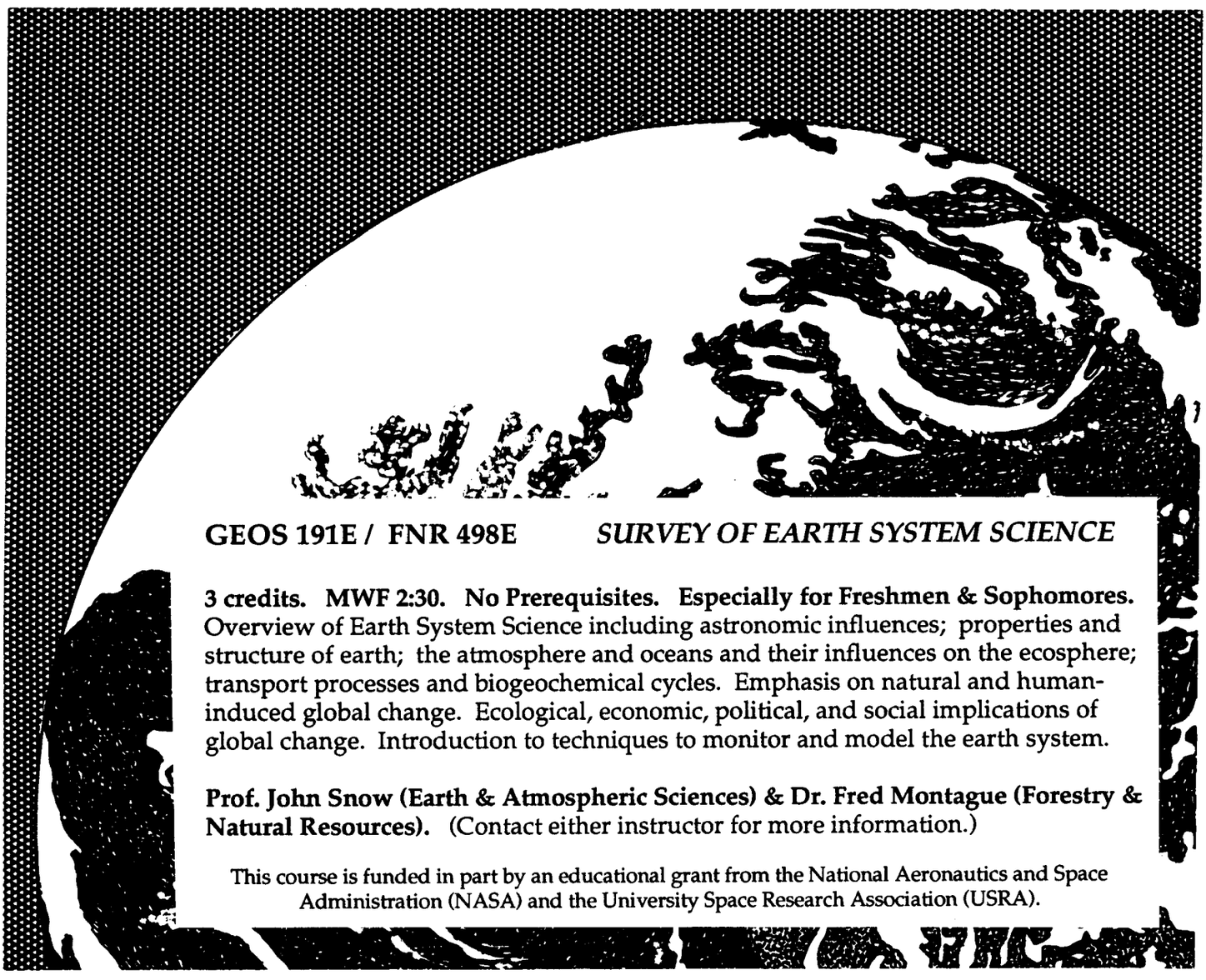
HOME PLANET

A new course for fall 1992

How much do you really know about your home?
Want to know more about global change?
Concerned about ozone depletion and global warming?

