A Systematic Approach to Atmospheric Science Education

Colorado College and Catamount Institute

Colorado College campus, circa 1874

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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

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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

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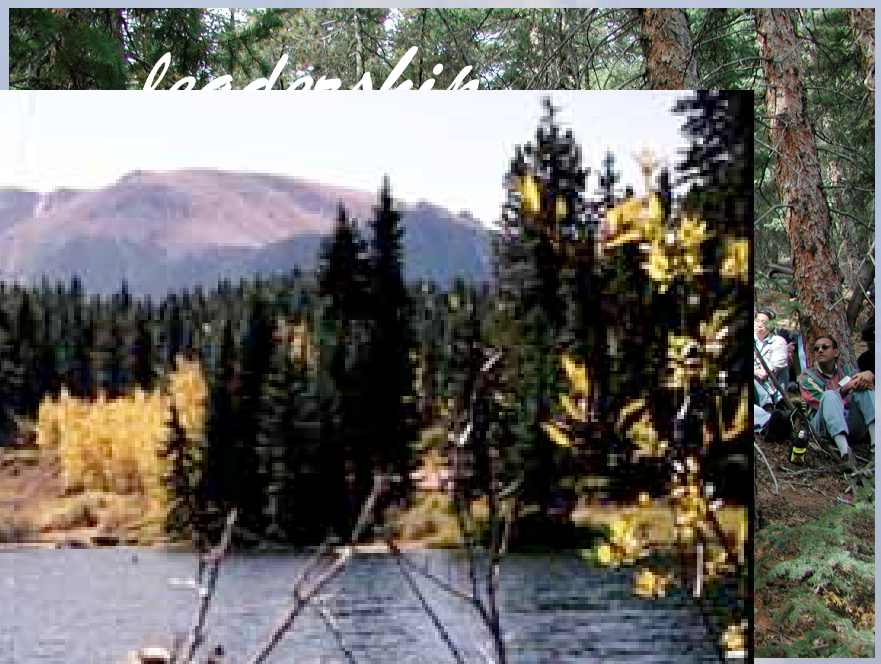
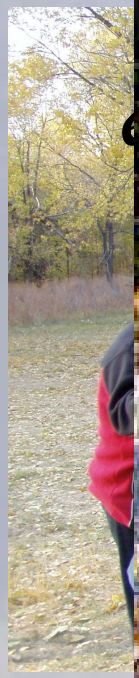
Inspiring ecological stewardship...





www.catamountinstitute.org

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- CAEE: Best New Program, 2002
- El Pomar Foundation: Best Environmental Organization, 2004
- More than 40 community partners annually
- Southern CO GLOBE Partner

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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

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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.

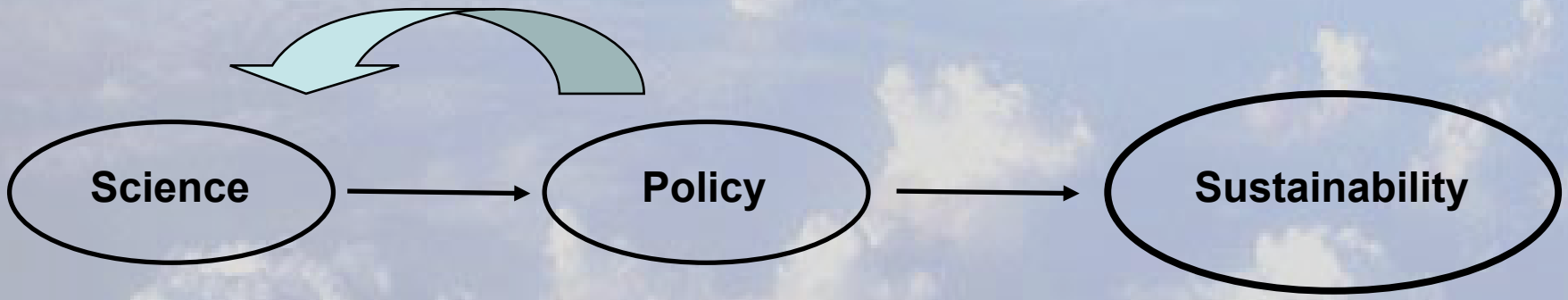
2. Identify Target Audience & Needs

- K-12 teachers and students
- Undergraduate students
- Graduate students
- Public

  Policymakers

  Stakeholders

Example:
What are the needs of policymakers?

