

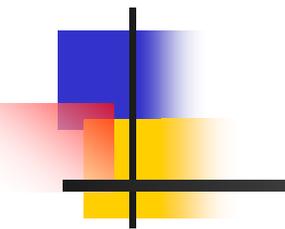
*Workshop on  
Education & Public Outreach in Nuclear Science  
Brookhaven National Lab, Dec. 1-3, 2006*

# A Vision for Nuclear Science Education and Outreach

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## I. Present activities (as submitted by community members)





## Kindergarten through 8<sup>th</sup> Grade

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- I. APS - Color me Physics
- II. Creighton - Merit Badge Clinic
- III. JLAB - BEAMS program

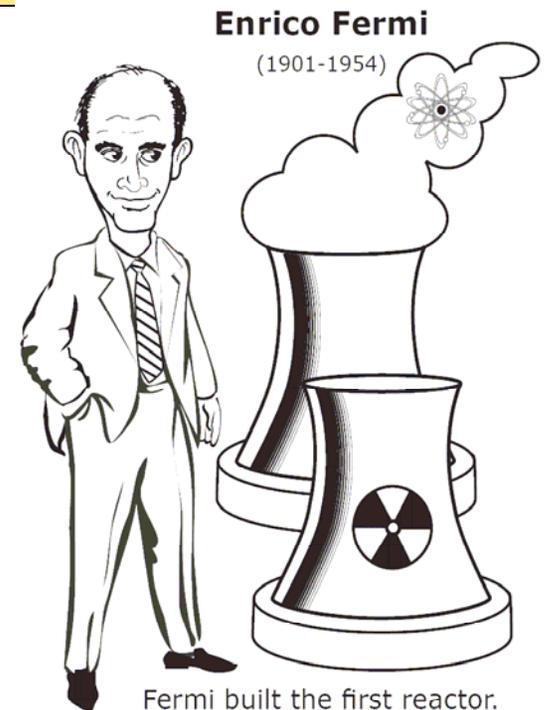
# Color Me Physics

Organization: APS

Grade Level: PreK-2

Source of funding: APS Contact: Jessica Clark & Kendra Rand

- Coloring book that introduces children to physics and some of its most famous characters.
- Includes one coloring page and a short description for each of the ten physicists featured.
- May be reproduced for non-commercial purposes
- More than 5000 given to children and teachers



Fermi built the first reactor. Which was an important factor

Running things efficiently, With atomic energy.

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I. Present Activities

# Creighton Merit Badge Clinic

Organization: Creighton University

Grade Level: 6 - 8

Source of funding: DOE

Contact: brnicky@creighton.edu

- Nuclear Science Merit Badge Clinic for Boy Scouts
  - 30 scouts will complete merit badge during one day workshop
    - First workshop  
March 3, 2007
  - Also working with individual troops
- Creating web bibliography of materials



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I. Present Activities

# BEAMS: Becoming Enthusiastic About Math and Science

Organization: Jefferson Lab

Grade Level: 6 - 8

Source of funding: DOE/Jefferson Lab

Contact: tyler@jlab.org

**BEAMS** is a partnership involving Jefferson Lab and Newport News City Public Schools that supports inner-city students as they progress from the 6<sup>th</sup> to the 7<sup>th</sup> and 8<sup>th</sup> grades. These students and their teachers visit Jefferson Lab for periods of two to five days for science and math activities conducted by the Lab's scientists, engineers, and technicians. The program's goals are to increase the representation of minorities and women in the science and engineering workforce, to motivate students and strengthen their academic preparation, and to provide teachers with classroom activities based on JLab science and technology. Specific BEAMS activities can be downloaded from <http://education.jlab.org/indexpages/activity6.php/>



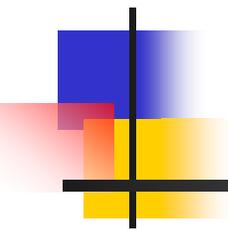
Approximately 1500 students participate in BEAMS each year. The BEAMS program has had measurable results, improving the math and science scores on Virginia Standards of Learning (SOL) tests for participating schools and garnering goodwill in the community for Jefferson Lab and basic research.

