Chesapeake Section

Two Problem Based Learning Laboratory Experiences

By
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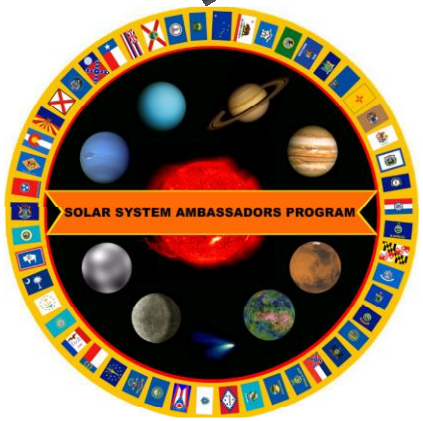

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Abstract

- Two small (21) interdisciplinary courses
  - Astrobiology
  - Energy and the Environment
- A flipped approach in lecture
  - Reading done before class
  - Review reading material interspersed with a personal response system series of questions
  - Address thoughtful questions in groups
- A flipped approach in lab
  - Students perform traditional lab exercises on their own
  - Turn in lab write ups for grading
- A problem based learning (PBL) approach to the lab
  - Students focus on a semester-long project culminating in a written paper and an oral presentation
  - Will lead to an edited publication of input from the students as well as papers by the faculty and graduate teaching assistant
  - Meeting participants will be subjected to the same teaching style that is utilized in the PBL based lab

