

# Education is Multiscale Too!



Elementary



Junior High



Graduate

**CMMAP E&D targets all of these!**



# E&D Accomplishments, Year 1

- Recruited and hired full-time **ED Manager** (Christine Aguilar) to guide day-to-day operations
- Organized **interactions among K-12 activities** in CMMAP, school districts, teachers, and partners
- Developed 27 new standards-based climate **inquiry activities**, and presented them **350 K-12 teachers**
- **20,000 K-12 students** explored LSOP hands-on science activities
- Colo **Global Climate Conference** for high-school students
- Developed and organized **climate science on UCAR web outreach** site (Windows to Universe: over 2,000,000 unique users/month!)
- 2-way **undergrad-to-grad connections** with Colo College
- Support for **16 CMMAP grad students** at 5 Universities
- Public **outreach based on IPCC** Summary for Policymakers
- 2-credit climate course for **29 middle-school science teachers**
- Opportunities in **climate science for diverse students** in elementary, high-school, undergrad, and grad school

## Highlights since Feb Meeting

- K-12 development through Little Shop of Physics & UCAR partners
- Colorado Global Climate Conference
- Undergraduate course on Global Climate Change developed at Colorado College
- Undergraduate climate content "movement"
- CMMAP Graduate Student Summer Colloquium

# K-8 Education: It's Up in the Air

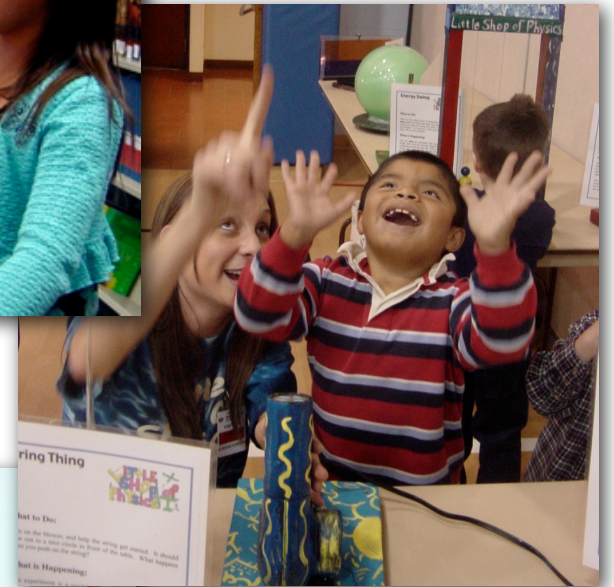


## School programs

*featuring open-ended,  
hands-on exploration*

In 2006-2007:

- > 20,000 students
- Diverse group of schools & students including rural & reservation schools
- Experiments with atmospheric focus  
*"It's Up in the Air"*
- Undergraduate interns
- 6000 visitors to annual Open House
- Written materials available in English and Spanish



# Enhancing K-8 Science



## Teacher Workshops

### *Ten Things You Should Know about the Atmosphere*

In 2006-2007:

- > 300 K-12 teachers
- Presentations on Shoshoni/Arapahoe, Navajo, Ute reservations
- 15 new low-cost, standards-based, hands-on investigations designed with assistance of Teacher in Residence



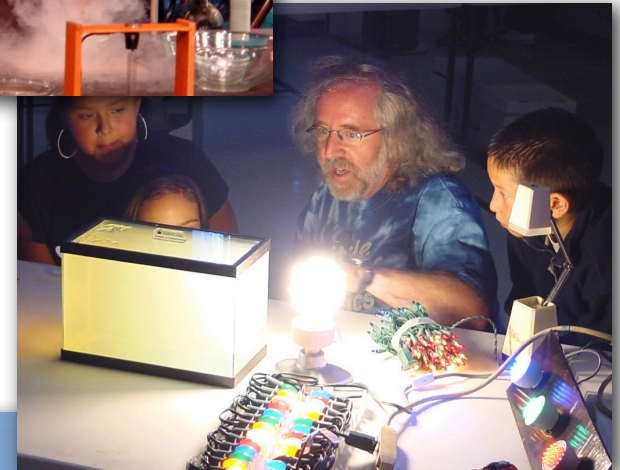
# Enhancing K-8 Science



## Television programs

*The Everyday Science show airs in Poudre School District & statewide*

- Two new shows in production: “Air” & “Clouds”
- Kits of instructional materials accompany episodes



