



# Fermilab Education Pipeline

## From Student to Scientist

Marge Bardeen

Fermilab Education Office (<http://ed.fnal.gov>)

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M. Bardeen, FRA Meeting, October 2012

# Outline

Background

Outreach to General Public

~~Grad Students~~

Undergraduates

K-12

# Programs at Every Level



Graduate +

Undergraduate

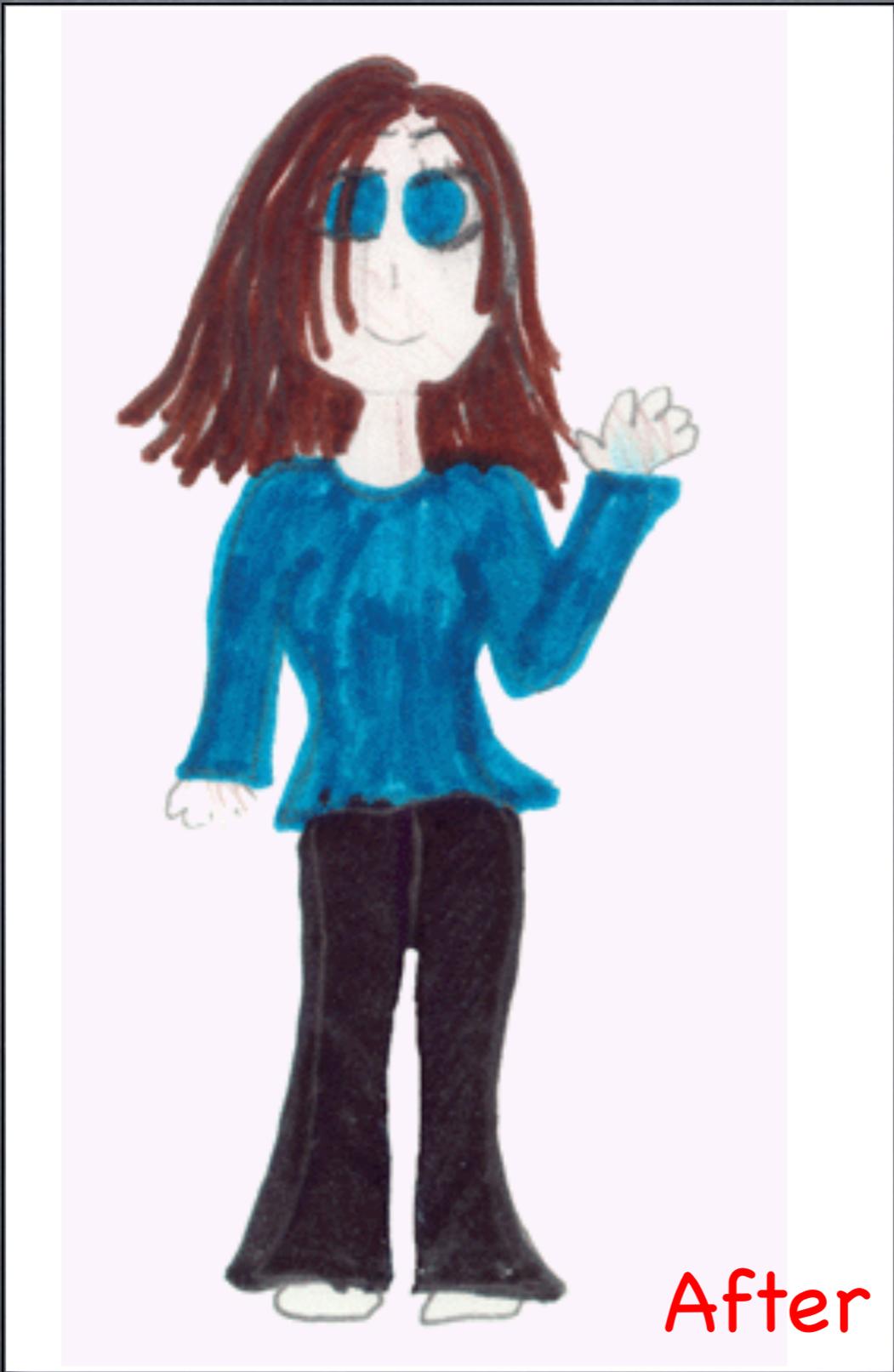
High School

Mid-Level

Elementary



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# "Org Chart"