- Students are significantly more positive about math and science than their peers not attending BEAMS
- Teachers report an increased understanding of science, careers, and applications
- Parents report BEAMS is a positive influence on their children
- Sixth grade student attendance rates improve during BEAMS activities

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Website: <http://education.jlab.org/beams/index.html>

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## High School Students

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- I. APS - Adopt-a-Physicist
- II. Cal Tech - CHICOS
- III. Creighton - Summer mini-course
- IV. Creighton - Cosmic Ray Outreach
- V. JLAB - Mentorship program

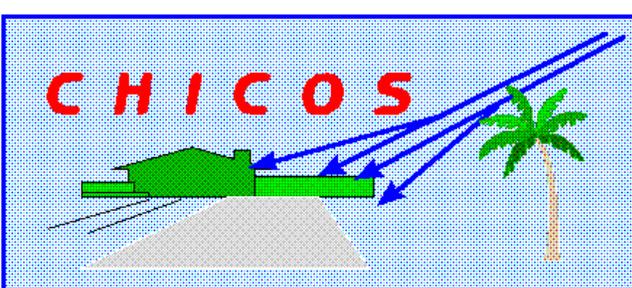
# Adopt-a-Physicist

Organization: APS                      Grade Level: High School

Source of funding: APS    Contact: Kendra Rand & Jessica Clark

- Physicists and high school students interact through discussion forums for a three-week period.
- Goals:
  - Expose high school physics students to the range of careers open to people with degrees in physics.
  - Advance the dialogue between the physics and high school education communities.
- Partnership with comPADRE and Sigma Pi Sigma





# California High school Cosmic ray ObServatory

- **Science:** Ultra-high Energy Cosmic Rays  
(65 School sites)  
1 publication, 2 in progress

- **Education/Outreach :**

Workshops for teachers (>50)

Summer programs for

teachers(20)/students(50)

Community college profs/students

Lab activities

(e.g., measure  $\mu$  half-life)

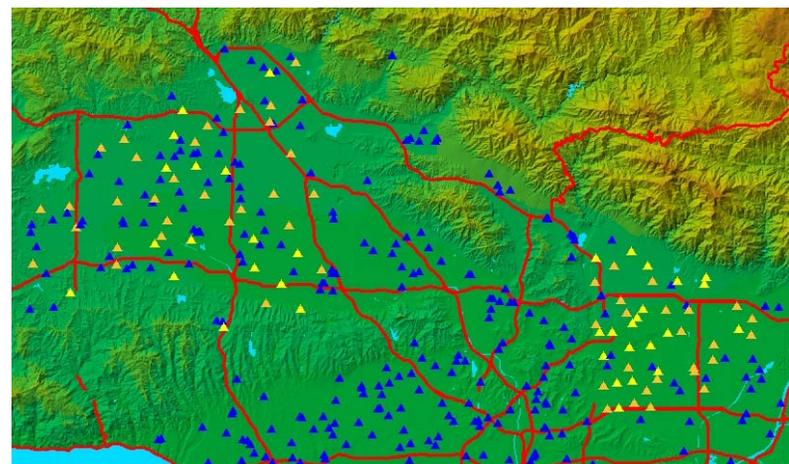
- **National/International recognition**

Articles in newspapers/magazines

Similar arrays being deployed worldwide

Could be part of a national nuclear program (like quarknet)

- **CHICOS is in jeopardy due to budget reductions**



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To Present Activities

# Creighton Cosmic Ray Outreach

Organization: Creighton University

Grade Level: 9 - 14

Source of funding: DOE

Contact: LyleSass@creighton.edu

- Construction of detectors by Introductory Physics students
- Visited 10 high schools across Nebraska to promote participation in a large array project
- Collaboration with CROP Project (University of Nebraska - Lincoln)



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Website: <http://physicsweb.creighton.edu/faculty/McShane/cuweb2/default.htm>

# Creighton Summer Mini-Course

Organization: Creighton University

Grade Level: 7 - 12

Source of funding: DOE, fee

Contact: mcherney@creighton.edu

- **Summer Mini-Courses:**
  - Junior and Senior High School Students
    - Part of larger summer program for gifted students
    - Repeated every 3 years
      - 4<sup>th</sup> offering in 2007
  - 3 one-week lecture and lab introduction to Nuclear Science



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I. Present Activities

# Mentorship for High School Students as a Volunteer Scientist

Jian-ping Chen, Jefferson Lab

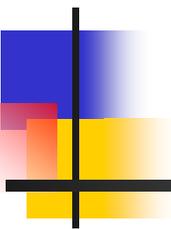
Organization: JLab + Governor's School; Grade Level: 11-12;

Source of funding: volunteer scientists;

Contact: Jan Tyler

- Honors Research/mentorship
- Students work with mentors to gain first hand research experience
  - Detector calibration, NMR, laser interference, ...
  - Work closely with local governor's school
  - Attract (often the best) students into (nuclear) science
  - Spread influence of JLab in the local community
  - Need more scientists volunteer

