

EPIC OF EVOLUTION: LIFE, THE EARTH AND THE COSMOS
Biology/Earth and Planetary Sciences/Physics 210A
Spring, 2008

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Class Meetings: MWF 1 - 2 PM, Crow Hall 204.

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Wysession (Geosciences 385, 5-5625, michael@seismo.wustl.edu)

Office Hours: Bernard: Mondays , 3 – 5 PM
Goodenough: Thursdays, 1 – 3 PM
Wysession: Tuesdays, 1 – 3 PM
Ditmer: Fridays, 2:30 – 3:30 PM in Monsanto 514
Hillier: Thursdays, 10 – 11 AM
Olsen: TBA

Website: http://epsc.wustl.edu/classwork/classwork_210a/

Course Description: The evolution of the universe, the Earth, and life, woven together. Themes of complexity, scale, energy and entropy applied to the Big Bang, We will also explore the implications of the epic for philosophy, religion, global polity, and environmental ethics.

Weekly Assignments: Each week you will be asked to complete 2 (roughly) one-page assignments, one of which we call the "Homework Question" and the other the "Evolutionary Narrative."

Homework Question: By Friday of each week, the lecturer for that week will hand out a question relating to the material in his/her lectures for that week. You are asked to turn in an answer to that question, no more than one page in length (double-spaced typing; it can be shorter), at the beginning of class on the following Wednesday. This assignment will be worth a maximum of 2 points, meaning that the cumulative number of possible points is 24 (of 100 for the course total). The first homework answer will be due Wednesday, January 30, and will be on the material in Weeks 1 and 2 of the course; **after that your answers to the homework questions will be due on the Wednesday of each week.**

Evolutionary Narrative: After each set of lectures, you are asked to turn in a work, usually of no more than one page, in which you present *or respond to* the scientific material of the previous week as a narrative. This can take many forms. For example, you might write a story as you would tell it to your mother or a younger sibling. You might choose to include your own feelings about the material from e.g. a philosophical or religious perspective. You might write it in prose or poetry, or include some fantasy or art (simple drawings fine!). The point is to give you the opportunity to take what you have heard the previous week and work with it. The 12 narratives will be graded largely on a pass-fail basis: We plan to give full credit (2 points) for every reasonable, on-time effort. (Last year, approximately 70% of the narratives fell into this category). However we reserve the right to give a grade of 0 or 1 for work that shows little or no evidence of thought or effort, and to give up to 3 points for work that is especially interesting or creative. The first narrative (on the first unit, Weeks 1 and 2) will be due on Monday, January 28. **After that, narratives will be due each Monday and should be based on the previous week's lectures.**

Late Policy: we will subtract 1/2 point per day for late responses and narratives.

Course Requirements and Grading:

Homework Questions (2% for each assignment)	24%
Narratives (2% each)	24%
Midterm exam (Wed., March 5, in class)	20%
Final Exam (Wed., May 7, 1-3 PM)	32%

Note: for those taking the course pass/fail, a grade of C- or better will be required to pass.

Required Textbooks:

Bryson, Bill
A Short History of Nearly Everything,
Broadway, 2003.

Goodenough, Ursula,
The Sacred Depths of Nature,
Oxford University Press, 1998.

Rue, Loyal,
Everybody's Story: Wising up to the Epic of Evolution,
State University of New York Press, 2000.

In addition to the above required texts, the following books are on two-hour reserve in the Biology Library (Life Sciences Building, Levels 2 and 3):

Rees, Martin,
Just Six Numbers.
Basic Books, 2000.

Officer, Charles and Page, Jake,
Tales of the Earth: Paroxysms and Perturbations of the Blue Planet,
Oxford University Press, New York, Oxford, 1993.

Press, Frank, and Siever, Raymond
Understanding Earth,
W. H. Freeman and Co., New York, 1998

Davidson, Jon, Reed, Walter, and Davis, Paul
Exploring Earth, 2nd edition,
Prentice Hall, 2001

De Waal, Frans
Our Inner Ape,
Riverhead Trade, 2006

Carroll, Sean,
Endless Forms Most Beautiful,
Norton, 2005.

