NASA Space Apps Challenge, 2023

# Project **StarPath**

*Local Event: Mahendragarh, India*

## Habitable Exoplanets: Creating Worlds Beyond Our Own

**Event**
Space Apps 2023

**Difficulty**
Beginner/Youth | Intermediate | Advanced

**Subjects**
Arts | Astrophysics | Climate | Earth | Planets & Moons | Space Exploration | Sun

Are we alone in the universe? To address this question, NASA's next flagship space telescope, the Habitable Worlds Observatory (HWO), will search for habitable planets beyond our solar system. What do you think these worlds will look like? Your challenge is to use publicly available information on habitable worlds to design your own habitable world and write about what life might be like on it.


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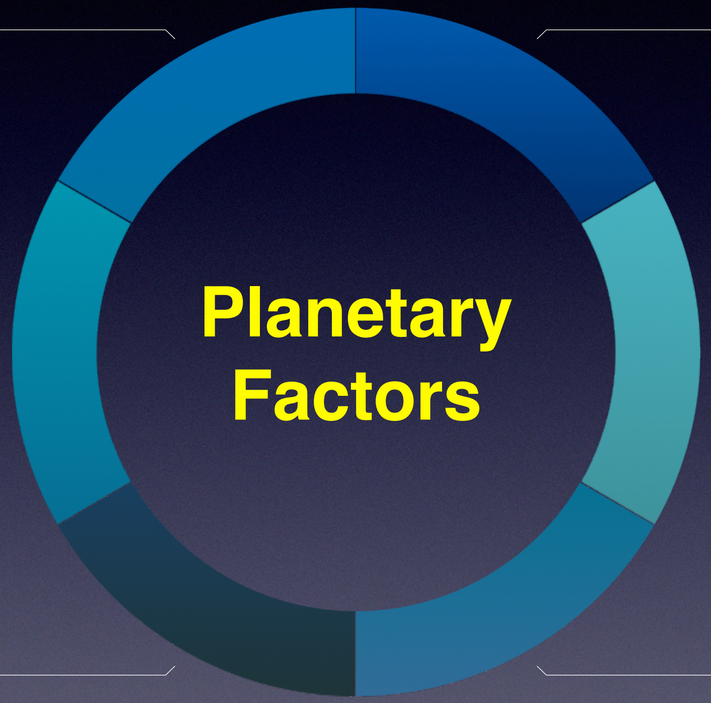
# Characteristics and parameters of the exoplanet




Life and Habitation

Planet type and mass

Geography, water, gases

Stellar Characteristics

Galactic orbit

Habitable Zone and Orbit

# Planet mass

- **Super-Earth** exoplanets have 1-10 times Earth's mass
- Our planet has a mass of ***1.35*** $M_E$
- Advantages:
  — tectonic plate activity, interior heating (longer core lifespan)
  — stronger magnetic field, protection from stellar radiations
  — thicker atmosphere retained for longer period
  — surface gravity tolerable by humans
  — allows for slightly wider habitable zone

- We downloaded data of first 100 planets (Earth itself excluded) from the ExoKyoto database, Super-Earth exoplanets category
- Average mass in dataset = 0.0146 $M_J$
- ***11%*** of super-Earth exoplanets have mass less than or equal to 0.0042 $M_J$ = ***1.35*** $M_E$ (upper limit)

