FURMAN UNIVERSITY Course Proposal

Author Name: Nicholas Schisler
Position and Department: Assistant Professor, Biology
Type of Proposal: Revisions to a current course

Course Identifiers

Discipline Prefix: SCI
Two-digit Course Number: 17
Catalog Title: Earth: A Living, Changing Planet
Suggested Title for the Transcript: Earth: A Living, Changing Planet

Catalog Description

Major discoveries and controversies in biology / earth science are analyzed with reference to their history, scientific basis, public perception, and impact on planet earth.

When will the first offering of the revised course occur (term and year): Spring 2009

Number of credits proposed for the course: 4

Departmental Information

Enter the specific prerequisites to the proposed course:

SCI 16 “Mission to Mars.” SCI 16 and SCI 17 are linked courses.

Enter a brief description of the relationship the course will have to the sequence of courses in your department. (Include or describe any overlapping content with other courses):

None; this is an interdisciplinary non-majors science course. This course has as a pre-requisite SCI 16 "Mission to Mars." Furthermore, SCI 17 is designed to complement and be a continuation of SCI 16, since SCI 17 studies our planet as a 'life-support" system for our species. In place of a semester long project involving the entire class, students will work in small groups on topics of their choice related to the overall theme of the course.

Enter a list of course topics and the approximate percentage of time in the semester you expect to spend on each topic: TOPIC TIME

***indicates topic with environmental emphasis as defined by Humans and Natural Environment Core requirement**

Instructor-Led Topics (28 lecture / discussion / case study)

1) Review of Scientific method; analysis of controversy; tools of rhetoric; perception and analysis of risk (2 lectures)

2) Formation of the Solar System (2 lecture)
*Analysis of habitability zone around stars
Whither Venus, Earth, Mars
Formation of earth-moon doublet
*Effect on present resource distribution
*Mining the moon for energy – helium-3
Chemistry of elements necessary for formation of life

3) Theories of the chemical evolution leading to formation of life on earth (2 lectures)
Origin of organic molecules
Miller's experiments
From organic molecules to protocells
"Genes first" models: the RNA world
"Metabolism first" models: iron-sulfur world and others

- Bubble Theory

Other models
- Autocatalysis
- Clay theory
- "Deep-hot biosphere" model of Gold

Counterarguments
- Hoyle – Dirty snowball
- Abiogenic synthesis of key chemicals
- Homochirality Problem

* Extraterrestrial life
- Mars – nature, contamination dangers
- Comet-borne plagues

4) *Biological Evolution (3 lectures)

Heredity

Variation
- Mutation
- Recombination

Mechanisms
- Natural selection
- Genetic drift
- Gene flow

Evidence for evolution

Outcomes
- Adaptation
- Co-evolution
- Speciation

5) *Extinction (2 lectures)

Genetics and demographic phenomena

Habitat Degradation

Predation, competition, and disease

Mass Extinctions
- Volcanism
- Asteroid impacts
- Gamma-ray bursts
- Earth’s magnetic field

The Martian Lifeboat

Post-human earth

6) The changing face of earth (3 lectures)

Processes driving oceanic composition

Sea floor spreading / plate tectonics

Glaciology

Mountain building
- * Effect on climate and life

*Why Mars is a “dead” world

7) *Climate change (4 lectures)
Atmospheric chemistry and physics
Effect of increasing CO2 on oceanic pH
Methane and methane hydrates
Oceanic currents and distribution of heat
Effect of continental drift on climate; modeling future climate and life forms on earth

8) DNA and Molecular Biology (4 lectures)
- Discovery of DNA – Science as a Social/Political Process
- DNA Double Helix
- Genetic Code
- Genetic Manipulation
- Genomics
- *Applications
  - E.g. Genetically modified organisms and their effect on the biosphere

9) *Biodiversity (2 lectures)
Numbers of species
- DNA “bar-coding”

Benefits
- Resistance to catastrophe
- Food and drink
- Medicines
- Industrial materials
- Other ecological services

Threats – Planet in Peril
- Destruction of habitats
- Species Loss
- Exotic species
- Genetic pollution
- Human Overpopulation

10) *Agriculture / Food Science (3 lectures)
Agriculture
- Ancient origins
- Agriculture in the Middle Ages
- Renaissance to present day

Crops
- Species Utilized
- World production of major crops
- Conservation of Germplasm – Noah’s Ark Re-visited

Food
- Food microbiology

Food safety - the causes, prevention of food-borne illness
Food preservation - the causes and prevention of quality degradation
Food engineering - the industrial processes used to manufacture food
Food chemistry - the molecular composition of food and the involvement of these molecules in chemical reactions

