THE DEEP UNDERGROUND
SCIENCE AND ENGINEERING
LABORATORY (DUSEL):
OPPORTUNITIES TO ENGAGE
AND INSPIRE

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From Gold Mine to Laboratory

1877

Circa 1930s

Circa 1980

May 2009

Circa 1970s

Feb 2010

May 2009
Physics and astrophysics: The Underground Universe

- What is the universe made of?
- How did the universe evolve?
- What happened to antimatter?
- What is dark matter?
- What are neutrinos telling us?
- Are protons unstable?
Early Physics Experiments

Large Underground Xenon (LUX) – search for dark matter

MAJORANA - neutrinos
What are the interactions among subsurface processes?

Can we reliably predict earthquakes?

Are underground sources of drinking water safe and secure?

Can we make the earth “transparent” and observe underground processes in action?
Geology (SDSMT, FNAL, UCB, LBNL, Montana, Wisconsin)
How does subsurface microbial life evolve underground?

Did life on Earth originate beneath the surface?

Is there life underground as we don’t know it?

How do biology and geology interact to shape the modern world?
Biology (BHSU, SDSMT, SDSU, Princeton, UTK, ORNL)
What are the mechanical properties of rocks?
How can technology lead to a safer underground?
How does rock respond to human activity?
How does water flow deep underground?
What lies beneath the boreholes?
DUSEL on the world stage
The Sanford Center for Science Education

The mission of the Sanford Center for Science Education at DUSEL is to draw upon the science and engineering of DUSEL, its human resources, its unique facility, and its setting within the Black Hills to develop and facilitate rich, innovative learning experiences that

- engage and connect diverse audiences of students, educators, scientists, engineers and the general public,
- inspire and prepare future generations of scientists, engineers and science educators, and
- deepen understanding of science and engineering.
Historical cultures of the region:
- Regional tribes
- Rural (ranching)

Contemporary Influences:
- Tourists/retirees, etc.
- DUSEL Scientists
- National/international enthusiasts

SCSE at DUSEL:
- Mining culture
Challenges and opportunities

1. Creation of a modern, innovative science education/visitor’s center while respecting and embracing the history and culture of the region
2. Remoteness of the location (geographically)
3. Remoteness of the science (vertically)
The Audience for the SCSE

Committed engagement
Science aficionados
Teachers as researchers
Undergraduate & Secondary students as researchers

Deeper engagement
Lifelong learners
Secondary teachers
Secondary students
Scientists as educators

Casual Engagement with the Science
Casual visitors/tourists
Primary teachers
Younger students

Sanford Underground Laboratory at Homestake
Early activities – onsite

Building partnerships, capacity, and prototyping future programs

General Public:
Neutrino Day 2010

K-12 Educators:
Spearfish science teacher inservice day

K-12 Students:
GEAR-UP Freshmen tour WWTP

Davis-Bahcall Scholars 2009
Undergraduates:
Dave Bozied Interns 2010

Spearfish science teacher inservice day
Sanford Underground Laboratory at Home
Early activities – offsite

Building partnerships, capacity, and prototyping future programs

General Public: New Sanford Lab Video (2010)


General Public: BHSU Pow-wow (2010)
Early activities – via Internet

Building partnerships, capacity, and prototyping future programs

vDUSEL demo

All levels: Virtual DUSEL

Scientists/Engineers: Internet 2 extravaganza – April 2010

K-12 Educators: Distance learning follow-up to summer PD

K-20: Remote data access from underground

Sanford Underground Laboratory at Homestake
HD Videoconferencing opportunities

- Connect a classroom with a scientist for a lecture or facilitated activity
- See science in action underground*
- Connect teacher workshops to a scientist
- Connect students to data (e.g. cosmic ray)

* Planning is in progress for an ‘Extreme Life’ pilot event for Fall 2011.
  - travel underground with a scientist looking for micro-organisms
  - go into a genomics lab and see how the organisms are analyzed
  - implications for life on other planets
2008  Early Science begins (geo, bio)
2009  Mine is dry to 4850’ level
2010  LUX Surface Lab complete
2011  Majorana underground lab complete
2012  LUX moves underground
2011  NSF approves DUSEL
2011  Mine is dry to 8000’ level
2011  NSF approves DUSEL
2014  DUSEL construction starts
2018  Surface campus/SCSE complete
2018  First DUSEL cavern ready for science
2019  First Mega-cavern ready for science