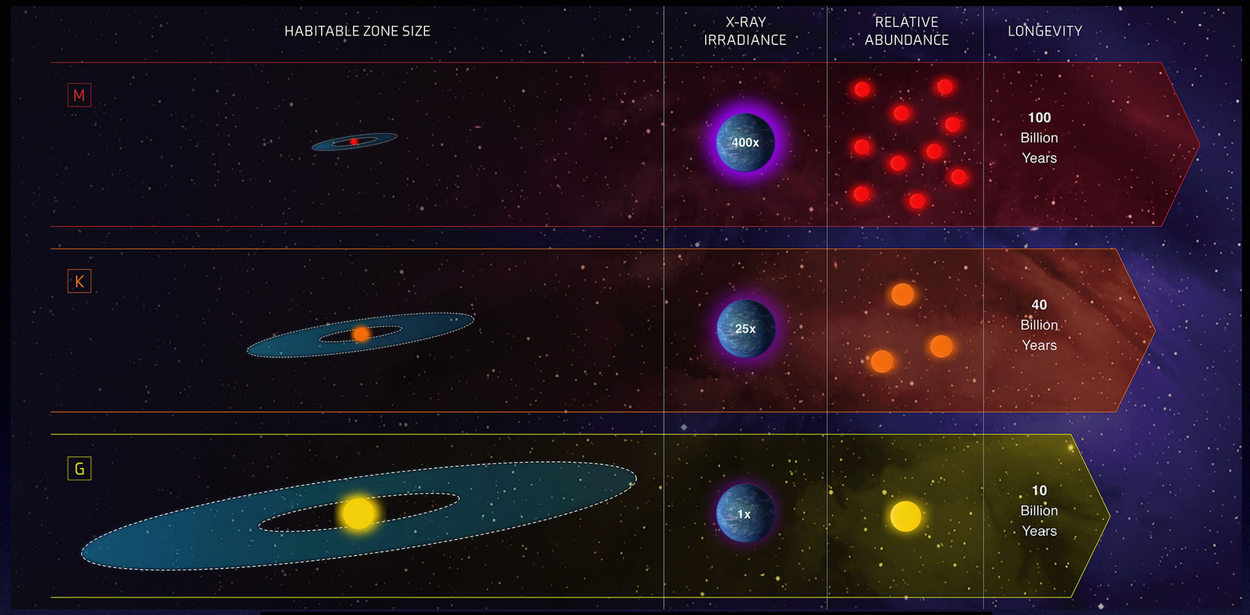
| No | Exoplanet's Name | Radius (Rjup) | Mass (Mjup) | Semi Major Axis (AU) | Eccentricity | Orbital Period (days) |
|---|---|---|---|---|---|---|
| 1 | AU Mic d | 0.0898 | 0.0032 | 0.0847 | 0.001 | 12.7381 |
| 2 | CD Cet b | 0.1284 | 0.0124 | 0.0185 | 0 | 2.2907 |
| 3 | CoRoT-24 b | 0.33 | 0.018 | 0.056 | 0 | 5.1134 |
| 4 | EPIC 201170410 b | 0.0934 | 0.0036 | 0.0349 | 0 | 6.7987 |
| 5 | EPIC 201238110 b | 0.167 | 0.0149 | 0.1346 | 0 | 28.1656 |
| 6 | EPIC 201757695 b | 0.081 | 0.0022 | 0.0296 | 0 | 2.0478 |
| 7 | EPIC 201833600 c | 0.089 | 0.0031 | 0.0416 | 0 | 3.9615 |
| 8 | EPIC 201841433 b | 0.093 | 0.0036 | 0.035 | 0 | 4.1698 |
| 9 | EPIC 205950854 c | 0.117 | 0.0082 | 0.0623 | 0 | 8.0507 |
| 10 | EPIC 206024342 b | 0.152 | 0.0136 | 0.0521 | 0 | 4.5076 |
| 11 | EPIC 206032309 b | 0.09 | 0.0032 | 0.0239 | 0 | 2.8781 |
| 12 | EPIC 206042996 b | 0.145 | 0.013 | 0.049 | 0 | 5.2971 |
| 13 | EPIC 206215704 b | 0.08 | 0.0021 | 0.025 | 0 | 2.2537 |
| 14 | EPIC 211939692.01 | 0.232 | 0.0202 | 0.1875 | 0.16 | 26.8549 |
| 15 | EPIC 211939692.02 | 0.232 | 0.0202 | 0.2428 | 0.06 | 39.553 |
| 16 | EPIC 212297394 b | 0.118 | 0.0084 | 0.0319 | 0 | 2.2894 |
| 17 | EPIC 212424622 b | 0.194 | 0.0171 | 0.1397 | 0 | 18.0983 |
| 18 | EPIC 212499991 b | 0.143 | 0.0129 | 0.2025 | 0 | 34.885 |
| 19 | EPIC 212587672 b | 0.1 | 0.0046 | 0.1185 | 0 | 15.2841 |
| 20 | EPIC 212737443 b | 0.231 | 0.0291 | 0.098 | 0.2 | 13.603 |
| 21 | EPIC 212737443 c | 0.24 | 0.0303 | 0.28 | 0 | 65.55 |
| 22 | GJ 15A b | 0.1199 | 0.0095 | 0.072 | 0.094 | 11.4407 |
| 23 | GJ 160.2 b | 0.1526 | 0.0245 | 0.079 | 0.02 | 9.7471 |
| 24 | GJ 163 b | 0.162 | 0.0311 | 0.06 | 0.02 | 8.6312 |
| 25 | GJ 163 c | 0.1516 | 0.0239 | 0.124 | 0.03 | 25.637 |
| 26 | GJ 163 f | 0.1474 | 0.0214 | 0.326 | 0.04 | 109.5 |
| 27 | GJ 176 b | 0.1533 | 0.025 | 0.066 | 0.08 | 8.7748 |

