CReSIS Education Programs

The United States is a leading nation in polar science, and research results have global significance. As well, the polar regions intrigue the public and provide opportunities for educational enrichment.

…. Kelly Falkner, Director of NSF Polar Programs

The National Science Foundation **(NSF)**
National Aeronautics and Space Administration **(NASA)**
Kansas Board of Regents **(KBOR)**

The University of Kansas **(KU)**
Elizabeth City State University **(ECSU)**
The Pennsylvania State University **(PSU)**
Indiana University **(IU)**
University of Washington **(UW)**
Association of Computer and Information Sciences and Engineering Departments at Minority Institutions **(ADMI)**
Los Alamos National Laboratory **(LANL)**
Centre for Ice and Climate, Niels Bohr Institute, University of Copenhagen **(CIC)**
Center for Polar Observations & Modeling **(CPOM)**
Indian Institute of Technology Kanpur **(IITK)**
University of Magallanes **(UM)**

CReSIS
Center for Remote Sensing of Ice Sheets

CReSIS Education

I. Overview of CReSIS Education Program
II. Graduate and Undergraduate Programs
III. K-12 Program and Teacher
IV. CReSIS Student Presentation

The Education Team

Linda Hayden, Director of Education

Peter Burkett, PSU Education Coordinator

Geoffrey Fox, IU Education Coordinator

Darryl Monteau, KU Education Coordinator

Darnell Johnson, ECSU Education Coordinator

Ian Joughlin, UW Education Coordinator

Andrea Lawrence, ADMI Education Coordinator

Cheri Hamilton, K-12 Outreach Coordinator

Brandon Gillette, Graduate Research Assistant

Xiushan Jiang, Graduate Research Assistant

Kuang–Chen Hsu, Graduate Research Assistant

Kelsey Leinmiller-Renick, RET Undergraduate Student

Vision & Mission for Education

Vision Statement for Education

To inspire, educate and train the next generation of scientists and engineers for the nation in center-related disciplines.

Mission Statement for Education

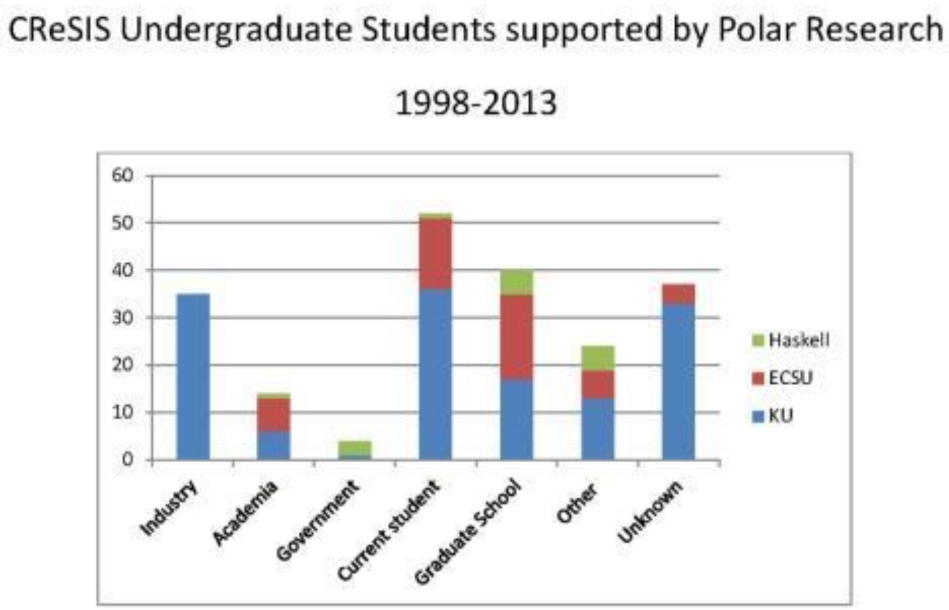
Educate and train a diverse group of students to participate and lead future research in international, multidisciplinary, polar science. Provide opportunities and paths for students at all levels to pursue careers in science and engineering.