SCHEDULE OF LECTURES

THE COSMOS AT A GLANCE (Bernard) Weeks 1 and 2 (Jan. 14 - 25)

A brief guide to the universe; Olber's paradox and the Doppler effect; an introduction to electromagnetic waves and elementary particles; a narrative history of the big bang.

Reading: Bryson, Introduction, and Chapters 1, 2, and 8.

Goodenough (TSDON), Chapter 1.

Rue, pp. 47-64; also (for class discussions and overview) pp. ix -43.

Note: Bernard's lectures from 2000 are on the web. There are some significant differences with the current treatment, but many aspects are quite similar. The transcribed lectures may be useful for clarification of points you did not understand in class, or for review for exams. You are not required to read them, however, and are not responsible for material covered in them that is not also covered in class or in assigned reading.

HEAT AND GRAVITY (Wysesession) Week 3 (Jan. 28 - Feb. 1)

The creation of the solar system, the formation of the Earth and Moon, and the internal heat-driven motions within the Earth.

Reading: Bryson, Chapters 4, 5, and 10.

EVOLUTIONARY HISTORY AND THE ORIGIN OF LIFE (Goodenough)

Week 4 (Feb. 4 - 8)

A walk back through evolutionary time and a plausible nonlife-to-life scenario that lifts up what being-alive entails.

Reading: TSDON, Chapter II
Bryson, Chapters 19, 20

Note: Powerpoints of Goodenough's 2008 lectures will be on website for review.

MICROCOSM AND MACROCOSM (Bernard) Week 5 (Feb. 11 - 15)

The four fundamental forces; the formation of galaxies and quasars; the birth of stars; thermonuclear processes; hydrogen and helium "burning" in stars.

Reading: Bryson, Chapters 7, 9, and 11.
Weinberg, "A Designer Universe?", and "A Designer Universe?: An Exchange," on web.

EARTH FORCES (Wysession) Week 6 (Feb. 18 – Feb 22)

Plate tectonics and the formation of continents, mountains, and oceans through plate motions.

Reading: Bryson, Chapters 12 and 13.

HOW SINGLE-CELLED ORGANISMS EVOLVE (Goodenough)

Week 7 (Feb. 25 - 29)

Generation, variation, and selection of simple biological traits, with a focus on cellular awareness.

Reading: TSDON through Chapter VI
ES through part I
Bryson, Chapters 21-23

MIDTERM EXAM: Wednesday, March 5

EARTH MATERIALS (Wysession) Week 8 (March 3 - 7)

The chemistry of rocks and minerals, including the results of melting, freezing, and squeezing rocks.

Reading: Bryson, Chapters 7 (review) and 14.

SPRING BREAK: March 10 - 14

STELLAR EVOLUTION (Bernard) Week 9 (March 17 - 21)

Red giants and white dwarfs; creation of heavy elements; supernovae and pulsars.

Reading: Bryson, Chapter 3; also reread Chapter 9.

HOW MULTICELLULAR ORGANISMS EVOLVE (Goodenough)

Week 10 (March 24 -28)

Embryos, brain-based awareness, sex, and death.

Reading: TSDON through chapter IX.

ES through part II.

Bryson, Chapters 24-25.

CURVED SPACE (Bernard) Week 11 (March 31 – April 4)

Maps and globes; Einstein's General Relativity; black holes; the shape of the universe and how it is determined.

Reading: Bryson, reread Chapters 3, 8 and 11.

Auden, "After Reading a Child's Guide to Modern Physics," on web.

WATER (Wysesession) Week 12 (April 7 - 11)

The shaping of the surface of the Earth through motions of water and ice; erosion, transportation, and deposition of rock; climate.

Reading: Bryson, Chapters 17, 18, and 27.

HUMAN EVOLUTION (Goodenough) Week 13 (April 14 - 18)

The primate lineage and the co-evolution of human brains, language, and culture.

Reading: complete TSDON and ES.

Bryson, Chapters 27-30.

REVIEW and SPECULATION Week 14 (April 21 - 25)

What Is The Universe Made Of? (Bernard) April 21

Any More Earths Out There? (Wysession) April 23

Human Nature in a Planetary Context (Goodenough) April 25

Reading: Bryson, Chapter 16.

FINAL EXAM: Wednesday, May 7, 1-3 PM