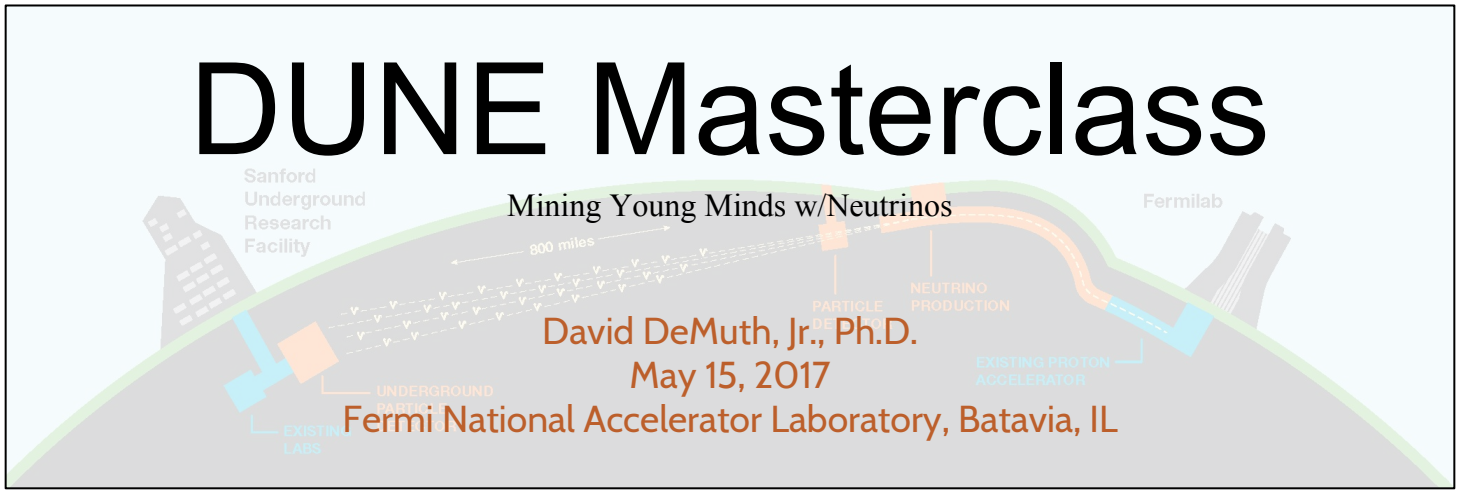
# DUNE Masterclass




Mining Young Minds w/Neutrinos

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May 15, 2017

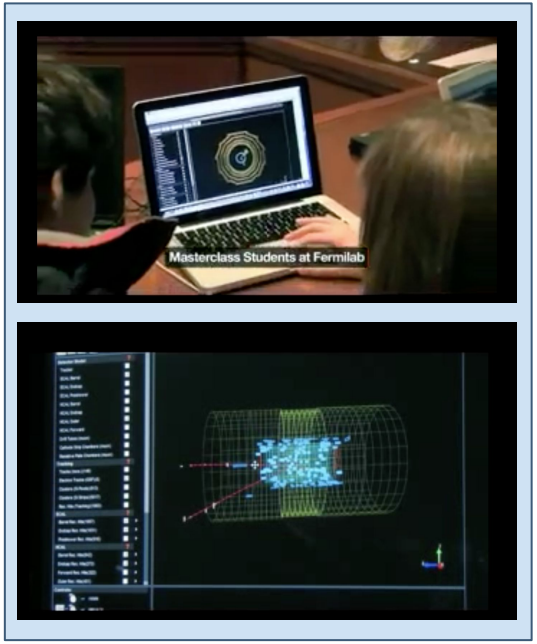
Fermi National Accelerator Laboratory, Batavia, IL

# DUNE Masterclass

Some very good models exist which provide a framework for a DUNE-focused Masterclass:

1. International Particle Physics Outreach Group (IPPOG)
2. Quarknet: Helping Develop America's Technological Workforce
3. Partnership of Integration of Computation into Undergraduate Physics (PICUP)

My goal is to partner with interested colleagues to develop a two day Masterclass training for teachers piloted during the Summer 2018 at Fermilab, with a stipulation that participants employ and assess these techniques in their classroom during the 2018-19 school year.




www.physicsmasterclasses.org

# Some Reasons on Why We Do This

- Motivate an interest in HEP, Physics, and prompting the next gen physicists
- Experience what it's like to be a physicists for the day.
- Analyze real experimental data (LHC, Alice, NOvA, ..., DUNE)
- Learn physics in the context of data analysis
- Provides concrete and inspiring examples of physics
- Develop an understanding and appreciation for multi-national mega-science
- Communicate HEP to the next generation of scientists
- Connect to CERN, connect to FNAL, connect to local university, potential recruiting opp.
- Lower the barriers for students to participate understand particle physics
- Not just for physicists
- Trigger interest in physics
- Demystify FNAL, SURF, CERN, ...
- Communicate research to general public, to next-gen scientists


https://www.youtube.com/watch?v=lMcIDQnJFlk

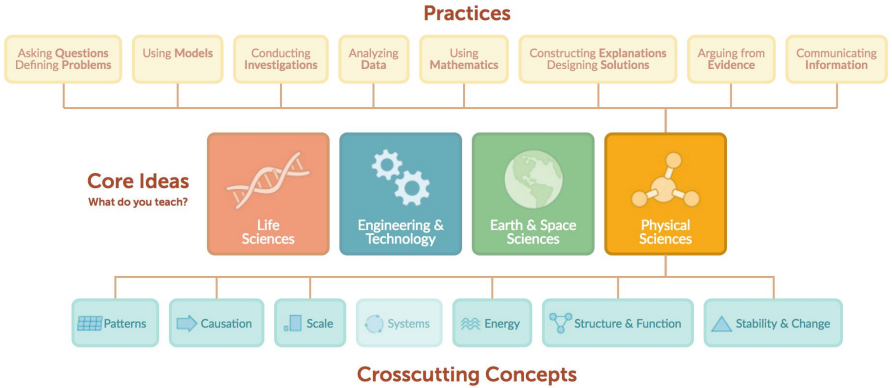
# Personal Goals

Build upon HEP experiences and STEM capacities in North Dakota to:

- Influence our nation's youth to become critical thinkers, problem solvers
- Discover concepts of physics set from a context of particles and fields
- Extract relevance from mathematical and computational thinking
- Develop skills that have students hitting the college-ground running
- Nurture student interest/capacity for physics, CS, and engineering degrees
- More...