HERE'S A NEW COURSE TO MAKE YOUR COLLEGE MAJOR MORE ENVIRONMENTALLY-RELEVANT.



GEOS 191E / FNR 498E ***SURVEY OF EARTH SYSTEM SCIENCE***

3 credits. MWF 2:30. No Prerequisites. Especially for Freshmen & Sophomores. Overview of Earth System Science including astronomic influences; properties and structure of earth; the atmosphere and oceans and their influences on the ecosphere; transport processes and biogeochemical cycles. Emphasis on natural and human-induced global change. Ecological, economic, political, and social implications of global change. Introduction to techniques to monitor and model the earth system.

Prof. John Snow (Earth & Atmospheric Sciences) & Dr. Fred Montague (Forestry & Natural Resources). (Contact either instructor for more information.)

This course is funded in part by an educational grant from the National Aeronautics and Space Administration (NASA) and the University Space Research Association (USRA).

Lecture 1 Revised: 19 August 1993

GEOS 191E/FNR 498E

SURVEY OF EARTH SYSTEM SCIENCE

ROOM 2118 CIVL

COURSE OUTLINE AND READINGS

Fall 1993

Instructors: C = Coles
H = Harshvardhan
S = Snow

Day/Date	Period	Instr	Subject
			COURSE INTRODUCTION
M 23 AUG	1	S,C	**Course Administration. Course Outline And Readings. Guidance And Instructions For Short Paper Preparation. Course Goals.** Review **Notes On The Philosophy Of Science.** Read p. 9-20 in course text.
W 25	2	S	**Overview Of Earth Systems Science - I.** The structure of the Earth System - earth, water, air, life. Read p. 31-56 in course text. + space scales
F 27	3	C	**Overview Of Earth Systems Science - II.** The constantly changing Earth: time ~~and space~~ scales; the geologic and fossil records. Continue reading p. 31-56 in course text.
M 30	4	S	**Overview Of Earth Systems Science - III.** Cycles and feedbacks; residence times. Example: The Hydrologic Cycle. Read p. 57-62 in course text.
W 1 SEP	5	S,C	**Observing The Earth System.** Satellites -- polar and geosynchronous; GOES, TIROS-N, LANDSAT, EOS; the "Earth Observing System". Video: Frank Eden of Martin Marietta on satellite design.

Day/Date	Period	Instr	Subject
			THE EARTH SYSTEM
F 3 SEP	6	S	**Formation And Evolution of the Earth System - I.** Solar and planetary formation and evolution; differentiation, outgassing. Read Chap. 4.
M 6			Labor Day -- University Holiday
W 8	7	C	**Formation And Evolution of the Earth System - II.** Formation of Earth's atmosphere and oceans; the appearance of life and its role in atmospheric formation -- stromatolites, photosynthesis, and free oxygen.
F 10	8	S C	**Practical Astronomy I - The Earth In Space.** The solar system; Earth's present orbit around the Sun; seasons; sunlight received at the top of the atmosphere as a function of latitude and time of year; the habitable zone. **External Forcing: Short- and Long-Wave Radiation.** Global energy balance; excess at the equator/deficit at the poles; water vapor - the greenhouse gas; other greenhouse gases.
M 13	9	S	**Practical Astronomy II - Variations In Earth's Orbit Over Long Time Scales.** The cyrosphere - present and past; long term modulation of the radiation budget; changes in eccentricity; precision and nutation; Milankovitch cycles and the ice ages. Final day for selecting topic for **First Short Paper.**
W 15	10	C	**Internal Forcing: The Interior of the Earth System.** Core and mantle processes; heat generation; convection.
F 17	11	C	**A Very Long Time Scale, Planet-wide Process: Plate Tectonics I.** Drifting continents and wandering poles - glacial and fossil evidence; Pangea and its breakup; evolution of the continents and the ocean basins; the plated structure of the Earth's surface.
M 20 SEP	12	C	**Plate Tectonics II.** Seafloor spreading, mountain building; the "Ring of Fire"; earthquakes, faults, and volcanoes; ties between plate tectonics and climate.