## Education Office (K-12)

Educator Workshops  
Teacher Resource Center  
Field Trips  
High School Tours  
Classes for Kids  
Special Events  
Classroom Presentations  
Online Resources  
Lederman Science Center  
- - -  
Support for Internships  
- - -  
Public Tours

## Office of Equal Opportunity

Internships -  
Diversity Pipeline

## Research Divisions

Internships  
Saturday Morning Physics  
Ask-a-Scientist

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## Office of Equal Opportunity

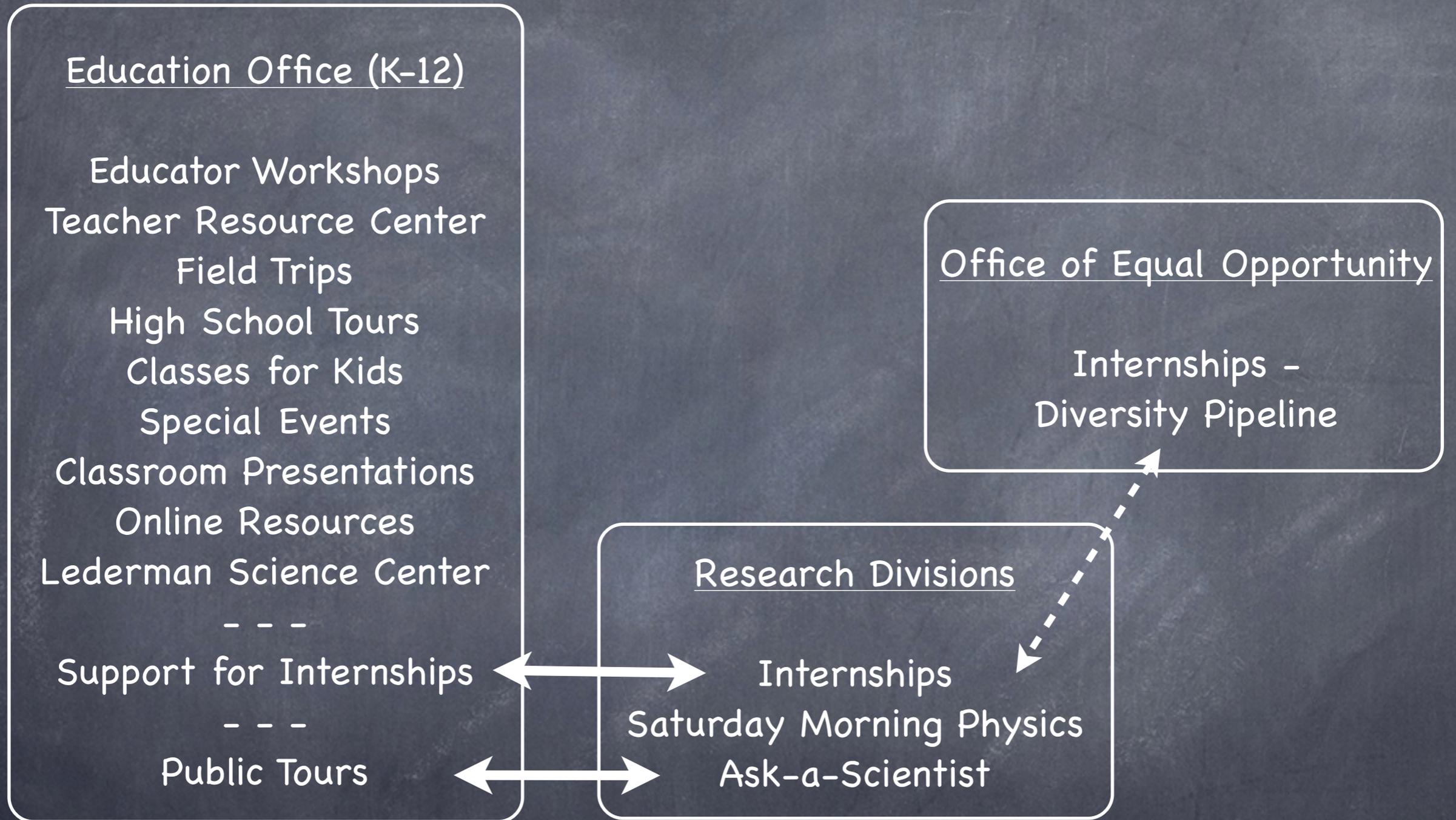
Internships -  
Diversity Pipeline