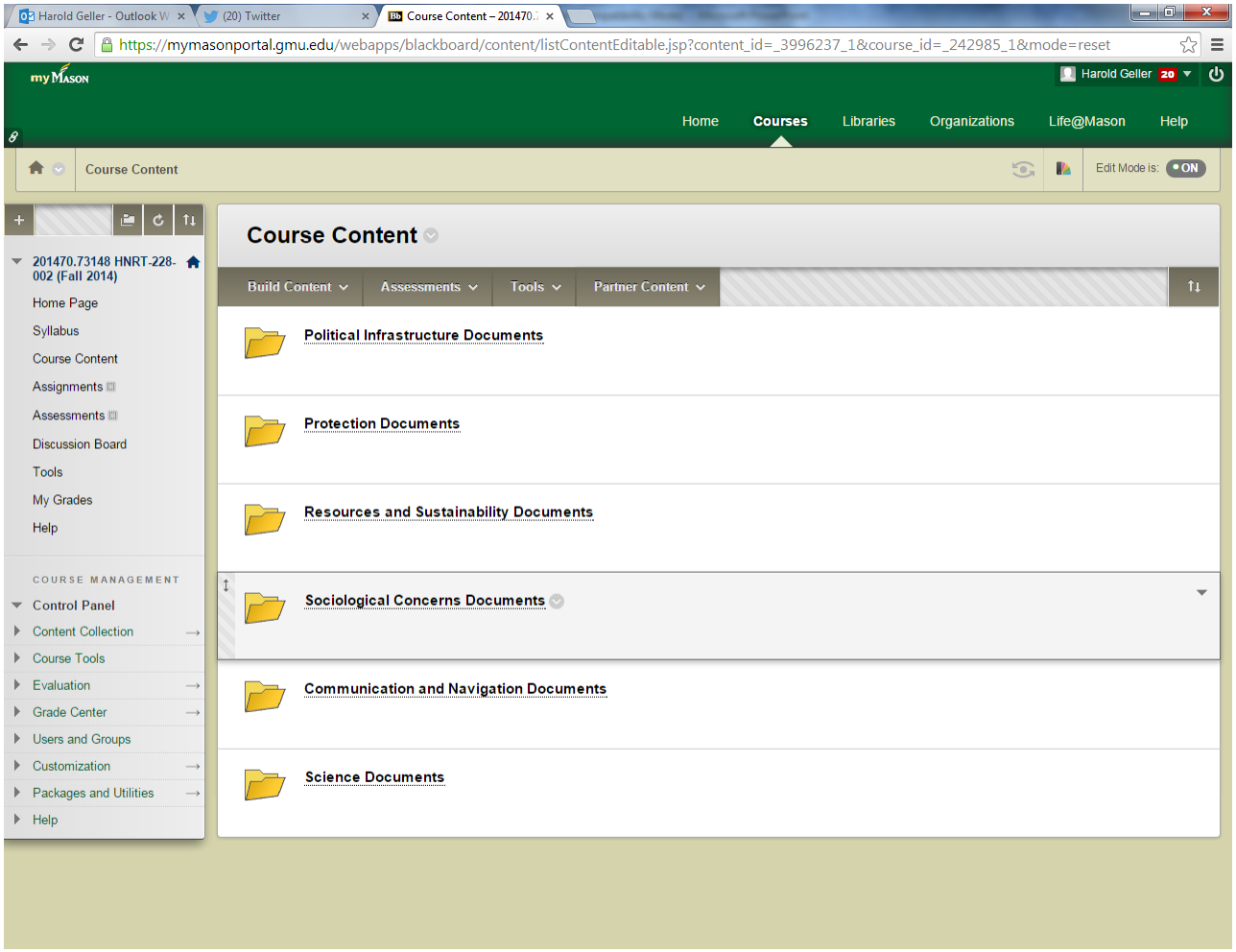
The Physics in Astrobiology

- Newton's Laws of Motion
- Universal Law of Gravitation
- Kepler's Law of Planetary Motion
- Einstein's Special Theory of Relativity
- $E = m c^2$ [-> travel time and fuel considerations]
- Einstein's General Theory of Relativity
- 1^{st} and 2^{nd} Laws of Thermodynamics
- Energy Concepts [potential, kinetic, etc.]
- Electricity and electronics
- Computers and their physical limits
- Conservation of Momentum

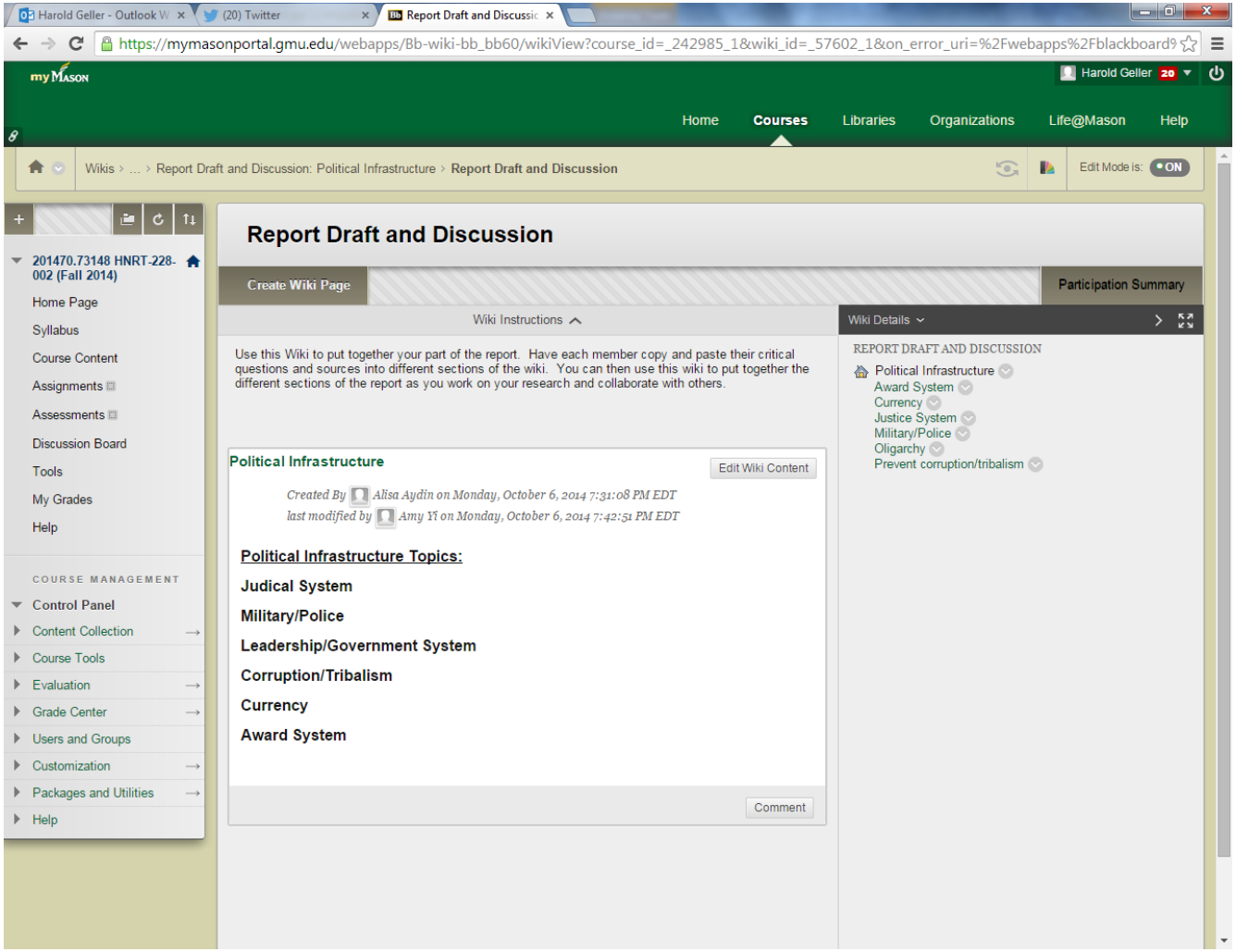
The Physics in Energy and Environment

- Fundamental concepts of energy
- Measurement and units of energy
- Solar energy
- Hydroelectric power
- Wind power
- Ocean thermal energy conversion
- Geothermal power
- Tidal energy
- Wave energy
- Nuclear energy generation and safety
- Nuclear weapons
- Nuclear fission
- Nuclear fusion
- Energy conservation
- Modes of transportation
- The atmosphere and air pollution
- Ozone layer
- Greenhouse Gas Effect