11) *Fraying Web of Life Case Studies (7 lectures)
- Linking People and Ecosystems
- Agro-ecosystems
  - Chemical Herbicide / Pesticide usage in Kansas
- Coastal Ecosystems
  - Re-plumbing the Everglades
  - Managing the Mangrove
  - Bolinao Rallies Around its Reef
- Forest Ecosystems
  - Up from the Roots - Regenerating the Dhani Forest through Activism
- Freshwater Systems
  - Working for water in South Africa
  - Managing the Mekong River
- Grassland Ecosystem
  - Sustaining the Steppe: Mongolia's grasslands

*** Possible Student-Led Environmental Topics (8 lecture / discussion / case study)**
Is Environmental Degradation Worsening?
Were Environmental Factors Responsible for the Mayan Collapse?
Is a Global Environmental Crisis Imminent?
Is World Population Growth Out of Control?
Does the Growing World Population Face Food Shortages?
Is the Threat of a Global Water Shortage Real?
Does Wilderness have Intrinsic Value?
Is the Threat of Global Warming Real?
Are Tighter Air Quality Standards Justified?
Is Sustainable Development Compatible with Human Welfare?
Can Green Marketing Save Tropical Rain Forests?
Is Municipal Waste Recycling Environmentally and Economically Sound?
Should the World Continue to Rely on Oil as a Major Source of Energy?
Should the Artic National Wildlife Refuge be Opened to Oil Drilling?
Nuclear Waste Disposal
Is Biological / Chemical Terrorism a Threat to the World Community?
Should Genetic Engineering be Banned?
Should Biotechnology be Used in Food Production?
Is Irradiated Food Safe to Eat?
Do Environmental Hormone Mimics pose a Potentially Serious Health Threat?
Is Pesticide / Herbicide Exposure Harmful to Human Health?
Are Electromagnetic Fields Dangerous to Your Health?

Laboratories
Genes in a Bottle
Isolation of the “Blueprint of life”
* Food and Water Contamination Assessment
Food Preservatives
Antibiotic and Disinfectants / Antimicrobial Product Testing
Got protein?
Alcohol Tolerance in Drosophila
pGLO bacterial Transformation
Using SNPs to Predict Bitter Tasting Ability
Power of the Sun / Assessment of Sunscreen
* Daphnia Toxicity testing
* Ames Test for Mutagenicity / Carcinogenicity
Forensic DNA Fingerprinting
* GMO Foods
Field trip to Johnson City TN fossil site
* Field trip to waste water treatment plant
Additional geology / earth science laboratories are under development.

A typical class meets two or three times per week for a total of 150 minutes. Please explain any deviation from this norm:

Laboratory will meet for three hours on a weekly basis.
Occasional field trip.

Who will normally teach this course?

Nicholas Schisler
Mike Winiski

Resources

List possible text(s) by author and title:

The biology-oriented textbook selected for the course is Starr, C., Evers, C.A. and Starr, L. ***Biology Today and Tomorrow***

The geology-oriented textbook selected for the course is Smith, G. and Pun, A. ***How Does Earth Work: Physical Geology and the Process of Science***

We will be working with the publishers to select a subset of chapters from each of these texts for student purchase to reduce costs.

For those topics that do not have referenced readings from the textbook, appropriate readings culled from various science publications. For example, excerpts from Goldfarb, T.D. ***Notable Selections in Environmental Studies*** will be used for background readings on environmental topics. Additional readings will be drawn from the Duskin series Taking Sides. These readings are currently being complied.

Links to appropriately screened materials from the online Encyclopedia Britannica and Wikipedia will also be provided.

Enter other resources required (computer hardware/software, videos, films, etc.):

Access to the Interdisciplinary Science Computer Laboratory (Riley 108) will be needed for some laboeatories.

Excerpts from professionally produced science videos will be used extensively in the course. Students will be provided with links to their web sites for background reading. For example:

In the biological sciences:
1) The scientific method and its ramifications will be explored using the NOVA video ***Judgement Day: Intelligent Design on Trial*** http://www.pbs.org/wgbh/nova/id/
2) The origin of life unit will make use of the ***Origins*** PBS series http://www.pbs.org/wgbh/nova/origins/
3) Aspects of evolution and extinction will be explored using excerpts from the PBS documentary ***Evolution*** http://www.pbs.org/wgbh/evolution/

In geology / earth science
1) ***How Earth was Made*** from the History Channel will be used to illustrate

the initial formation of the solar system and planets
1) Plate tectonics and climatic effects will be explored using ***Cracking the Ice Age*** http://www.pbs.org/wgbh/nova/ice/
2) Nova's ***What's Up with the Weather?*** will be used to explore climate change http://www.pbs.org/wgbh/warming/

Will additional funds be required for this course (for example, field trip or workshop training)? If so, explain plans to obtain funds or whether the funds have already been obtained:

Standard lab fee to support the laboratory/field trip portion of the course.