## Research Divisions

Internships  
Saturday Morning Physics  
Ask-a-Scientist



# "Org Chart"



# HOW MATTERS!



Engagement with science  
Partnerships with educators

# ~200 Volunteers



Make classroom presentations.

Help us get the science right.

Advise/mentor teachers and students.

Speak with students and teachers.

Interact with the public.

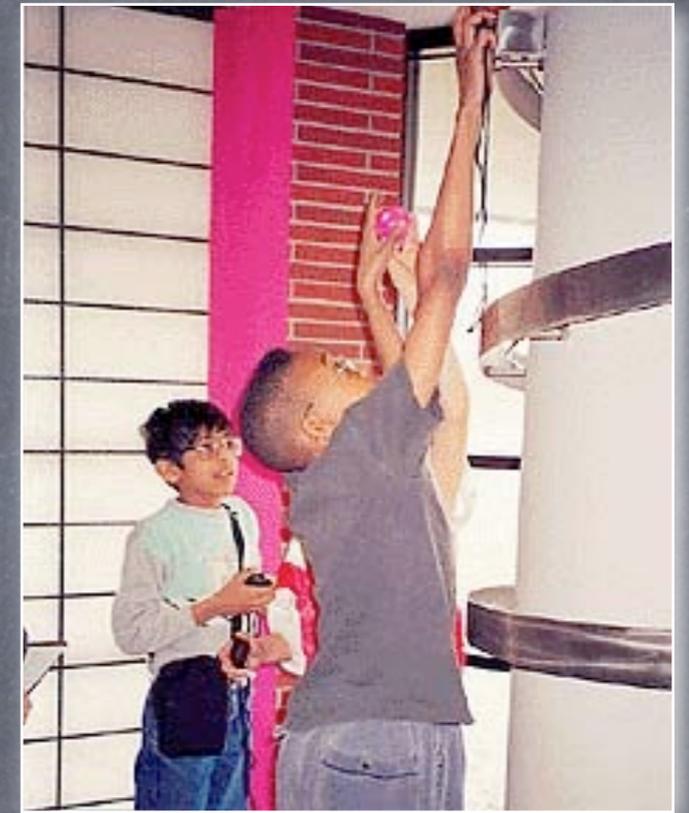
Speak, do demos and help out at special events.

# Fermilab Friends for Science Education

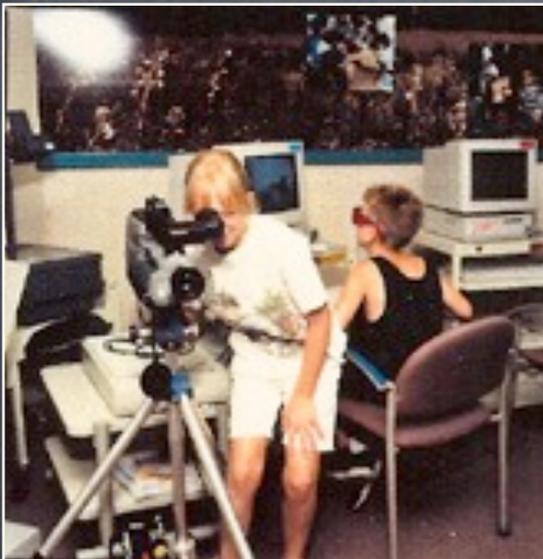
Established in 1983 to support innovative science education programs at Fermilab.