## Podcasts

*Available on iTunes store*

- Based on episodes or “Science Minute” segments
- All new content will have atmospheric focus
- Future episodes will be in English & Spanish

**EveryDay Science**



**Brian Jones Little Shop of Physics**  
Category: K-12  
Language: English  
Total: 4 episodes

Free



# Enhancing K-8 Science

## Research

*Can we produce measurable effects?*

In 2006-2007:

- Focus groups with teachers at several schools aid in developing of programs
- Work with Sociology Department to develop techniques for significant assessment



# Colorado Global Climate Conference

- Over 100 high-school students
- Keynote by Dr. Susan Solomon (IPCC)
- Daylong seminar & workshop series
- Hands-on exhibits
- Career & scholarship information





# HS Global Climate Conference

- Workshops:
  - Climate system
  - Climate models
  - Alternative energy
  - Climate policy
  - Climate ethics
  - Mitigation & Adaptation
  - Visualization
- Inquiries/Demos
  - LSOP
  - Energy & Engines



**Denver? Pueblo? Durango? LA? NYC?**



# Climate Science for Teachers

- Full semester (2 credits) upper-level undergraduate course on weather and climate in one week!
- 29 science teachers and preservice teachers from local school districts
- Standards-based inquiry activities including many take-home "kits" for later classroom use
- Field trip to NCAR vis lab and UCAR teacher resources



# Clouds in a Bottle



# Engage, Explore, Explain, Extend, Evaluate

Eight blocks, 3.5 hours each

- Follow the Energy
- Radiation and Energy Balance
- Pressure, Density, & Vertical Motion
- Clouds, Convection, and Precipitation
- Weather vs Climate
- What Makes the Wind Blow
- Global Circulation Systems
- Oceans and Climate Variability
- Climates of the Past
- Climates of the Future



# Conventional Instruction

A ball is tossed straight up; it rises and then falls. After the ball has left the thrower's hand and is headed upward,

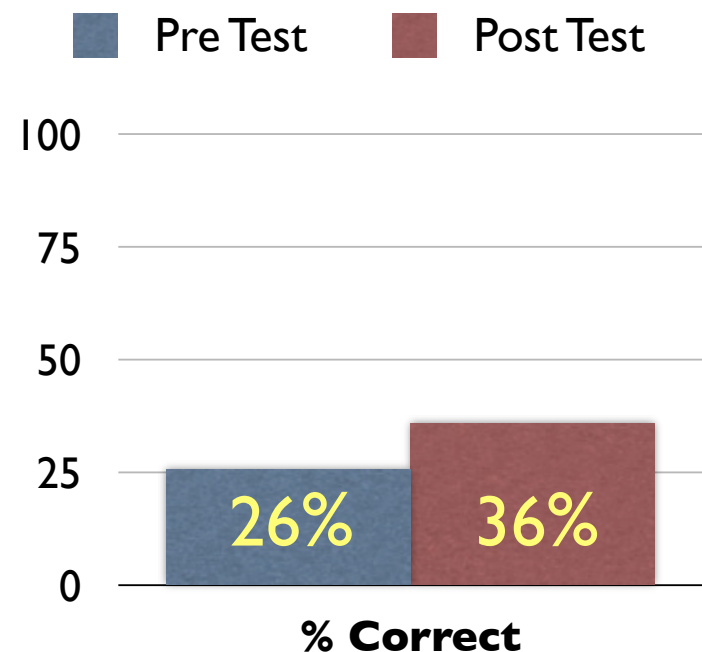
- A. The net force is directed upward.
- B. The net force is directed downward.
- C. There is no net force.