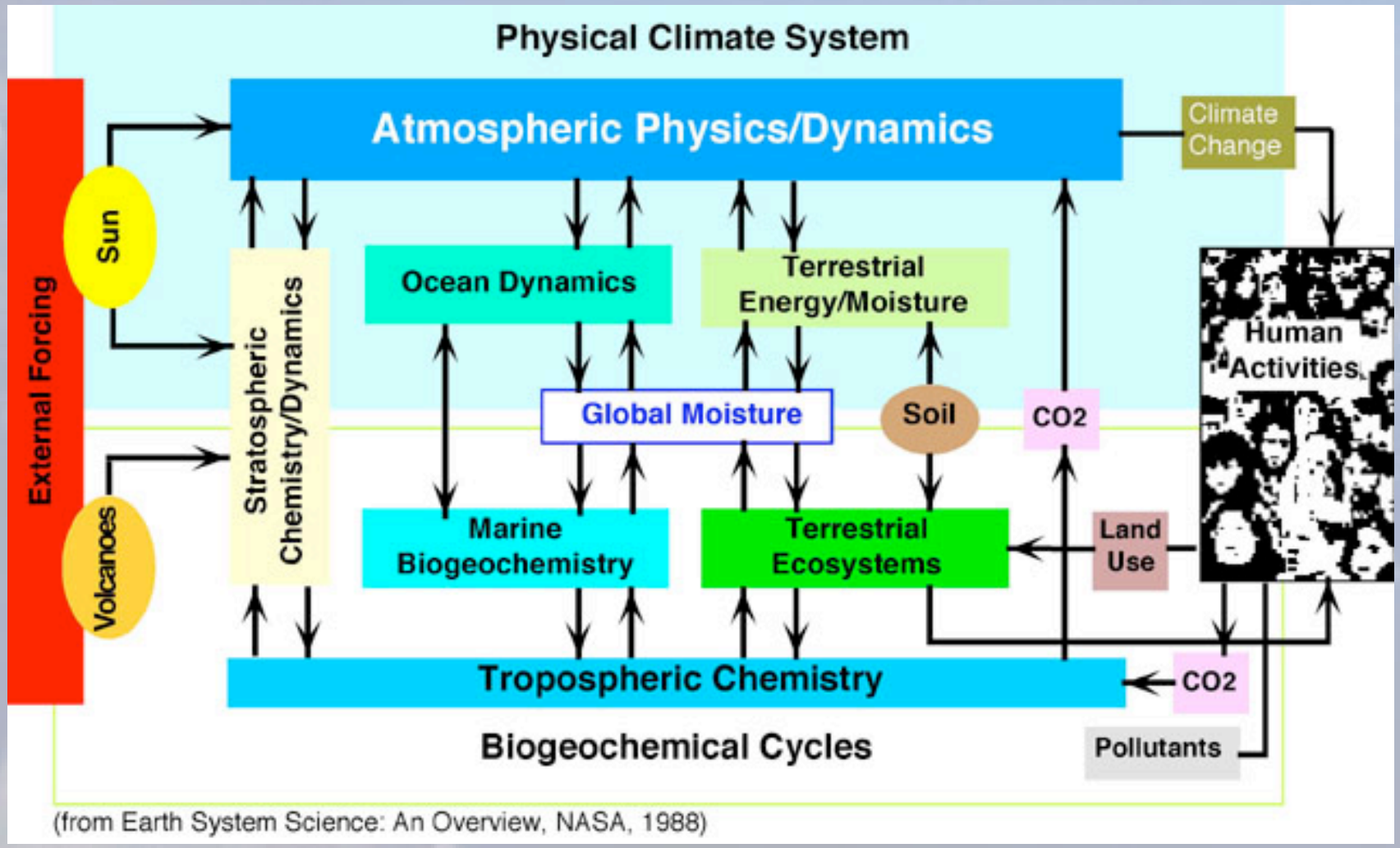


3. Establish Curricular Goals

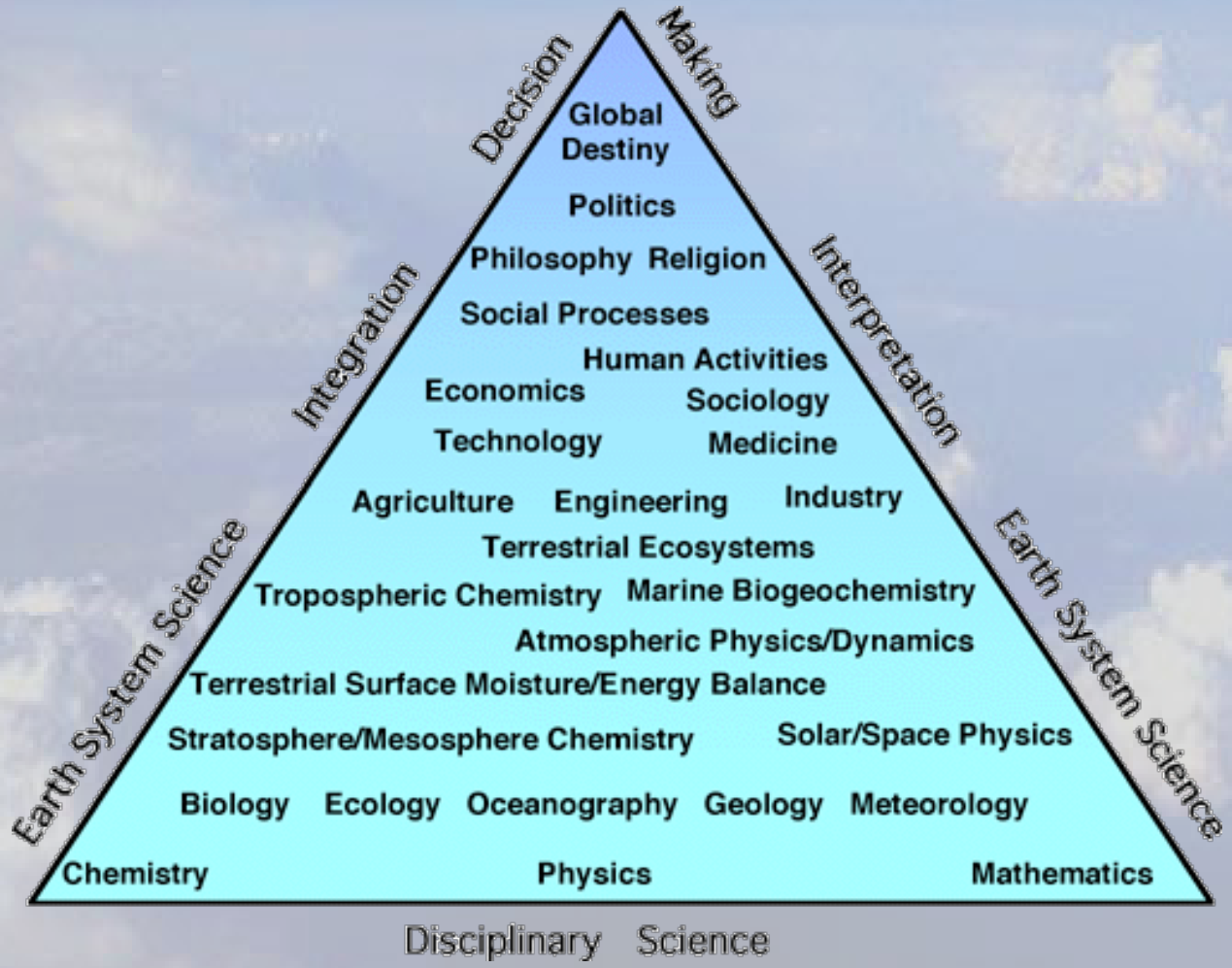
"Earth System Science courses are distinguished from Earth Science courses through their explicit multidisciplinary focus on the **connections, interactions and feedbacks** between the system components: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, and exosphere."*

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

4. Evaluate Curricular Material



5. Assess Students' Prior Knowledge



Johnson, D.R , Ruzek, M., Kalb, M., "Earth System Science and the Internet", Computers and Geosciences, Special Issue: The Year 2000 Challenges, v. 26, no. 6, July, 2000 pp 669-676

