

Office Hours: TBD

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## SYLLABUS

We on the cusp of finally *scientifically* answering the age-old question: "Are we alone?"

I. A quick review of elementary astrobiogeochemistry and ecological comparative planetology for non-majors

Starting with: A brief tour of our cosmos...

1. Our place in the universe: Our galactic supercluster, local companions and our own galaxy
2. Our solar system: In a habitable zone in a habitable galaxy
  - a) Oort cloud
  - b) Kuiper Belt
  - c) Planets, moons and asteroids
  - d) Our star!
3. Our blue planet: A life-sustaining atmosphere, ocean and a whole lot more
  - a) Internal structure (and how we know all this)
  - b) Plate tectonics - the unifying theory of geology
  - c) The carbon cycle - Earth's thermostat

II. Life on Earth

1. Linnaean Kingdoms, Woese Molecular Domains and concepts of cladistics
  - a) Zoology, mycology and botany basics
2. Cellular biology, biochemistry, molecular biology
  - a) DNA--> RNA--> protein: The Central Dogma of molecular biology
  - b) Deviations from the Central Dogma

### 3. Molecular microbiology

- a) Extremophiles - the key to understanding life as we *don't* know it...?
- b) Weird life right at home: Chemolithoautotrophy and other ways of life

### 4. Interdependence of biology and geology:

- a) How long would our oxygen last if all plants died?
- b) Where did our present atmosphere come from?
  - i.) Cyanobacteria: Earth's first mass polluters
  - ii.) Coccolithophores, corals and carbon dioxide: Secrets of climate control

## III. Life in the past and Earth in the past

### 1. Dinosaurs, Gorgonopsians and friends

- a) Synapsids, euryapsids, anapsids and diapsids - Holes in the head
- b) Past climates: Snowball Earth, Hothouse Earth and mass extinctions
  - i.) The Milankovitch cycles
- c) Mass extinctions: "The Big Five"
  - i.) Mechanisms
    - (1) The Ordovician, hypernovas and gamma ray bursts
    - (2) Bolides from above - The K-Pg ("K-T") extinction and the death of the dinosaurs
    - (3) Nemesis theory, galactic rotations and the Oort cloud killers
    - (4) The Permian extinction - the Siberian traps, CH<sub>4</sub> clathrates, a green sky, toxic fumes, anoxia and the mother of all extinctions
    - (5) An unsettling future:
      - {A} The death of our Sun
      - {B} The death of our dynamo (and the loss of our shields...)
      - {C} Where do we go from here?

## IV. A closer look at our Solar System

1. A tale of two planets: Our "sinister" sister and the Red Planet - where did they go wrong?

2. Moons galore!

a) Volcanism here and abroad (far abroad, *way* far abroad)

b) Life as we know it and as we don't know it (*really* don't know it)

i.) In this corner: Water, the undisputed universal solvent and the basis of life as we know and love it. And the challenger... from Saturn's moon Titan : Liquid methane!? Huh??

ii.) And for our main event... The reigning king of chemistry (who even has a whole course in his honor), the "element with all the bonds": CARBON! And the challenger, from the same Group in Mendeleev's Periodic Table (and of Star Trek Horta fame): SILICON!

3. Just how weird is our own Moon?

a) What if it weren't there? (Would Milankovitch have had a harder problem?)

b) Will it always be there?

c) Where did it come from? (Answers from Apollo!)

d) Would we be here if it weren't???

V. Chirality and the molecules of life

1. Meteors, minerals and the origin of life

a) More about extremophiles

i.) Black smokers, hyperthermophiles, acidophiles, radiophiles and "can a water bear survive a round trip to Mars without a space suit?"

VI. The Miracle Planet

1. Does the Fermi Paradox solve the Drake equation?

a) The "Copernican Principle" vs the "Rare Earth Hypothesis"

VII. The Kepler Mission, exoplanets and the search for another Earth

1. Detection of new worlds

2. Zeroing in on a place like home

3. Finding a suitable place for when the lights go out...

a) Are others doing the same thing right now?

b) Contact

i) Would super-intelligent aliens be friendly towards us?

{A} Lessons from history

{B} Lessons from Hollywood

Suggested Reading:

Required Viewing (will be provided):

The Andromeda Strain

War of the Worlds

Contact

Europa Report

2001: A Space Odyssey

Forbidden Planet

Alien

Jurassic Park

The Core

independence Day

Anticipated basis for grading:

1. One exam

2. One (or two) term papers

3 One seminar presentation ( vs two term papers)

4. Seminar participation/homework

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