## CSU Introductory Physics for Scientists & Engineers, Fall 1991

**Pre Test:** All students, at start of course.

**Post Test:** All students, after six weeks of mechanics instruction.

*Note: Students in the class had done well on quantitative problems regarding tossed and dropped objects.*

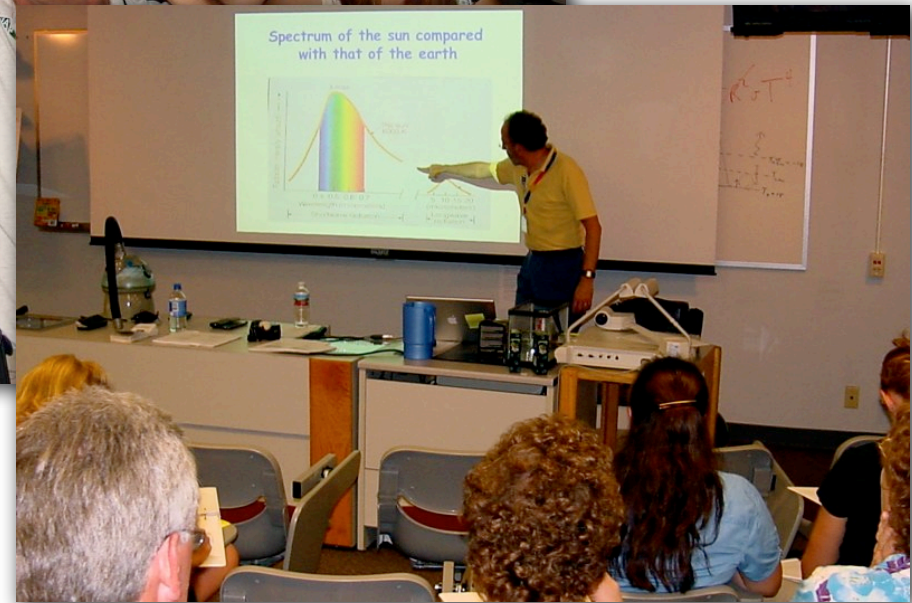


**Conventional (lecture-dominated) instruction shows little effect on student learning of basic concepts in the introductory course.**

# Atmospheric Science for Educators

The class used a mix of lecture and interactive engagement throughout. Lessons followed the “5 E” format:

- Engage
- Explore
- Explain
- Extend
- Evaluate



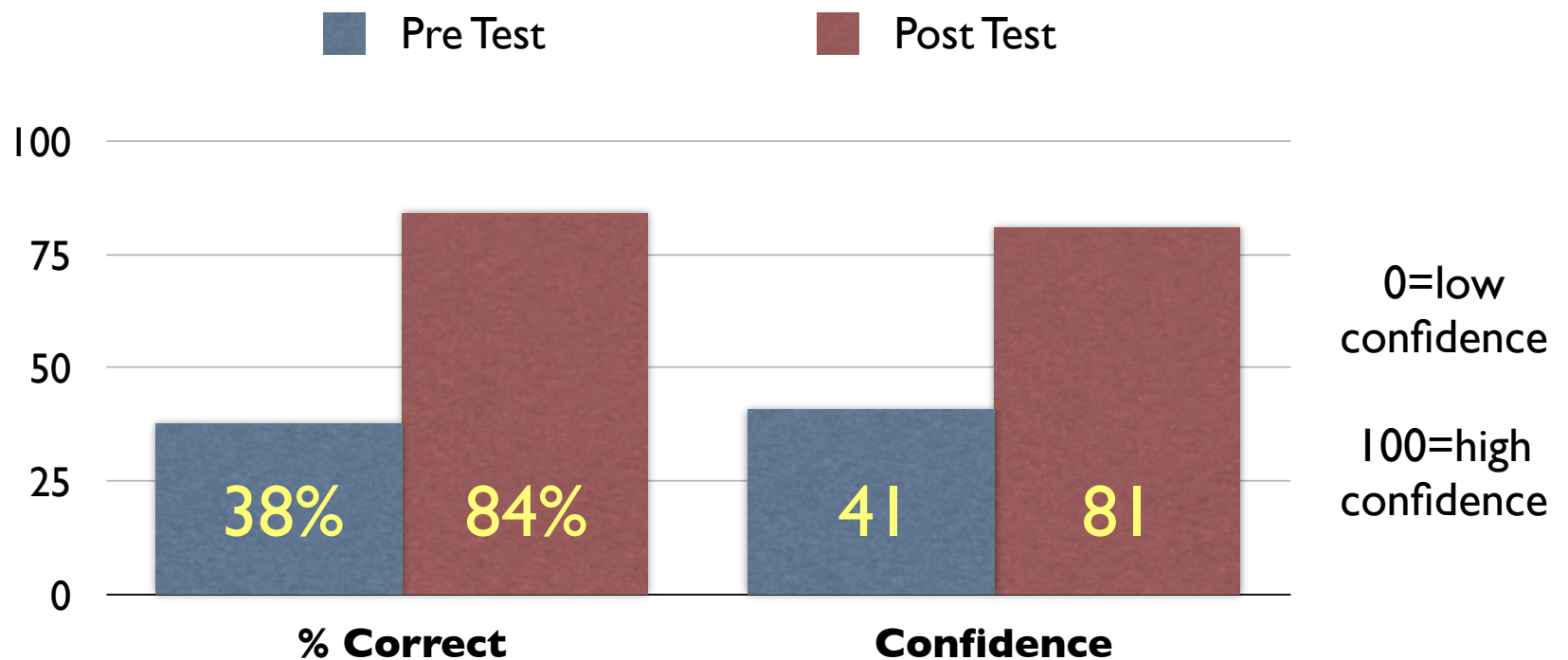
**By using effective pedagogy we were able to show more significant learning gains as well as to model techniques of effective instruction.**

# Basic Science Concepts

On a cool night, dew condenses on the roof of your car.

As the water vapor condenses to make the droplets of liquid water that you see as dew,