# Teacher Preparation and Development



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- I. JLAB - Science Afternoons
- II. JLAB - Teacher Academy
- III. LBNL - Preservice Teacher Institute
- IV. LBNL - Nuclear Wallchart and Cosmic ray detector
- V. PPPL - Plasma camp

# JSAT: JLab Science Afternoons for Teachers

Organization: Jefferson Lab

Grade Level: 6, 8

Source of funding: DOE/Jefferson Lab

Contact: tyler@jlab.org

Jefferson Lab developed the very successful TAPS – Teacher Academy in Physical Science – program. Due to funding and space limitations the TAPS program can only serve a limited number of teachers (24 teachers per summer). The JSAT initiative allows Jefferson Lab to impact an additional 30 teachers each year and also places Jefferson Lab as the community’s leader in teacher professional development.

- Each teacher participates in 16 sessions per year, usually held every other Wednesday from 5:00 – 7:00 pm. All workshop sessions are led by “graduates” of the three-year TAPS/DOE-ACTS program.
- Each session includes an activity, project, and/or lecture developed for the TAPS program and covers material that will be taught in the teachers’ classroom in the current grading period.
- Selected Jefferson Lab scientists and users are invited to make presentations to the teachers to increase the teachers’ content knowledge in current science and research.
- Teachers receive 40 recertification points each year and are eligible to receive 3 graduate credits in Physics from the University of Virginia.



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Activities

# Teacher Academy in Physical Science

Organization: Jefferson Lab

Grade Level: 5 - 8

Source of funding: DOE Office of Science

Contact: tyler@jlab.org

Jefferson Lab's **Teacher Academy in Physical Science (TAPS)** is one of the Department of Energy's Academies Creating Teacher Scientists (ACTS) programs. TAPS is a four-week summer classroom and research program for upper elementary and middle school teachers designed to build teachers' skills in the physical sciences over a three-year period.

TAPS includes the following components: a rigorous course (50 hours) in basic science (physics in 2007, chemistry in 2008, geophysics in 2009) taught by an expert teacher from a local high school; lectures (20 hours) on current research by Jefferson Lab staff, workshops (40 hours) on research-based effective teaching methods for the physical sciences; and team-based experiential learning (50 hours) under the guidance of Jefferson Lab staff.

All participants take a test on the first and last day of the program to measure science content knowledge. In 2004, the teachers' average score on the physics test increased 18 percentage points after completing JLab's TAPS program. The teachers' average test score during the 2005 chemistry-based program increased 29 percentage points, while the scores increased by 21 percentage points during the 2006 geophysics-based program.



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Present Activities

Website: <http://education.jlab.org/taps/index.php>

# LBL Preservice Teacher (PST) Intensive Research Institute

Organization: LBNL (CSEE+NSD+ALS)

Grade Level: undergrad

Source of funding: DOE OS - Workforce Dev  
(+ volunteer scientists)

Contact: [p\\_mcmahan@lbl.gov](mailto:p_mcmahan@lbl.gov)

- Pilot program for PST students with minimum science credits (2003 - 2005)
- Goals
  - Deeper understanding of scientific research
  - Direct experience with modern scientific instruments
  - Update and enhancement of students' knowledge of the scientific concepts, principles and theories behind experiments
- Activity - 4 2-week workshops (3 in nuclear science)
  - Nuclear Science and Neutron Activation Analysis
  - Natural Terrestrial Radioactivity
  - Cosmic Ray Detection
  - Fingerprint Analysis at the Infrared Beam Line
- Partnership with Fresno Collaborative for Excellence in the Preparation of Teachers (Cal State Fresno)