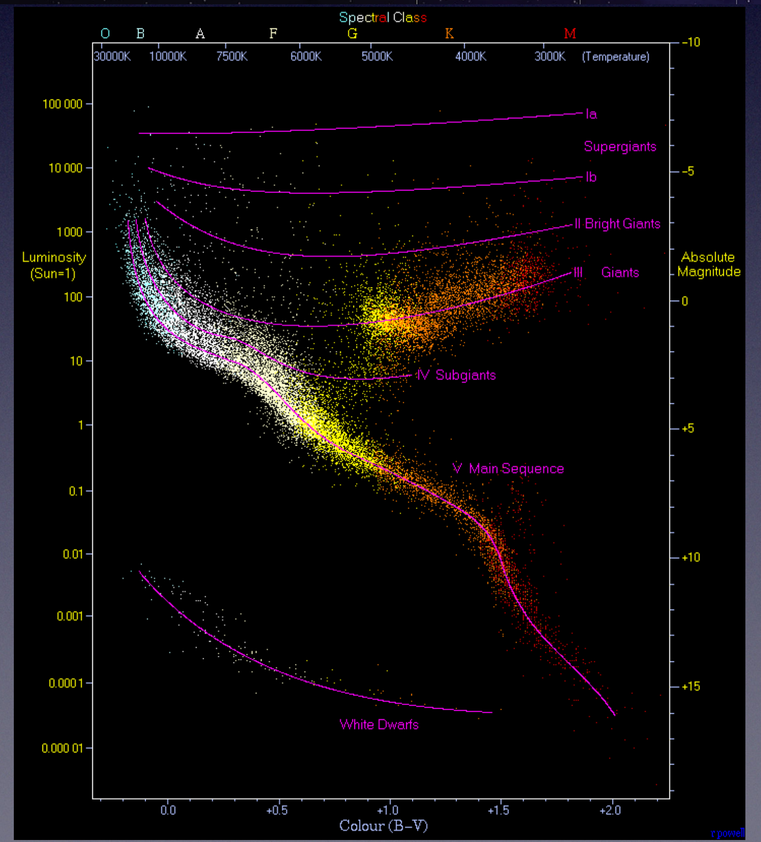
| AVG MASS (Mjup) | | |
|---|---|---|
| 0.01460505051 | ≈ | 0.0146 |

# Stellar type of host

- ***K-type main sequence*** stars (*orange dwarfs*) are the most ideal for harboring habitable exoplanets
- *Cooler* and less luminous than the Sun
- More *abundant* in the universe
- Superior *longevity*
- *Stable* stellar activity
- *Goldilocks zone* not too close to star's surface