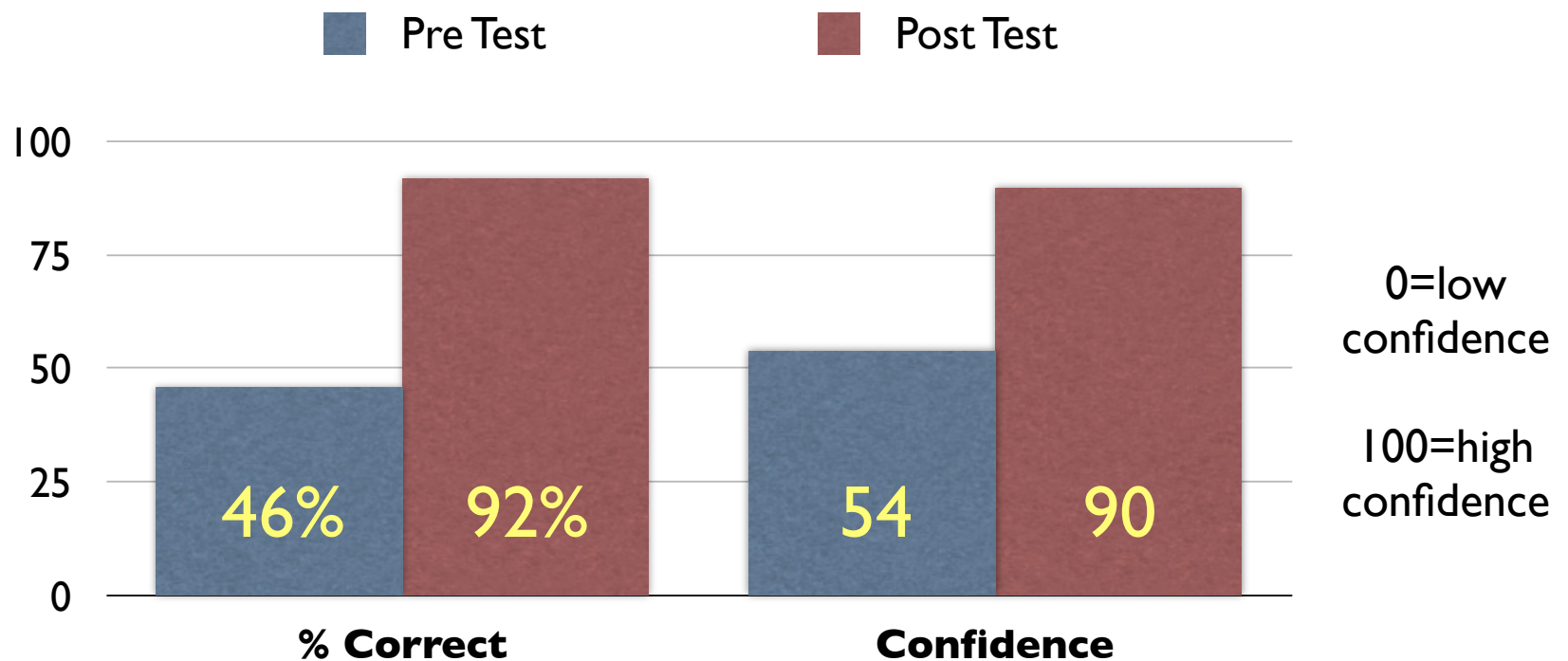
- A. Heat energy is transferred to the roof of your car, warming it.
- B. Heat energy is transferred from the roof of your car, cooling it.



# Atmospheric Science Concepts

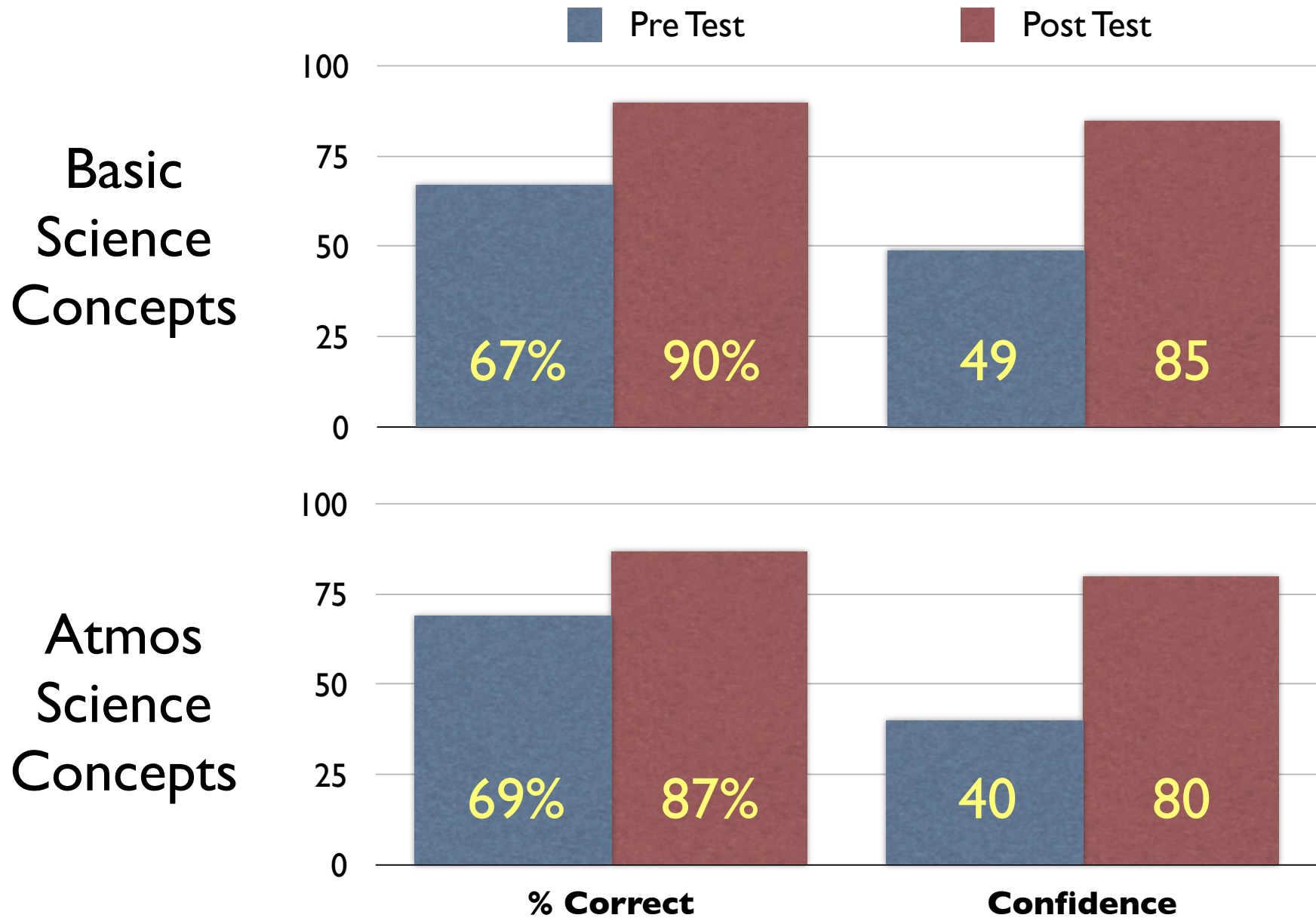
On a clear night, the temperature drops more than on a cloudy night. How do clouds “insulate” the earth?