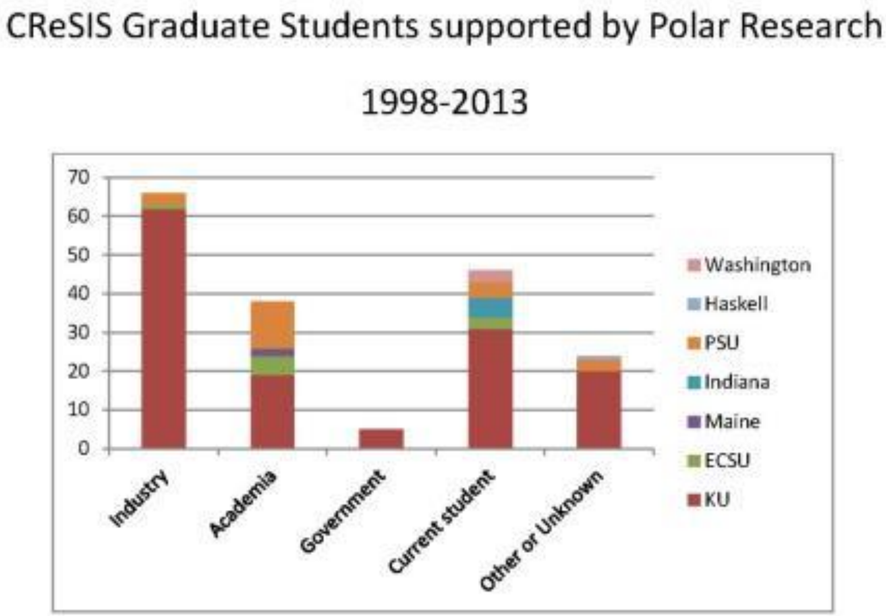
Education Objectives

Graduate and Undergraduate Education

- Develop and teach courses that broaden technical and scientific education across partner institutions using videoconferencing facilities
- Integrate Center research into science and engineering undergraduate and graduate courses.
- Expand these courses to other disciplines by leveraging a new KU NSF-IGERT program known as Climate Change, Humans, and Nature in the Global Environment (C-Change)
- Educate students in subjects outside their primary discipline, such as geoinformatics, glaciology, and remote sensing.
- Provide internship opportunities in industry, national laboratories and internationally.
- Organize monthly "all-hands" meetings that include presentations on some aspect of the Center's mission.
- Engage graduate and undergraduate students in Center decisions through the CReSIS student organization.
- Increase the pool of underrepresented graduate students through exchange program, such as REU's between research universities and minority-serving institutions.
- Motivate students to pursue careers in the STEM fields; including reinforcing the necessary foundational skills.

CReSIS Student Support





A total of 206 UGRA's and 184 GRA's have been supported since 1998. 103 are currently working in Industry and 53 in Academia.

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Undergraduate/Graduate Program

- Courses Offered
  - Geosciences (Penn State)
  - Remote Sensing/Math (ECSU)
  - Electrical Engineering and Computer Science (KU)
  - Aerospace Engineering (KU)
  - Information Technology (IU)

- Enrollments

  Fall 2012/Spring 2013:

  - 8 Graduate courses/1 Undergraduate course
  - 127 total students enrolled in courses

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Undergraduate/Graduate Program

- Graduate Recruitment
  - National Society of Black Engineering Conference (NSBE)
  - Relationships with KU School of Engineering, Geography
  - ADMI Institutions
  - REU program

- Study Abroad/Hosting Opportunities
  - KU CReSIS hosting 2 international PhD students for the spring 2013 (University of Copenhagen and Technical University of Denmark)
  - 3 KU CReSIS GRAs participated in Operation IceBridge Airborne Radar Surveys with NASA P-3
  - 2 PSU GRAs and 1 KU GRA participated in the NEEM/NEGIS mission to Greenland