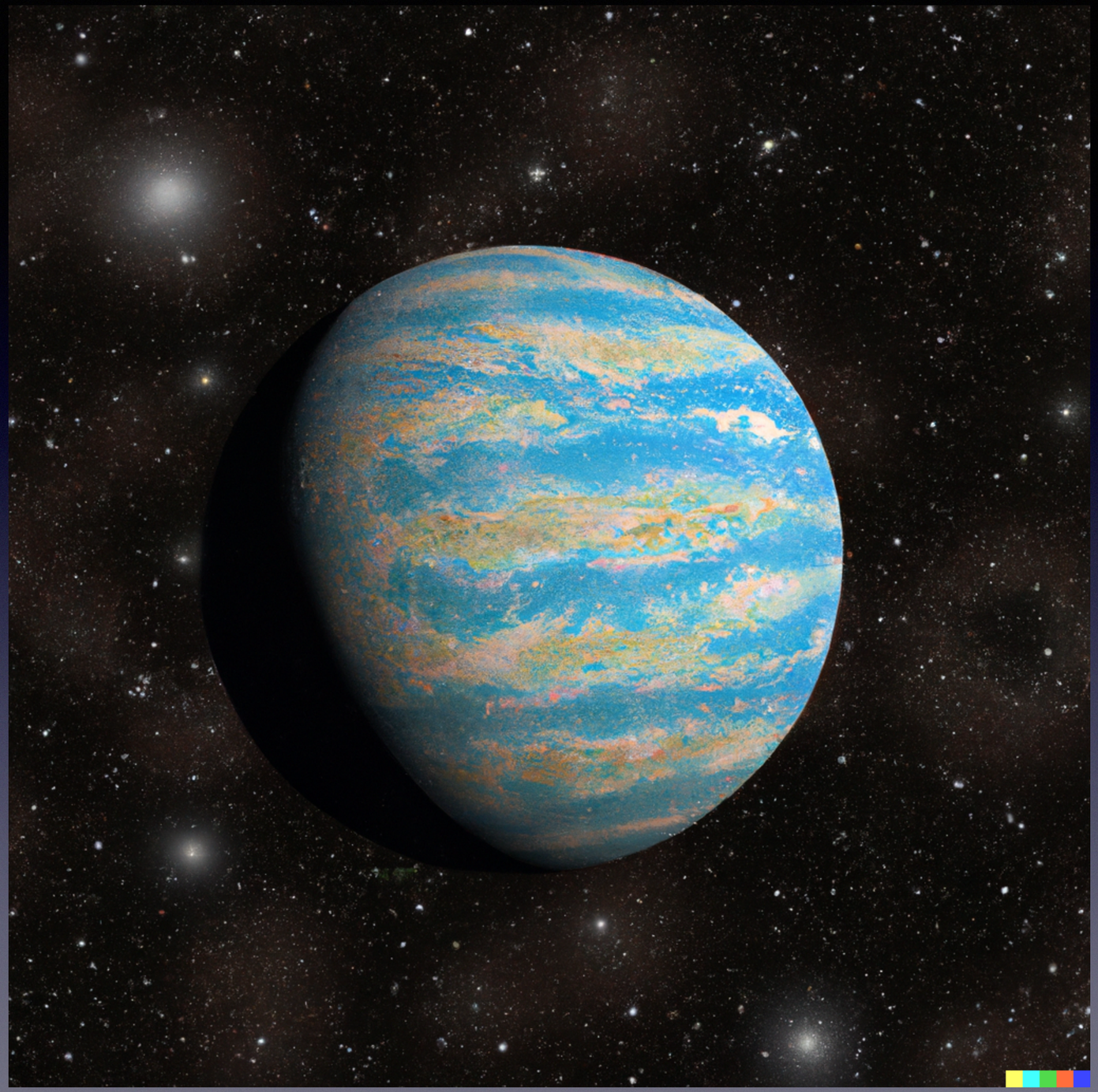
Habitable (Goldilocks) zone: region around a star where temperature is just right for liquid water to exist on the surface of an orbiting planet



# ***Asterion,*** our new home for humankind!

- As our planet contains large bodies of liquid water, we wanted to choose a name symbolising the eternal relationship between life and water
- Asterion is a river god in Greek mythology, and the name literally translates to ‘starry’. Rivers are the paths of water
- Due to this, the name of our planet being Asterion is directly linked to our team name, Project StarPath



An original AI render of the exoplanet *Asterion*

# Features of exoplanet *Asterion*

- Surface gravity of 1.35 *g*
- Very little axial tilt of 8°, therefore no noticeable seasonal variation
- Atmospheric composition
  N2=70%, O2=25%, CO2=3%, other=2%
- Average temperature of 293.15 kelvin
- Expansive shallow oceans cover most of the area between 40°N and 40°S
- Large volcanic and mineral-rich islands
- Mountain ranges in north, plains in south
- Vegetation divided into latitude-dependent biomes — tropics, plains, tundras
- Avian and ground-based higher organisms evolved, forming a complex ecosystem

# Thank you!

*May the Force be with you*

*A still from Star Wars*