Information Pertaining to Revised Courses

Enter the original course number: 17

Enter the original course title: The Changing Universe

Summarize which of the preceding information constitutes revisions to the course (e.g., description, topics, etc.):

Like its predecessor, this is an issues-oriented course but provides its content in the context of major discoveries and current problems in science that are analyzed in light of their historical background, scientific foundation, perception by the public, and impact on understanding of planet earth. Student-led discussions on current environmental issues account for up to 20 percent of course content. The laboratory is inquiry-based with emphasis on applied microbiology, toxicology, genetics, molecular biology, and paleontology. In the laboratory, students will generate, analyze, and draw conclusions from their own datasets.

Provide a rationale for the revisions proposed:

The course uses a modular framework for topical discussions based on critical analysis of the primary scientific literature. Instructor-directed discussions use case and problem-based approaches to learning. The weekly laboratory provides practice with hypothesis generation and data analysis.

Curriculum Information

Is this course being proposed to fulfill the First Year Seminar program, any Core / Global Awareness (CGA) requirements or the May Experience? yes

If so, specifically identify the requirements to be fulfilled by the course:
•Global Awareness: Humans and their Natural Environment (NE)
•Natural World (NW)

Departments and/or programs of study *other than your home department* that should review this proposal:
•Biology (major)
•Chemistry (major)
•Earth and Environmental Sciences (major)
•Physics (major)

Enter a brief description of the relationship the course will have to the curricula, such as required course or elective:
This is an interdisciplinary science course for non-science majors that will provide the student with opportunities for critical analysis of primary scientific data. This course has as a pre-requisite SCI 16 “Mission to Mars.” Furthermore, SCI 17 is designed to complement and be a continuation of SCI 16, since SCI 17 studies

our planet as a “life-support” system for our species.

CGA Information

Natural World

What scientific theories concerning the empirical study of the natural world will be covered? Approximately how many class hours will be dedicated to each of these scientific theories?
The entire course is focused on scientific discovery and how these have been applied to the benefit or detriment of human-kind and the biosphere. Some of the many "theories" discussed include:
Origin of the earth
Origin of life
Evolution
Extinction (e.g. K-T asteroid theory of dinosaur extinction)
Molecular Biology (e.g. use of genetically modified organisms in agriculture etc.)
Biodiversity

Please describe, and give at least one example of, how you will demonstrate to students on what foundations theories are constructed, how they are applied, and how data is interpreted

In the weekly laboratory, students will generate hypotheses, collect, and analyze data in the areas of applied microbiology, toxicology, genetics, molecular biology, and paleontology.

For example, to demonstrate the importance of molecular biology in modern society, students will gather a number of different foodstuffs from the cafeteria or grocery store and determine if they

have been genetically modified.

For example, to demonstrate our place in the tree of life, students will assess phylogenetic trees that incorporate as many genes and species as possible (including humans) to discern relationships and similarities.

Please describe, and give at least one example of, how students will be led to an appreciation of the tentative, progressive, and cumulative nature of scientific knowledge.

The entire course is focused on major discoveries and current problems in science that will be analyzed in light of their historical background, scientific foundation, perception by the public, and impact on planet earth. For example, the development of the modern theory of evolution will be discussed by assessing how advances in species classification, geology, heredity, and cell biology support the concept of natural selection as defined by Darwin.

Global Awareness: Humans and their Natural Environment

Please describe which aspects of the interactive relationship between humans and the natural environment will be covered in class, and what course materials will be used. How will these topics be addressed throughout the entire course?

The entire course is based on how science has led humanity to a better understanding of planet Earth and our own biological nature. Instructor-led discussions will focus on major discoveries in the earth and biological sciences that will be analyzed in light of their historical background, scientific foundation, perception by the

public, and impact on planet earth. Students will research and present opposing viewpoints on various environmental issues and from critical analysis of available data will critique opposing positions and develop a framework for successful conflict resolution. Topics could include issues related to environmental hormone mimics, ecosystem modification, emerging diseases, biotechnology and food production, biological warfare, electromagnetic fields and human health, human origins or any other relevant, instructor-approved area of student interest (see list of topics above).

Please give an example of how this course may foster an appreciation for the interactive relationship between humans and the natural environment.

Lecture/discussion will focus on how life and the physical planet have co-evolved and how humans are now altering the environment with potentially disastrous effects. (see list of topics above).

A weekly three hour laboratory will allow students to investigate topics such as food and water contamination, the effect of environmental chemicals on different organisms, as well as the impact of biotechnology on the environment using an inquiry-based framework that allows generation of data for subsequent analysis.

Students will also tour a local sewage treatment facility to underscore how human-generated waste products can potentially affect the environment.

Click here to send e-mail to the author of this proposal