2003: NAA at a nuclear reactor

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I. Present Activities

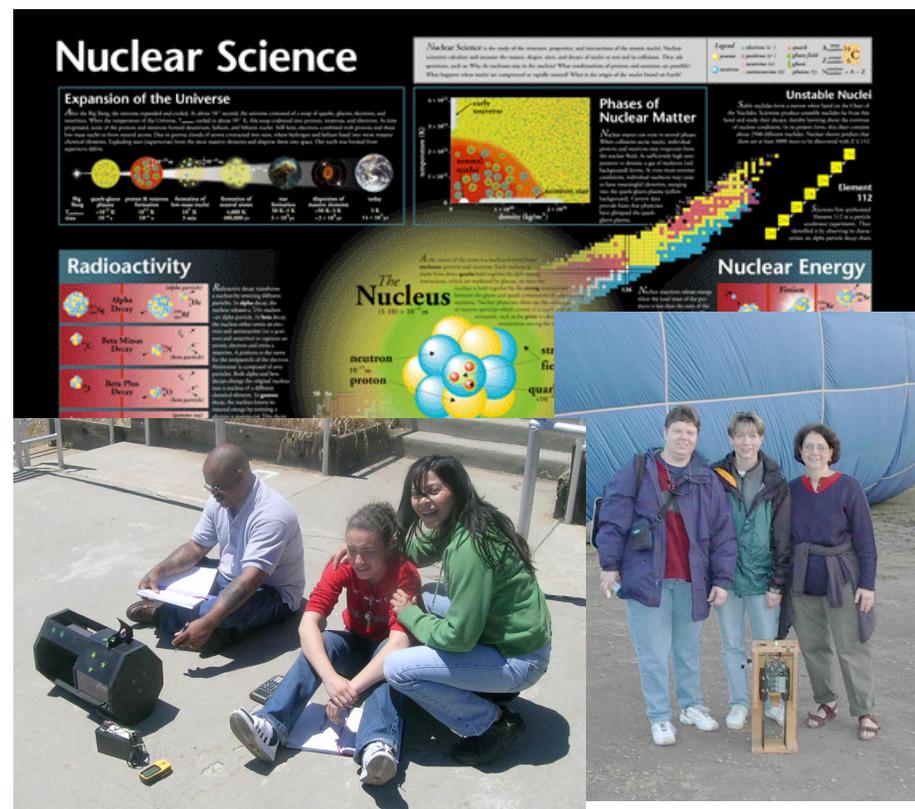
# Nuclear Wall Chart + Cosmic Ray Detector

Organization: LBNL Project Grade Level: 7-College

Source of funding: DOE + private

Contact: Howard Matis - [hsmatis@lbl.gov](mailto:hsmatis@lbl.gov)

- Nuclear Wall Chart
  - CPEP - Contemporary Physics Education Project sponsored
  - Distributed 100,000 copies around the world
  - Largely self-sustaining
  - Small updates
- Website - ABC's of Nuclear Physics
  - Nearly 1 million viewers
  - Modernization should be done
- Cosmic ray detector
  - About 100 built around the world
  - Used in High Schools and Undergraduate projects
  - Needs a new design and a better way to distribute



2007 Nuclear Science Long Range Plan: A Vision for Education and Outreach  
I. Present Activities

Website: <http://www.lbl.gov/abc>

# Plasma Camp

Organization: PPPL

Grade Level: Primarily high school teachers

Source of funding: DOE - OFES

Contact: [azwicker@pppl.gov](mailto:azwicker@pppl.gov)

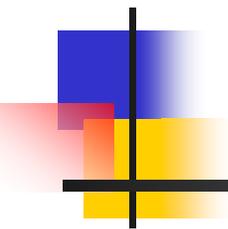
- 1-2 week-long professional development workshop
  - 12 teachers/year for up to 3 consecutive years
  - Plasma-centered curricula written during workshop - tested and modified in subsequent years
  - \$2,000 mini-grants for equipment/dissemination
  - Thousands of students participate every year in the exams, demos, labs, and independent projects created by their teachers during Plasma Camp.

Location of Plasma Camp Participants: 1998 - 2006



2007 Nuclear Science Long Range Plan: A Vision for Education and Outreach

I. Present Activities



## Undergraduate

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- I. ACS - Nuclear and Radiochemistry summer schools
- II. Clark - Science of WMD Course
- III. Creighton - REU Program
- IV. JLAB - Other Activities
- V. TUNL - REU Program

# Nuclear and Radiochemistry Summer Schools

Organization: ACS

Grade Level: undergraduate

Source of funding: U.S. DOE

Contact: Paul Mantica (mantica@msu.edu)

- **Activity:** 6-week intensive lecture and laboratory work on the fundamentals of nuclear science, radiochemistry, and their applications in related fields
- **History:** The San Jose State University site began in 1984. The Brookhaven National Laboratory site was started in 1989.
- **Audience:** Undergraduate students entering their junior or senior year. Each site hosts twelve students annually.
- **Impact:** More than 400 undergraduates have participated in the program. A number of participants are now active practitioners of nuclear science.
- **Partners:** American Chemical Society, Division of Nuclear Chemistry and Technology and the U.S. Department of Energy, Office of Science



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I. Present Activities

# Science of Weapons of Mass Destruction

Organization: Clark University

Grade Level: undergraduate

Source of funding: internal

Contact: [dbrenner@clarku.edu](mailto:dbrenner@clarku.edu)

