

## ***EVOLVING WORLDS: Life from Anaerobes To Aerobes (“From slime to the sublime”)***

Principal Instructor: David Catling (dcatling@u.washington.edu).

Mon, Wed: 11am-12.20pm (lectures)

Th\*: 9.30am-10.20am (review of a recent paper from the literature)

\*Except for Th Oct 22: A 9.00am-10.20am lecture.

Location: Johnson Hall, Room 377 (QRC Library meeting room). 4 credits.

### **DESCRIPTION**

This course reviews the latest geological, biological and chemical research on the most significant times in Earth's history when life grew more complex and the atmosphere and oceans changed from anaerobic to oxygenated. We also discuss the comparative evolution of Mars, the concept of "Snowball Earth", relevant microbiology, bioenergetic change, and thermodynamic metrics concerning what life is and the detection of life.

<b>Wk</b>	<b>Wk start</b>	<b>Session</b>	<b>Faculty</b>
1		<b><i>Comparative Planetary Evolution</i></b>	
	10/5	I Volatile delivery to Earth & Mars	Don Brownlee
		II How do planets oxidize? Earth, Mars, Venus	David Catling
		III Research Paper Discussion: Mars vs. Earth oxidation.	
2	10/12	I Environments on Early Mars: A mineral perspective	Josh Bandfield
		II Hydrothermal systems and early life on Mars & Earth	John Baross
		III Paper review: Mars methane	
		<b><i>Atmospheric Change and “Snowball Earth” at 2.4-2.2 Ga</i></b>	
3	10/19	I O <sub>2</sub> evolution and Mass-Independent Isotope Fractionation (MIF) in Sulfur	Mark Claire
		II Research Paper Discussion: TBD?	
		III *Early evidence for photosynthesis	Roger Buick
4	10/26	I The Rise of Oxygen: Why and How Did It Happen?	David Catling
		II Organic Haze	Shawn Domagal-Goldman
		III Research Paper Discussion.	
5	11/2	I Paleoproterozoic Snowball Earth:	David Catling

## Provisional syllabus for Fall 2009

	II	Theory and Evidence	Steve Warren
	III	Research Paper Discussion: Snowball Earth or hailstorm of hype?	
6		<b><i>Evolution of Microbial Metabolism: From Anaerobes to Aerobes</i></b>	
11/9	I	Anaerobic Metabolism I: Methanogens	John Leigh
	II	<i>Veteran's Day Holiday – No Class</i>	
	III	Research Paper Discussion	
7		<b><i>Bioenergetics and Entropy in an Anerobic vs. Aerobic World</i></b>	
11/16	I	Anaerobic Metabolism II: Sulfate reduction	Dave Stahl
	II	Microbial photosynthesis	Jim Staley
	III	Research Paper Discussion	
8	11/23	I Oxygen, Metabolism, and the Size of Life	David Catling
	II	<i>Thanksgiving holiday – No Class</i>	
	III	<i>Thanksgiving holiday – No Class</i>	
9	11/30	I Entropy in Physics vs. Entropy in Information Theory; Relation to Life	David Catling
	II	Linking it all together: What is Life?	David Catling
	III	Research Paper Discussion	
10-11		<b><i>Student Paper Presentations</i></b>	

### GRADING:

Students should select a topic to review for a term paper by the end of Wk 5. This written paper will be marked and will also be presented orally by the student in Weeks 10 or 11.

During research paper discussions, students will be asked to present at least one research paper. This part of the course is graded to ensure good presentations.

Research Paper Discussion:	15%
Written term paper:	65%
Presentation of term paper:	20%

### SUMMER READING:

Reading that should be undertaken prior to the course:

- Andrew H. Knoll (2003) *Life on a Young Planet: The First Three Billion Years of the Evolution on Earth*, Princeton University Press (\$29.95)
- Erwin Schrodinger (1992) "What is Life?" in *What is Life? With Mind and Matter and Autobiographical Sketches*, Cambridge Univ Press (\$19). This general background to the nature of life is an old classic, originally published in 1944. Amongst other things, in this short essay, Nobel prizewinner Schrodinger first said that life must run on some kind of "code" like a computer program, i.e., he introduced the term "genetic code" to the English language. However, some scientists have criticized aspects of the essay, which we will discuss in the course.