Chandra Astrophysics Institute (CAI) Summer Session 2006 Summary:

For more information about MKI Education and public outreach programs go to space.mit.edu/EPO
For more information about the CAI, click on "Chandra Astrophysics Institute" and then "New CAI webpage". Log in as our guest with username "jkepler" and password "astro"

From June 26 – July 28, 2006, the 23-day CAI summer session was implemented for the second time at MIT. The educational approach of the CAI is based on the Rutgers Astrophysics Institute at Rutgers University in New Jersey, now in its 9th year. Participants took part in group investigations of physics and astrophysics, using a teaching technique intended to reflect the way new knowledge is created in scientific research.

Educational approach:
As an example of our approach, consider our investigation of the nature of light over 2 days:

- Participants made **observations** of several behaviors of light in the classroom and small groups were asked to develop and present an explanation for ALL these observations.
- **Developing these alternate explanations (models)** is an important part of applying creativity to science that is often lacking in classroom situations, but is one of the most valuable tools in scientific research.

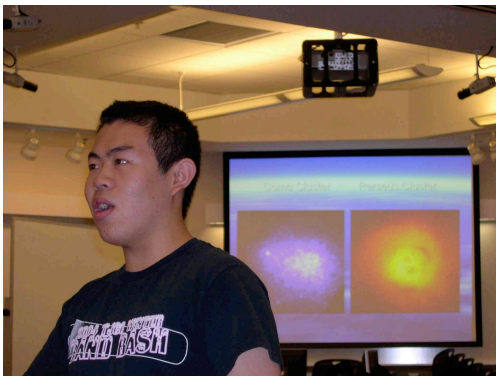
- Using these models to make **predictions** about the behavior of light in other situations (i.e. how light heats up water) helped to eliminate models with incorrect or incomplete predictions and leave only useful models—in our case, a model of light as a flow of particles of a specific amount of energy. However, no model or explanation is ever COMPLETELY correct or ALWAYS applicable! (Later, we considered a wave model of light…)
- Our model of light was then **applied** to understand more about stars and other astronomical sources that produce light. In this way, we've developed a tool (i.e. a model of light and its production) to learn about the physical parameters (i.e. temperature, distance, luminosity, etc.) of objects in distant corners of the universe!

This same process of observation, model building, testing predictions and application to real problems was applied to the concepts of motion, gravitation, atomic physics and stellar evolution (i.e. the process of a star's birth, life and death) in order to build a "toolbox" of astrophysics knowledge.

Most astronomical sources of x-rays are stars in the later stages of their lives (i.e. white dwarfs, neutron stars and black holes), so it was vital to understand the model of the formation of these objects in order to interpret data about them…

Research analysis and projects:
Participants then learned to use software tools developed and used by professional astronomers to analyze data from the Chandra X-ray Observatory. Observations of a supernova remnant, x-ray binary star system and galaxy cluster were analyzed and models to explain these observations were subsequently developed by small groups in our scientific community. Over time, the guidance provided by the instructors was slowly removed, leaving participants to decide for themselves which models are most likely "correct"—reflecting the way real science is performed and validated.

Throughout the next year, the MKI research scientists involved in the CAI will help mentor 4 research projects being undertaken by 6 student research groups from our 7 Boston-area high schools:



Galaxy Clusters:
- Summary: X-rays help shed light on the dark matter that is present in enormous groups of galaxies in far corners of the universe.
- Student research group: Arthur Su, Ken Zhao (Newton North HS)
- Mentor: Dr. Andy Young (MIT)

X-Ray Binary: Neutron star or black hole?:
- Summary: X-ray source 4U 2129 dropped in brightness 23 years ago—x-ray observations with Chandra can only now help to confirm whether it may contain a black hole or a neutron star.
- Student research group: Andrew Caide, Aisling Hunt (Cambridge Rindge and Latin HS)
- Mentors: Dr. Mike Nowak (MIT)

The Galactic Center:
- Summary: Most astronomers now believe there is a supermassive black hole at the center of our galaxy—What can Chandra help us learn about it and other nearby objects?
- Student research groups:
  - Allen Chew (Boston Latin School), Keng Lei and Jason Liao (Boston Latin Academy)
  - Louis Gao, Hunter Zhao (Boston Latin School)
- Mentor: Dr. Fred Baganoff (MIT)

Supernovae and Supernova remnants
- Summary: Massive stars die in explosions that outshine the entire galaxy. Properties of the "leftovers" leads to a better understanding of what these stars were made of and how they contributed to the development of life.
- Student research groups:
  - Shakib Ahmed, Al Soedomo, Saphorn Ny (Lynn English HS), Alycia Steele (Lynn Classical HS)
  - Angela Martinez (John D. O'Bryant School for Math and Science)
- Mentor: Dr. Albert Kong (MIT)

For more information, contact Mark Hartman (mhartman@space.mit.edu, 617 258 8258)