Day/Date	Period	Instr	Subject
W 22	13	S/H	**Transport Processes - I.** Earth's fluid envelopes: water and air; structure of the oceans; the global current systems; storage of heat in the oceans; structure of the air; the global wind patterns; relative time scales in the oceans and air.
F 24	14	S	**Transport Processes - II.** Structure of the Earth's atmosphere and oceans; their role in maintaining the climate; the poleward transport of heat, moisture, and angular momentum. **First Short Paper** due.
M 27	15	S	**Overview Of Three Biogeochemical Cycles: Water, Carbon, Nitrogen.** Reservoirs, organisms, environment and chemical changes. Read Chap. 6.
W 29	16	S	**The Hydrologic Cycle, Revisited.** Water in the air, in the earth, in the oceans; in the cryosphere; fresh water versus salt water; natural and human influences.
F 1 OCT	17	C	**The Carbon Cycle.** The role of life; sources and sinks; burning of fossil fuels; forest clearing and agriculture; plankton; recycling of surface material - the rock cycle (carbonate - silicate biogeochemical cycle). H/O: Sarmiento article on carbon cycle in the ocean.
M 4	18	?	**Ecosystems I.** Introduction to biomes; the oceans; ocean currents and upwellings; fisheries; phytoplankton - physical and biotic characteristics. Read Chap. 5.
W 6	19	?	**Ecosystems II.** The land; forests, grasslands and deserts - low, middle and high latitudes; physical and biotic factors.
F 8	20	?	**Ecosystems III.** Arctic tundra and Antarctica; physical and biotic factors.
M 11 October Break			No Class/University Holiday
W 13 OCT	21	C	**Climatic Response I: Short time scale response - Sunspots (Or The Lack Thereof) And The Little Ice Age.** Read Chap. 7.

Day/Date	Period	Instr	Subject
F 15	22	S H	**Climatic Responses II.** Volcanoes and short term climate; 1816 - the "year with no summer" (Tambora); Krakatoa; Pinatubo. Final day for selecting topic for **Second Short Paper.**
M 18	23	S	**Climatic Responses III.** El Nino/El Nina and droughts, floods, forest fires and fisheries.
W 20	24	C,S	**Mid-Term Examination.**
F 22	25	C,S	**Review And Critique Of Mid-Term Examination.**
			MODELING THE EARTH SYSTEM
M 25	26	S	**Lovelock's Daisy World - A Radiative Equilibrium Model.** Introduction to models and modeling; the parable of Daisy World. Read p. 62-72 in Chap. 2.
W 27	27	H	**Modeling The Earth System I.** Land-air-ocean interactions; near-term climate change; the need for coupled models.
F 29	28	H	**Modeling The Earth System II.** Predictions for the future; model sensitivity. **Second Short Paper** due.
M 1	29	H	**The Role(s) Of Clouds In Climate And Climate Change.** Complex feedbacks.
			HUMANS AND THE EARTH SYSTEM
W 3 NOV	30	S	**The Greenhouse Effect.** Carbon dioxide and other trace gases; the role of water vapor, the real "greenhouse" gas; evolution of the greenhouse effect and the resolution of the Faint Young Sun Paradox.
F 5 NOV	31	S	**The Enhanced Greenhouse Effect I: Where Are We Going And How Do We Know?** Trends in carbon dioxide and other trace gases; observations of CO_2 from Hawaii. Chap. 3 (All).