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# Lederman Science Center



# General Public

Ask-a-Scientist • Tours • Lecture Series • Arts Series



# Education Office Programs

- . . . strengthen primary and secondary school education by using Lab resources to improve teaching and learning.
- . . . support summer intern programs for undergraduate students.



# Research Internships

ed.fnal.gov/interns

## IMSA Interns

### Teacher Programs and High School Student Programs

<p><b>TRAC - Teacher Research Associates Program</b></p>  <p>Fermilab's Program for STEM teachers</p>	<p><b>QuarkNet Summer Research Program</b></p>  <p>For current high school students</p>	<p><b>TARGET - Fermilab's Science and Engineering Program</b></p>  <p>For 10th &amp; 11th graders in Illinois</p>
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### Undergraduate Programs

Use the program chart to help you choose the right program for you.

#### Program Chart - Former Interns

<p><b>CCI - Community College Internships</b></p>  <p>For community college students</p>	<p><b>IPM - Internship for Physics Majors</b></p>  <p>For foreign students in US &amp; non-US universities &amp; majoring in physics.</p>	<p><b>Italian Students - INFN and ISSNAF</b></p>  <p>For Italian physics &amp; engineering majors</p>	
<p><b>Lee Teng Undergraduate Internship</b></p>  <p>For juniors and exceptional sophomores in U.S. institutions when applying .</p>	<p><b>PARTI - Physics of Accelerators and Related Technology for International</b></p>  <p>For physics &amp; eng. majors in former U.S.S.R. countries</p>	<p><b>SIST - Summer Internships in Science and Technology</b></p>  <p>For majors in physics, elect. &amp; mech. eng. and CS in 4-year U.S. colleges</p>	<p><b>SULI - Science Undergraduate Laboratory Internship</b></p>  <p>For U.S. citizens from 4 and 2-year institutions &amp; majoring in physics</p>

### Graduate and Faculty Programs

<p><b>GEM - Graduate Fellowships in Engineering and Science</b></p>  <p>For Hispanic, Native American and Black U.S. citizens and permanent residents</p>	<p><b>SSSA - Italian Engineering Graduate Students</b></p>  <p>For graduate students from the Scuola Superiore di Sant'Anna of Pisa</p>	<p><b>VFP - Visiting Faculty Program</b></p>  <p>For faculty members with option to bring students</p>
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#### TRAC - Teacher Research Associates Program



Fermilab's Program for STEM teachers

#### QuarkNet Summer Research Program



For current high school students

#### TARGET - Fermilab's Science and Engineering Program



For 10th & 11th graders in Illinois

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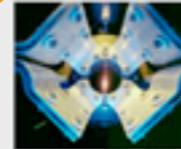
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For juniors and exceptional sophomores in U.S. institutions when applying .

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# Some 2012 Topics

Dark Matter in the Solar Neighborhood

Measuring Ground Motion with Seismometers

Asymmetry of the Milky Way

Visualization of the Electron Cloud in the Main Injector

QuarkNet  
Student  
Research

[quarknet.fnal.gov/fnal-uc](http://quarknet.fnal.gov/fnal-uc)





11 Teacher Workshops

# Professional Development



Teacher Resource Center



QuarkNet



Cosmic Ray Detector



11 Teacher Workshops

Teachers teaching teachers,  
modeling effective teaching,  
aligned with standards

## Professional Development

“ . . . trusted teachers to set up and run programs.  
. . . on the cutting edge of technology training, cross-curricular  
work and helping set up teacher alliance groups.  
. . . helped develop a renaissance in my teaching career.”