# NGSS and ESSA

NEXT GENERATION SCIENCE STANDARDS
For States, By States

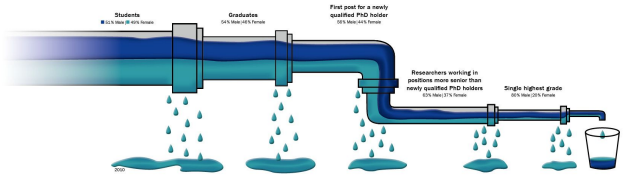



NGSS Opportunities

- Practices and Crosscutting Concepts (ALL)
- Embrace, requires what teachers are constrained to teach
- Can we make their teaching better, easier, efficient

ESSA Opportunities

- Problem-based, Project-based, STEM
- Model integrative STEM
- Collaborative problem solving

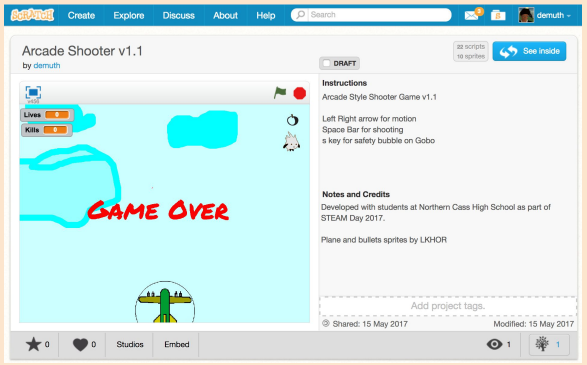


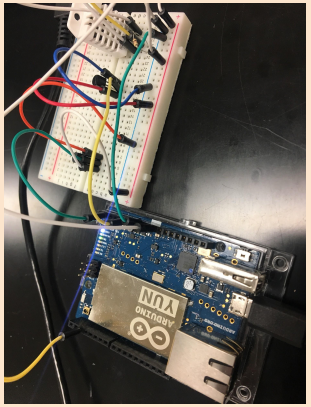
# Ideally STEM Education Begins Early

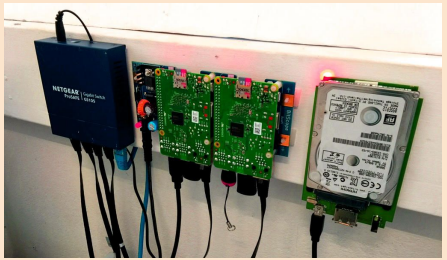
## Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)



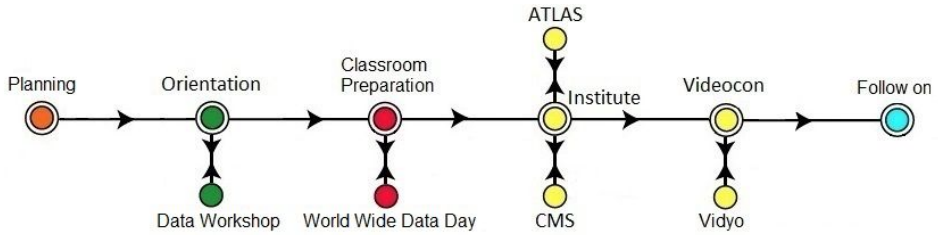





Can a Longer-term Goal include the Nurturing of Interest in STEM in Earlier School Days?

# Timeline

- Establish planning group - Summer 2017
- Prioritize programmatic breadth - Summer/Fall 2017
- Plan for DUNE, using existing live data
- Program for teachers, 2 day
- Program for students, 1 day
- FNAL + 1 metro, + 1 rural
- Explore Grant funding
- Expand templated program to U.S. Universities



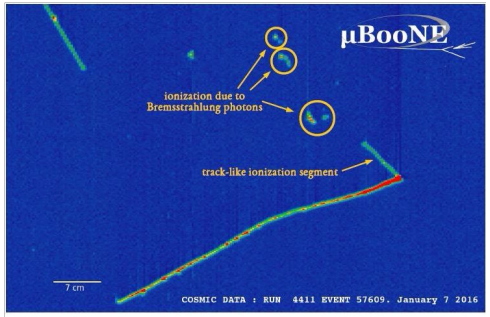
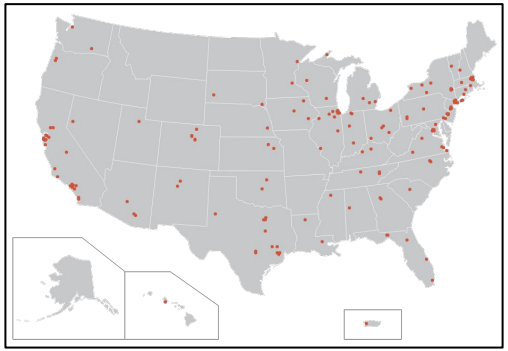




**Figure 3**: Candidate Michel electron event from cosmic-ray data, which produces a track-like segment of deposited charge due to ionization as well as several radiative photons.



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