- A. They trap warm air near the surface of the earth.
- B. The condensation of water vapor keeps the clouds warm.
- C. They block the transmission of infrared radiation to space.





# Overall Results



# Undergraduate Ed

- New interdisciplinary course for nonmajors prototyped at CC:  
**Intro to Global Climate Change**
- "**Changing Climates @ CSU**" group working to infuse studies of global change into every part of undergrad curriculum
- Undergrad research scholarships, research exchanges, and summer **internships**



# CMMAP Summer Grad Colloquium

- Provide an opportunity for all CMMAP graduate students to interact with each other and other scientists
- Support collaborative research among the graduate students involved with CMMAP
- Planned as a two week long annual workshop held at different locations each year



# Summer Grad Colloquium 2007

- Intro to CMMAP Research, history, organization, & plans
- Student presentations on research
- CMMAP Team Meeting
- Art & Science of Teaching
- Career Development Workshop
- Field trip to research site in RMNP
- Science/Public Policy interface



# Diverse Graduate Students

- CMMAP supports 16 graduate students
  - 8 are women, 1 is African-American
- Partnership with Hampton University
  - Collaborative research visit in 2007
  - Support for 2 graduate students in 2008
  - Undergraduate research internships
- SOARS Proteges (3) and Fellows (2)



# Understanding & Overcoming Barriers

- Studies of gender and culture discourse in science texts and media
  - PhD research by Samantha Farro
  - Publications & presentations
  - Results to support CMMAP materials
- Study of women in science careers
  - "Differential Attrition from Graduate Engineering Programs: Is it a factor in Underrepresentation of Women?"
- Assessment of the McNair program



# Packaging, Porting, & Partners

- Many CMMAP E&D achievements are mature, evaluated, and very portable!
- LSOP Atmospheric Inquiry units on web, DVD series, even iTunes!
- Entire Climate for Teachers course is online, including both lectures and activities
- Diversity recruiting not just for CSU
- **Help us reach your schools and cities!**