Lee Marek

# Preview Collection of K-12 Instructional Materials

Curriculum materials & books

Multimedia

Reports, periodicals & newsletters

Educational supply catalogs

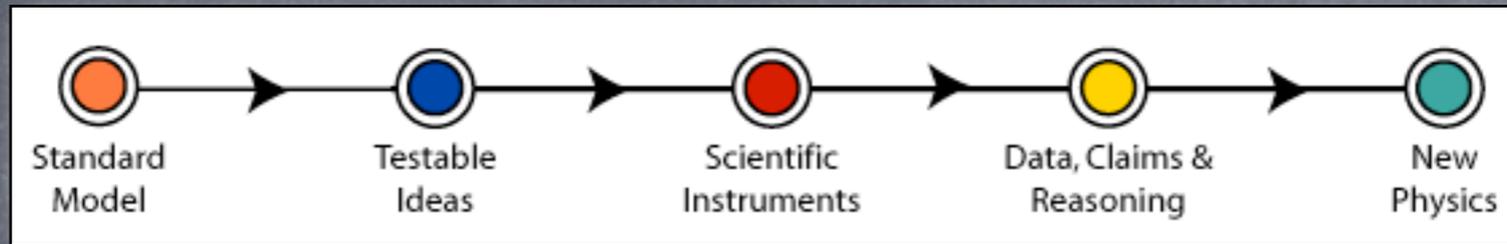
## Professional Development



Teacher Resource Center

Workshops  
Consultation Assistance  
Bibliographies  
Reference Services

# QuarkNet: Discovery Science



Professional  
Development

Joining the research community

Research-based

Long-term

Support for teachers

Huge volunteer effort



QuarkNet



[quarknet.fnal.gov](http://quarknet.fnal.gov)



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# QuarkNet: Discovery Science

● Particle physics research relies on indirect evidence to support claims.  
Scientists check for statistical uncertainties and systematic uncertainties, whether other experiments are able to verify new discoveries.



Online CMS Event Display    Fermilabyrinth    The Particle Hunters    Mini-Boone Results



QuarkNet



Professional  
Development

Joining the research community

Boot Camp for teachers

Research for teachers/students

Cosmic Ray Studies

CMS, Cosmic, LIGO e-Labs (I2U2)

CMS & ATLAS Masterclasses

[quarknet.fnal.gov](http://quarknet.fnal.gov)



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# High School Students

Masterclasses • e-Labs • Saturday Morning Physics • STEM Career Expo • Tours



**CMS e-Lab** Project Map Library Data Posters Site Map Assessment  
Text Version Cool Science About Us guest Log out

**Home: Join a national collaboration of high school students to study CMS data.**

**Project Map: To navigate the CMS e-Lab, follow the path; complete the milestones. Hover over each hot spot to preview; click to open. Along the main line are milestone seminars, opportunities to check how your work is going. Project milestones are on the four branch lines. [Getting Around the e-Lab](#)**

**Legend**  
● Milestone Seminar  
● Milestone

**Milestones (text version)**

Your team may use the milestones above, or your teacher may have other plans. Make sure you know how to record your progress, keep your teacher apprised of your work and publish your results.

# Elementary and Middle School Students Engaging Students in Scientific Investigations



Phriendly Physics (K-5)

Beauty and Charm (6-8)

Science Adventures

Scout Programs

Insects (Primary)

Prairie - Our Heartland (3-5)

Particles and Prairies (6-8)

# Classroom Presentations & Special Events

At a Career Fair



In the Classroom



At the Open House

At USA Expo

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Welcome

**Educators**

Physicists

Students

Visitors



Welcome to the website of the Fermilab Science Education Office. Click on the different audience tabs to find science education resources and information about our activities suitable for you. Click the videos to see the audiences in action.