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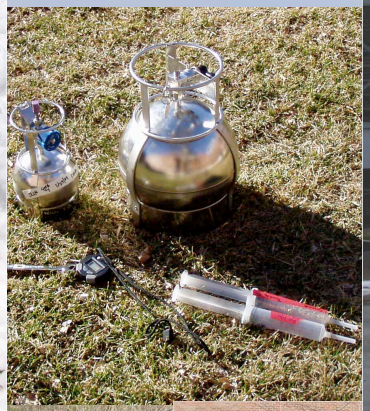
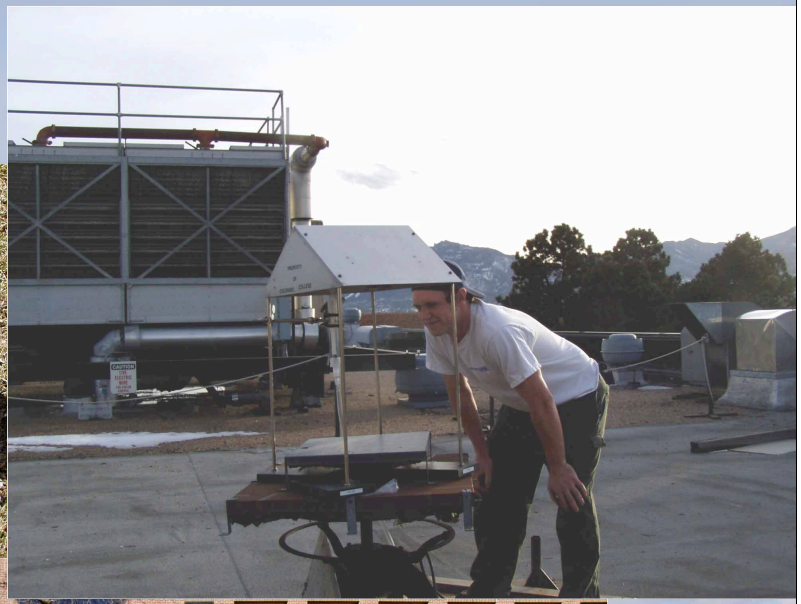
6. Match pedagogy & generative questions





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7. Teaching & Formative Assessment

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CC's LEED-CertifiedTutt Science Center

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)

8. Summative Assessment

- Student Assessment of Learning Gains (ChemLinks/NSF)

  http://www.wcer.wisc.edu/salgains/instructor/default.asp

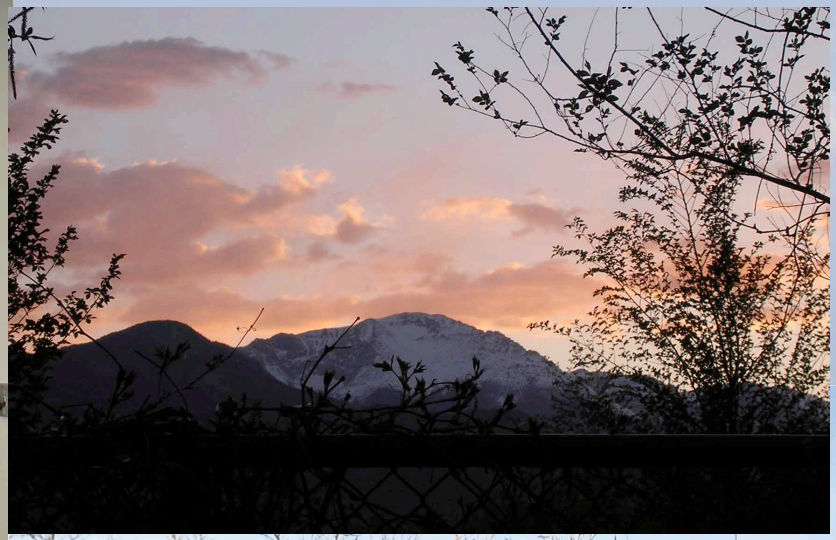
- Rubrics (formative & summative)
- PALS (SRI/NSF)

