A Systematic Approach to Atmospheric Science Education

Colorado College and Catamount Institute

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Colorado College

- Oldest higher education institute in CO
- Nationally ranked liberal arts college
- ~2000 undergraduate students
- Located in Colorado Springs, CO
- Block Plan classes
CC’s Science Curriculum Expertise

NSF-Funded Education Projects:
• ChemLinks Systemic Changes in Chemistry Project
• Project Kaleidoscope
• SENCER
• Instrumentation & Lab Improvement
• Predicting Women’s Success in Science
• MAT Science Education

Foundation-Funded Education Projects:
• Mellon Foundation Interdisciplinary Curriculum
• Mellon Foundation Policy/Science Integration
• Sherman Fairchild Environmental Instrumentation
• Hughes Bridge Program
Inspiring ecological stewardship...
• CAEE: Best New Program, 2002
• El Pomar Foundation: Best Environmental Organization, 2004
• More than 40 community partners annually
• Southern CO GLOBE Partner
CMMAP Funding

**Colorado College:**
- Two annual student scholarships
- Two annual summer undergraduate student research stipends
- One annual undergraduate block research stipend
- Graduate Student and Faculty Exchanges/Visits
- Class Field Trips

**Catamount Institute:**
- Integration of atmospheric curriculum into existing after-school program for minority and underserved students
- Assessment of results on minority retention
- Increasing geographic scope of after-school program as a national model
Systematic Curriculum Development

1. Understand the mission
2. Identify target audience and needs
3. Establish curricular goals/objectives
4. Evaluate existing curricular material
5. Assess students’ prior knowledge
6. Match pedagogy to generative questions
7. Teach & evaluate with formative assessment
8. Summative assessment
9. Incorporate new findings (go to step 3)
10. Disseminate curriculum
1. Understand the Mission

Educate and train a diverse population in Climate and Earth System Science:

- Enhance teaching and learning at all educational levels;
- Improve science pedagogy;
- Enhance the science and engineering pipeline through mentoring and recruiting at earlier academic levels;
- Study diversity problems, solutions and disseminate results;
- Disseminate science results through multiple media;
- Engage stakeholders and policymakers.
2. Identify Target Audience & Needs

- K-12 teachers and students
- Undergraduate students
- Graduate students
- Public
- Policymakers
- Stakeholders
Example:
What are the needs of policymakers?
3. Establish Curricular Goals

“Earth System Science courses are distinguished from Earth Science courses through their explicit multidisciplinary focus on the connections, interactions and feedbacks between the system components: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, and exosphere.”*

*Science Education Resource Center at Carleton College: http://serc.carleton.edu/introgeo/earthcoursedesign/whatis.html
4. Evaluate Curricular Material

(from Earth System Science: An Overview, NASA, 1988)
5. Assess Students’ Prior Knowledge

6. Match pedagogy & generative questions
7. Teaching & Formative Assessment
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Atmospheric Focus

Air (EV)
Global Climate Change I (EV/BY/GY)
Global Climate Change II (EV/CH/PC)
Meteorology (PC/EV)

Atmospheric Components

Introduction to Environmental Science (EV)
Introduction to Earth Systems (GY/EV)
Quantitative Methods in Environmental Science (MA/EV)
Water (EV)
Energy & the Environment (EV)
Environmental Chemistry (CH/EV)
Ecosystem Ecology (BY/EV)
Analysis of Environmental Data (EV/MA)

CC’s LEED-Certified Tutt Science Center
8. Summative Assessment

- Student Assessment of Learning Gains (ChemLinks/NSF)
  http://www.wcer.wisc.edu/salgains/instructor/default.asp
- Rubrics (formative & summative)
- PALS (SRI/NSF)
- FLAG
  http://www.flaquide.org/
9. Incorporate New Findings
10. Disseminate Results

- Project Kaleidoscope
- Council of Undergraduate Research
- Journal of College Physics Teaching
- Journal of Earth System Science Education (DLESE)
- Teaching Issues and Experiments in Ecology (ESA)
- Journal of Chemical Education
- AGU, AMS, ACS, ESA...
- Council of Environmental Deans & Directors (NCSE)
- CC MAT Program
- Hughes Bridge Program
- GLOBE network
- UCAR
- Nova/PBS
- Focus the Nation
- Natural Intelligence
Catamount Sustainability Model

Science

SYSTEMS

Service

Stewardship

Sustainability
Young Environmental Stewards Program

- Science
- Technology
- Leadership
YES Students

Demographics

- Up to 150 in grades 4th–8th
- Minority/underserved/special needs
- 80% of the students have never participated in after-school programs.
- 50% or higher students of color
- 60% or higher free/reduced lunch
- Nominated by their teachers.
YES Schools

- Score low on state testing
- 9 schools from 5 districts
- Each school group receives 15 YES sessions a year, or around 50 hours of instruction.
- Expansion to new locations in Years 3-5 through Urban League and other connections.
YES Program Assessment

- YES effectively targets low-income and minority students, and maintains their ongoing participation.

- YES students increase knowledge and skills in environmental science, stewardship, leadership and technology.

- YES students strengthen leadership skills through community-based service projects.

- Collegiate and Senior Stewards learn valuable environmental education techniques.

New studies???
Systematic Project Integration

- CMMAP Research Scientists
- CC Professors
- CC Students & Scholars
- YES Teachers & K-12 Teachers
- YES Students & K-12 Students
- CMMAP Grad Students
- Grad Students