Use the navigation bar at the top and bottom to learn more about us and our programs.

### Quick Links to Programs

- [Tours](#)
- [QuarkNet](#)
- [Fermilab - UChicago Center](#)
- [LInC Online](#)
- [Science Adventures](#)
- [Teacher Workshops](#)
- [Saturday Morning Physics](#)
- [Scout Programs](#)
- [Registration](#)
- [Internships](#)

**Volunteer Opportunities  
for Employees and Users**

### Quick Links to Resources

- [Lederman Science Center](#)
- [Teacher Resource Center](#)
- [Data-based Investigations](#)
- [Fermilabyrinth](#)
- [Prairie Resources](#)
- [Web-based Materials](#)

[ed.fnal.gov](http://ed.fnal.gov)

Fermilab Ed Site

Search

Google™ Custom Search



Like 78

More ways to follow ...



**Check out the  
Teacher Workshops**



**Attend the Family  
Outdoor Fair  
June 10th, 1 - 4 PM**

**Get FermiGear!  
Click Here**



Calendar for All

June, 2012

- 6 Get to Know Fermilab Guided Tour
- 9 Dinosaur Hunt
- 10 Junior Prairie Rangers - Prairie Pin Session 4

[More...](#)

### Education Office News

· [Bison, birds and bugs at Fermilab Family Outdoor Fair](#)

# By the Numbers

16,000 kids in classrooms

10,200 kids at the Lab

2,700 kids (+families too) for special events

— — —

800+ people for Ask-a-Scientist

3,000+ people on tours



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# K-12 Education Office Programs

# K-12 Education Office Programs

## **Research Experiences**

Academic Year High School Interns  
QuarkNet Summer Research (Student/Teacher Teams)  
TARGET  
TRAC

## **Field Trips/High School Tours**

Lederman Science Center  
Physics Science Experiences  
Beauty and Charm  
Phriendly Physics  
Prairie Science Experiences  
Insects at Work in Our World  
Prairie - Our Heartland  
Particles and Prairies  
Tours

## **Teacher Resource Center**

Resource Collections  
Workshops  
Chem West

## **Classroom Resources**

Classroom Presentations  
Data for Students  
I2U2 e-Labs & Science Investigations  
Online Resources  
What is scientific research?

## **Classes for Kids**

Prairie Rangers  
Saturday Morning Physics  
Science Adventures  
Scout Programs

## **Special Events for Kids and Families**

DUSEL Education Collaboration  
QuarkNet Masterclass  
STEM Career Fair  
Wonders of Science  
Family Open House  
Family Outdoor Fair

## **Awards (Supported by Fermilab Friends)**

Fermilab Science Award  
Fermilab Science Scholarship  
Program Scholarships

## **Professional Development for Teachers**

Fermilab/U Chicago QuarkNet Center  
I2U2 Teacher Workshops  
Physics Experiences Teacher Workshops  
Prairie Experiences Teacher Workshops  
Prairie Workshops  
QuarkNet Boot Camp  
QuarkNet Outreach  
Summer Secondary Science Institutes

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# Evaluation

Outside evaluators for NSF-funded QuarkNet & I2U2

Aurora University evaluation for credit-bearing workshops

Participant surveys for other professional development

Kid surveys for informal classes

Docent evaluation for tours & field trips

## What Visitors Say

“ . . . we thoroughly enjoyed our day, from the beginning in the Lederman Science Center to our time in Wilson Hall and the Linac.”

“ . . . we had frantic people calling to register for the science program when they knew Fermilab was coming!”

“ . . . we truly appreciated your candor, humor and your praise for engineering as a career.”

# Education Office Challenges

## Development:

Updating physics programs to reflect Fermilab post-Tevatron physics

Developing discovery science resources

Aligning materials & workshops with Next Generation Science Standards

Piloting local masterclasses for high school students

Completing the Lederman Center physics playground

## Ongoing Issues:

Number of undergraduate interns

Space