Day/Date	Period	Instr	Subject
M 8	32	S	**The Enhanced Greenhouse Effect II.** Geophysical and biological impacts; sea level change; effect on plant growth; increased respiration.
W 10	33	S	**Ozone In The Atmosphere.** Ozone chemistry; sources and sinks; transport processes; the shielding effect of the ozone layer; ozone near the surface; the role of atmospheric dynamics; the appearance of oxygen, ozone, and life in Earth history.
F 12	34	S	**The "Ozone Hole" I.** Stratospheric ozone; CFCs and the formation and destruction of ozone in the stratosphere; surface chemistry in stratospheric clouds; the role of atmospheric dynamics.
M 15	35	H	**The "Ozone Hole" II: Observational Evidence.** Dobson and TOMS measurements; the Antarctic ozone hole; differences between the southern and northern hemisphere; global decline in stratospheric ozone; NASA global ozone video.
W 17	36	?	**The "Ozone Hole" III: Biological Impacts Of Increased UV At Surface.** Observational evidence; impacts on agriculture, human health, and biodiversity; the Montreal Protocol; what the future may hold. Final day for selecting topic for **Third Short Paper**.
F 19	37	?	**Human Impacts On The Earth System I.** Population and urbanization; human conversion of natural ecosystems and impacts on Earth's energy balance. H/O: Anthes' paper.

Day/Date	Period	Instr	Subject
M 24	38	?	**Human Impacts On The Earth System II.** Energy generation and use; impacts on the carbon cycle and atmospheric chemistry.
W 24 Thanksgiving			University Holiday
F 26 Thanksgiving			University Holiday

M 29	39	?	**Human Impacts On The Earth System III - Large and Small.** Agriculture; irrigation; desertification; deforestation.
W 1 DEC	40	?	**Human Impacts On The Earth System IV.** Summary. Humans, technology and culture -- a new geological force. **Third Short Paper** due.
F 3	41	?	**Global Change I.** Maintaining biological diversity; impacts of tropical deforestation.
M 6	42	?	**Global Change II.** The challenge of resource management; stewardship of the Earth.
W 8	43	C	**A Critical Analysis -- The Gaia Hypothesis.** The Earth as a self-regulating system; homeostasis; negative feedback and natural selection. Read Chap. 1.
F 10	44	C,S	**Course Summary.** How the world works!
M-F 13-17 DEC		C,S	**Final Exam.** (Time/place to be announced)

Survey Course

Drs. Chaney, Harshvardan and Ogg (and formerly Dr. John Snow, now a dean in Oklahoma) taught the Survey course "Home Planet" during the Fall of 1994. Enrollment was still rather small (probably because such development courses are not listed in the regular course catalog), but our new topic-oriented module approach seemed to work quite well. The Survey course will now be hosted by the Department of Forestry and Natural Resources as "FNR 103 Introduction to Environmental Concerns", in which we have merged our earlier "Survey of Earth Systems" course and their existing environmental course. As part of this merger, we will incorporate a range of climate-geology-ocean feedback presentations and an overview of ecosystem responses. We anticipate an enrollment of about 100 students, based upon the combined enrollment of the two base courses. We may dual-list this course as "FNR/Atmos" to reflect the new orientation.

One recommendation from our experience in teaching an Earth Systems Survey course during the past 3 years is that non-science students often lack a breadth of general knowledge about the world. For this audience, we first tried to present an extensive background before we rose to the level of actual understanding of major geo-atmos-bio feedbacks. However, this type of course tended to resemble a traditional Earth Science course that is taught in high school -- and a significant portion of our audience had already had such a course and promptly "fell asleep". Earth Systems courses should not be a general Earth-Atmosphere science course -- an overview approach being taken by some new textbooks on "Earth Systems".

Therefore, we decided to reduce the overview approach, and just develop a few selected topics in depth that would illustrate some major workings of the Earth System. For the 1994 course, we concentrated on (1) the Greenhouse and Carbon Cycle, using radiation balances, Stella model exercises, and case examples from the geological record. (2) Mass Extinctions of Life, which shows possible scenarios from rapid climate change, astronomic and volcanic effects, and oceanic disruptions, which also gave more examples of the previous carbon cycle module, and (3) Ecosystem-Climate feedbacks. Some additional single-wee excursions included Ozone and El Niño.

The 1995 Fall course will concentrate on the Ecosystem-Climate system, but with examples of long-term influences on "Gaia" and evolution by geological and oceanographic processes.