Semester course (3 hours lecture + laboratory) that covers the history and science involved in the development of weapons of mass destruction (chemical, nuclear, biological)

- Audience: undergraduate students at all levels and from all disciplines
- Goals: promote an understanding of WMDs and the efforts made to contain them
- Focus: topical science education for non-science majors and dialog between students from diverse cultures and disciplines
- Partners: guest lecturers from the FBI and state emergency response personnel

# Creighton Undergraduate Research

Organization: Creighton University

Grade Level: undergraduate

Source of funding: DOE, College funds

Contact: [mcherney@creighton.edu](mailto:mcherney@creighton.edu)

- Undergraduate Participation in Research at STAR and ALICE
  - 5 - 7 students
    - Earn credits during semester
    - Paid during summer
  - Slow controls and data analysis
  - Presentation of work
    - Internally, Regionally, Nationally and Internationally
  - Also graduate students and postdocs



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Website: <http://physicsweb.creighton.edu/faculty/star/index.html>

# Other Outreach/Education Activities at JLab as a Scientist

Organization: Jefferson Lab;

Grade Level: 6-8, undergrad, grad

Source of funding: volunteer scientists;

Contact: Jian-ping Chen

- BEAMS program: (6<sup>th</sup>-8<sup>th</sup>) (see Jan Tyler's presentation)  
(Become Enthusiastic About Math and Science)  
Teach local middle school students science activities, attract their interest in science.
- Summer Undergraduate Research Program
  - Get students involved directly in the forefront research
  - Attract the (best) students into nuclear/particle physics
- Graduate Students
  - Supervise graduate students in PhD and MS program
  - Provide the best opportunities/choices for the students
  - Nurture and support the students throughout the whole period

# Triangle Universities Nuclear Laboratory REU Program

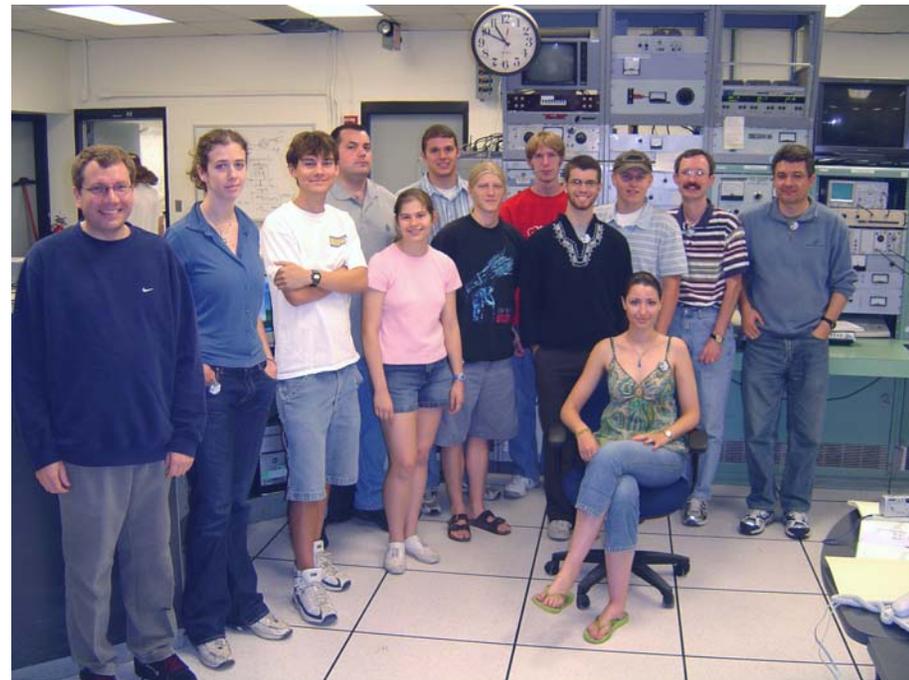
Organization: TUNL (Duke, NCSU, UNC-CH) Undergrad: Soph, Jr, Sr

Source of funding: NSF

Contact: J. Kelley (reu@tunl.duke.edu)

## ■ Nuclear Physics REU:

- Introduces students to fundamental aspects of nuclear physics research through focused lectures, seminars and a 10-week research project at a hands-on university-based nuclear lab
- Provides students an experience that closely represents research at the graduate school level
- Great opportunity to evaluate each of the three universities forming the laboratory partnership



2007 Nuclear Science Long Range Plan: A Vision for Education and Outreach

I. Present Activities

Website: [www.tunl.duke.edu/students/reu.html](http://www.tunl.duke.edu/students/reu.html)