Exploring Exoplanets
A bid to find Habitable Worlds
Religious Bias

- Beliefs blocking search for alien life
  1. Mankind is God’s prized creation
     - Geocentric Solar System
       ○ Heliocentrism proved by:
         ■ Copernicus, Galileo
  1. Counterintuitive to divine plan
     - Life solely due to Providence
       ○ Theory of Evolution due to:
         ■ Charles Darwin
- Importance of Scientific Thought
Looking for life in the Cosmos

- Life elsewhere might look very different
- What environments do we look for?
  - We know earth-like can support life
    - “Exoplanet” = planet orbiting star
  - Life-supporting criteria:
    1. Within the “habitable zone”
      - $0 \, ^\circ \text{C} < \text{surface temp.} < 100 \, ^\circ \text{C}$
    1. Stable host star
    2. Atmosphere
    3. Rocky surface
Types of Exoplanets

- Gas Giant
- Neptunian
- Super Earth
- Terrestrial
Gas Giants

• Largest exoplanet classification
  ○ Within our Solar System: Jupiter
  ○ Usually >/= the size of Jupiter

• Criteria for life:
  1. May orbit within habitable zone
  2. May have stable host star
  3. Unlikely to have atmosphere
  4. No rocky surface

**Conclusion:** Unlikely to support life
Example

47 Ursae Majoris b
- Gas Giant Exoplanet

Life-supporting criteria:
- 1. Habitable zone
- 2. Stable host star
- 3. Atmosphere
- 4. Rocky surface

* Star and planet not to scale
Neptunian

- Smaller than Gas Giants
- Within our Solar System: Neptune/Uranus
- Criteria for life:
  1. Few orbit within habitable zone
  2. May have stable host star
  3. Gaseous atmosphere made of:
     - helium, hydrogen, perhaps water vapor?
  4. Solid (not rocky) surface of:
     - water, ammonia, methane

**Conclusion**: Unlikely to support life
Example

- Neptunian Exoplanet

BD-06 1339
- stable, K-type star

Life-supporting criteria:
- 1. Habitable zone
- 2. Stable host star
- 3. Atmosphere
- 4. Rocky surface

* Star and planet not to scale
Super Earth

- Mass = 3 - 10 earth masses
- Not much is known about them
  - None in our Solar System
  - Large ones act as small Neptunians?
  - Small ones act as large Terrestrials?

**Conclusion:** May support life, depends on whether conditions are similar to a Neptunian or a Terrestrial world
Example

- Super Earth Exoplanet

LP 890-9
- stable, M-type star

Life-supporting criteria:
- ✔ 1. Habitable zone
- ✔ 2. Stable host star
- ❓ 3. Atmosphere
- ✔ 4. Rocky surface

* Star and planet not to scale
Terrestrial

- Mass: 1-0.5 earth masses
  - Within our Solar System: Earth, Mars...
- Criteria for life:
  1. Many orbit within habitable zone
  2. May have stable host star
  3. May have stable atmosphere
     - some certainly do
  4. All have rocky surface

**Conclusion:** Great potential for life as we know it!
Example

- Terrestrial Exoplanet

Life-supporting criteria:
- ✔ 1. Habitable zone
- ✔ 2. Stable host star
- ❓ 3. Atmosphere
- ✔ 4. Rocky surface

* Star and planet not to scale
What if nothing is out there?

- Drake equation considers 3 types of life:
  1. Civilization
  2. Intelligent Life
  3. Generalized Life
  - At least 1 world (Earth) is a civilization
    - Is it possible to have 1 civilization, 1 intelligent world, and 1 world supporting generalized life?
    - Or would we expect more worlds of simple life than complex?
In case of additional interest...

Link to full Honors Research Paper: https://docs.google.com/document/d/1jBrGQlOq69kx-_8P0jC3QKo89YsM8ccNv1tbdHde5_s/edit?usp=sharing


10 remarkable earth facts. ESA. (n.d.). Retrieved May 5, 2023, from https://www.esa.int/Applications/Observing_the_Earth/10_remarkable_Earth_facts
Thank You!

Questions?