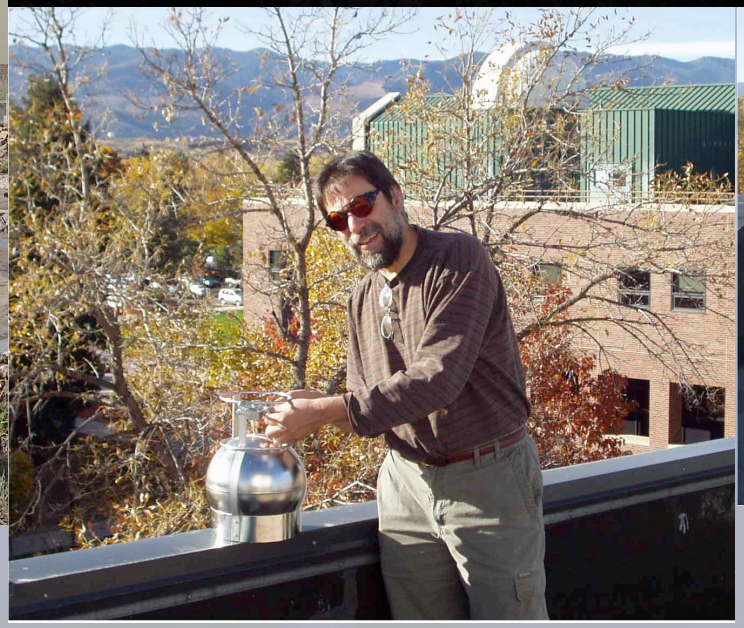
  http://pals.sri.com/pals/index.html

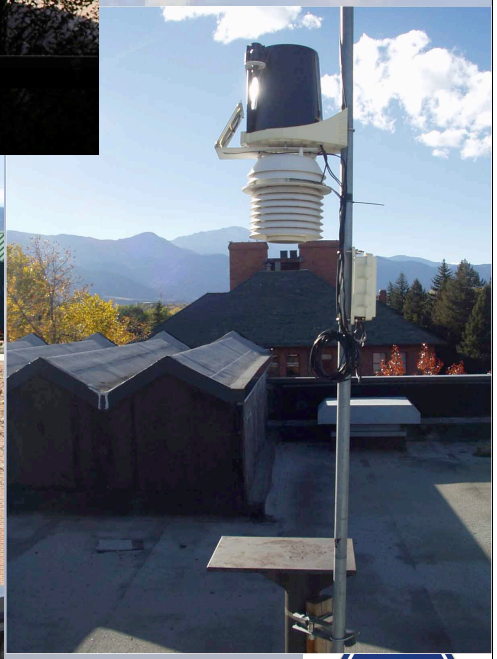
- FLAG

  http://www.flaguide.org/

9. Incorporate New Findings







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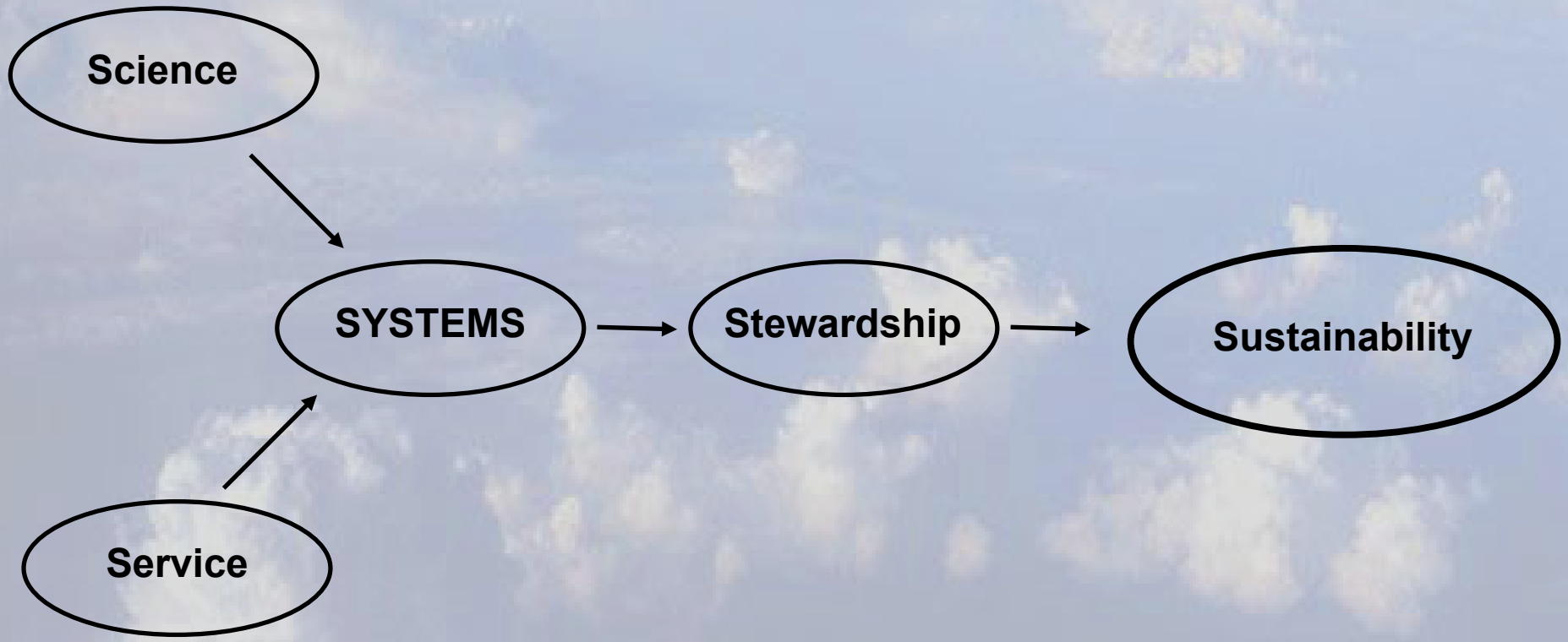
10. Disseminate Results

- 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



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???

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Systematic Project Integration