Learning Management System



Use of a Wiki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Home
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Assessments
Discussion Board
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COURSE MANAGEMENT
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Help
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Create Wiki Page
Participation Summary
Wiki Instructions
Use this Wiki to put together your part of the report. Have each member copy and paste their critical questions and sources into different sections of the wiki. You can then use this wiki to put together the different sections of the report as you work on your research and collaborate with others.
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Edit Wiki Content
Created By Alisa Aydin on Monday, October 6, 2014 7:31:08 PM EDT
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Political Infrastructure Topics:
Judical System
Military/Police
Leadership/Government System
Corruption/Tribalism
Currency
Award System
Comment
Wiki Details
REPORT DRAFT AND DISCUSSION
Political Infrastructure
Award System
Currency
Justice System
Military/Police
Oligarchy
Prevent corruption/tribalism

Course Mechanics

- Geller leads flipped lecture
- Astrobiology in a small class (~20) environment
- Reading assigned before class
- Personal response system used to quiz
  - Formative assessment
- Break up into groups of 3 or 4
- Assign a leader, a recorder, and 1 or two others
- Give 3-5 thoughtful questions requiring critical thinking and scientific reasoning
- Share out results

Course Mechanics II

- Lab meetings now flipped too
- Problem Based Learning added
  - Design an interstellar trip to the stars
- Prabal Saxena guides lab sections
  - Collects home lab assignments
- Questions addressed and shared out
- Overarching goal of PBL lab
  - design multigenerational star ship voyage to the stars
- Overarching questions addressed first
  - Where to go?
    - Class consensus
    - Kepler 186f
- Richard Oh (Thomas Jefferson High School)
  - Addressing propulsion systems design

Political Infrastructure Questions

- Judicial System
- Military/Police
- Leadership/Government System
- Corruption/Tribalism
- Currency
- Award System

Spaceship Protection Questions

- How do we protect from interstellar debris?
- How do we protect from cosmic radiation?

Life Sustainability Questions

- How to make food sustainable.
- How do we create a suitable climate and how to renew resources like Oxygen, C02, temperature, pressure, etc.

Sociological/Governance Questions

- What types of jobs are necessary to be self-sustaining?
- What type of education system/ instructional materials will we implement?

Communication/Navigation Questions

- How to navigate?
- Should we send a smaller ship ahead that we could store extra fuel on or a small probe
- Communication is needed but what information is important and priority?
  - What information will be useful to send back to earth, i.e. star maps, route inefficiencies, etc.

Science Questions

- What are conditions likely to be on the planet?
- What do astronauts need?
- How are we going to collect and report data back to Earth?
- What is our goal—colonization or bring back data?

Energy and Crisis Management

- Contingencies for destruction of coal mines, oil rigs, etc.
- Depletion of oil reserves
- Transition to renewable energy resources
- Infrastructure and emergency response

Renewable Energy

- Barriers to renewable energy resources
- Renewable resources best for which regions
- Impact on low income families
- Legislation favoring renewable energy

Energy Usage and Efficiency

- Nuclear energy advancements
- Policy for energy usage
- Coal usage effects and pollution
- Pros and cons of fracking

Energy Policy Issues

- Attitudes of various public sectors
- Influence of PAC type groups
- Renewable energy resources and public policy

Global Implications of Policy

- What are the Global Implications of Energy Policy?
- What can we learn in the break down of relationships between the "West", South America, Asia, and the Middle East?
- Analyze how each region implements their energy/ environmental policy concerning global warming, fossil fuel usage, and renewable energy research.

Economic Tradeoffs of Policy

- What is the economic impact of transitioning to renewable energy?
- How much oil is produced domestically in the U.S.?
- Why are the gas prices so low right now?

Problem Based Learning Lab

- In lab, review material from laboratory assignments turned in
- Assign groups to form in order to address different issues of project
- Address questions in lab that can apply scientific reasoning and critical thinking to the problem-based issues
- Share out and peer review
- Write and present project results

Acknowledgements

- Prabal Saxena
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- Richard Oh
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- The students of HNRT 228 Astrobiology
- The students of HNRT 228 Energy and the Environment

Coming Soon

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This volume examines the multidisciplinary aspects of the design of a mission to the stars. The feasibility of a journey to the stars in a lifetime of a single human being is quite unlikely. Therefore, during the conduct of a one semester course in astrobiology, undergraduate students, and some high school students, were asked to contribute to the design of a multigenerational starship. The laboratory section for the course within the Honors College of George Mason University was taught in the manner of a problem based learning pedagogy. Not only were the science and engineering aspects of a multigenerational starship voyage addressed, but also the sociological and psychological aspects of such a journey to the stars were examined. We hope this gives an insight into the complexity of any future generation's journey to the stars.

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Multigenerational Starship Design Considerations

Harold A. Geller

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A Problem Based Learning Laboratory Experience

Edited by Harold A. Geller