Science of the Springs
Astrobiology in Yellowstone National Park
What is Astrobiology?

Astro:
stars, universe

+ Biology:
the study of life
  • New field of science: combines geology, biology, chemistry, astronomy

3 main questions
  • How did life begin?
  • Are we alone?
  • What is the future of life on Earth and beyond?
Yellowstone Hot Springs and Extraterrestrial Life: What’s the connection?

Environments as analogs

- Early Earth
- Extrasolar planets

Limits of life

- Habitability
- Extremophiles
Extremophiles

Tiny, extreme-loving microbes

• Bacteria & Archaea
• Microbes are found EVERYWHERE on Earth.
• Extremophiles when extreme!
• Yellowstone is one of the best places to study extremophiles.
• Variety and accessible
Where can we find life?

• exceedingly hot
• in below-freezing temperatures
• dry deserts
• very acidic
• deep underground
• at the bottom of the ocean
• other planets?
How is Yellowstone like early Earth?

- Around 3.5 billion years ago: only rocks, gases, water, and HOT temperatures
- First life to emerge: microbes
- Iron-sulfur compounds
Where in Yellowstone are scientists doing research?

- **Norris Hot Springs:** Acidic and Toxic Metals Similar to early Earth
- **Old Faithful:** No Oxygen or Light Methanogens
- **Grand Prismatic:** Photosynthetic Microbes Microbial Mats
- **Mammoth Hot Springs:** Limestone Biosignatures
Why are microbes so important to astrobiology?

- First life on Earth
- Relatively simple
- Very hardy

Images from: microscope.mbl.edu
What is habitability?

Where can life live?

- Habitability is the potential for an environment to develop and sustain life.
- Extremophiles broaden our definition of habitable.
- Determining habitability in the solar system and universe