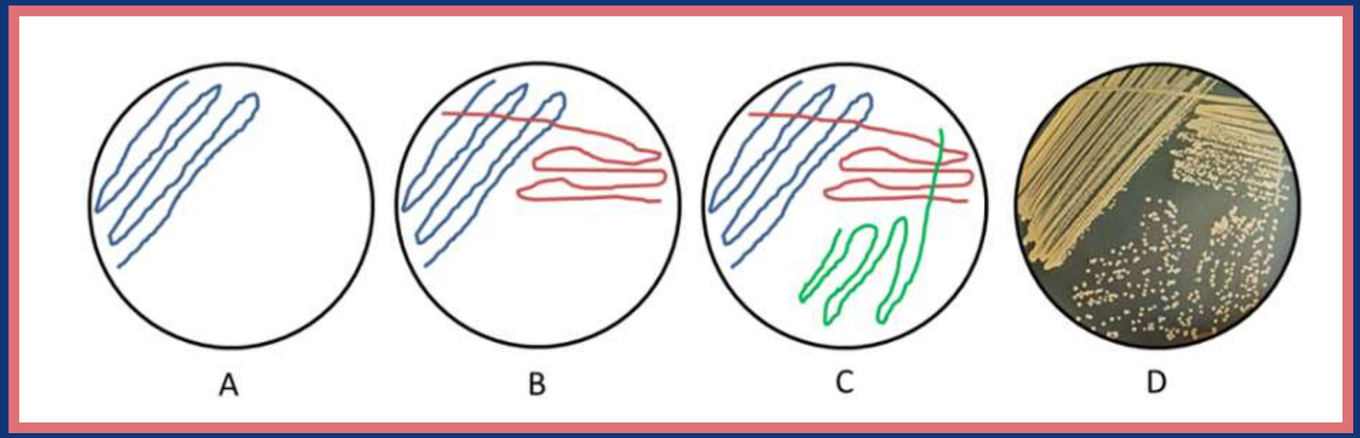


PURPOSE OF THE EXPERIMENT

- To investigate the survival of extremophiles (microbes that thrive in extreme conditions) under simulated Martian environments.

INDEPENDENT VARIABLES

- Salinity
- Temperature
- UV Radiation



(Ellis 2022)

Results from these analogue experiments guide the search for potential habitats and life signs on Mars.

FUN FACT!

Astronaut M. Scott Carpenter (NASA 2022)

View of Western Africa and the Atlantic Ocean (NASA 2022)

CONCLUSION

- Mars holds incredible potential for discovering life beyond Earth!

- Finding life beyond Earth would expand our understanding of life and challenge our Earth-centric view of it!


THANK YOU!