Undergraduate/Graduate Program

- Undergraduate/Graduate Presentations and Publications
  - 5 ECSU REU students and 1 PSU graduate student attended the IGARRS 2012 conference in Munich, Germany
  - Brandon Gillette's (PhD/GRA) article titled "Explorations of our Frozen Planet" was published in the December 2012 edition of *Science Scope*
  - Brandon Gillette (PhD/GRA), Kelsey Leinmiller-Rennick (undergraduate) and Steve Foga (MS/GRA) collaborated on an article titled "Remote Sensing – Radar Analysis" which was published in the February 2013 edition of *The Science Teacher*
  - Xiushan Jiang (PhD/GRA) and Brandon Gillette (PhD/GRA) will be at the 2013 American Educational Research (AERA) conference on their paper titled "How Effective is Problem-Based Learning in K-12 STEM Education Compared to Lecture-Based Learning? A Meta-Analysis of Quantitative Studies from 1990-2012)"
  - Emily Arnold (PhD/GRA), attended the Antenna Application Symposium and gave a presentation "Identification and Compensation of Aircraft Integration Effects in Wing-Mounted Phased Array for Ice Sheet Sounding"

Research Experience for Undergraduates (REU) Program

Program objectives were :

1. To provide summer educational opportunities for undergraduate students in the areas of polar science and cyberinfrastructure; and
2. To attract a diversified pool of talented students into careers in science and engineering, including teaching and research related to polar science and cyberinfrastructure (CI).

2012 Program Demographics:

- 57% of participants were women
- 78 % of participants were minority students (70% Black, 4% Hispanic, 4% Native American)

Research Experience for Undergraduates (REU) Program

KU

ECSU/PSU

IU

Research Experience for Undergraduates (REU) Program

Students spent eight weeks conducting supervised research projects sponsored by CReSIS via NSF. One REU student from an ADMI institution returned for a second summer. The 2012 demographic distribution included students from 13 institutions; eight of these were minority-serving institutions (MSIs). Many of these colleges/universities have limited research opportunities in STEM. These institutions included:

MSIs
=====
St. Augustine's College
Elizabeth City State University
Mississippi State University
Winston Salem State University
Spelman College
Jackson State University
Norfolk State University
Haskell Indian Nations University

Non-MSIs
========
Gettysburg College
University of Alaska Fairbanks
Rice University
Kansas State University
UCLA

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Research Experience for Undergraduates (REU) Program

Research Projects:

- Geothermal Heat Flux Beneath the Greenland Ice Sheet Calibrated and Observed Basal Meltwater Conditions
- How does precipitation and temperature contribute into the decreasing glacier mass balance?
- Traveling Radars: Designing a Sled
- Transmit Waveform Shaping for a FMCW Radar
- Utilizing Datasets from the CReSIS Data Archives to Visualize Greenland Echograms Information on Google Earth
- Using CReSIS Radar Data to Determine Ice Thickness at Pine Island Glacier by Topographic Identification of Surface
- FutureGrid Curriculum: Communicating Parallel and Distributed Computing Concepts for Disadvantaged Communities
- Multidimensional Scaling: Visualizing Gene Sequencing Data

CReSIS Student Organization (CSO)

- CSO
  - K-12 Outreach Activities
    - Ice, Ice Baby Training for Students
  - All-Hands Presentations
  - Workshops/Seminars for Students
    - Writing
    - CV/Resume
  - Social Activities
    - Bowling night
    - Monthly donuts/coffee
    - CSO Olympics
    - Graduation Recognition
    - Royals game

CSO Graduate Student Mentoring Award

"The CReSIS Graduate Student Mentoring Award was enacted to recognize the outstanding contribution that our graduate students make to the CReSIS education and outreach efforts,

The CSO award acknowledges Master's and Ph.D. graduate students at CReSIS institutions who have greatly contributed to the research and professional development of future scientists and engineers. Awardees receive a certificate and $500 from the CReSIS Student Organization.

Recipients of this award must meet a number of qualifications established by CReSIS, including the following:

- The awardee has worked collaboratively for four or more weeks with a team of one or more undergraduate students on a CReSIS related project.
- The awardee must have the recommendation of a CReSIS faculty member to be considered for this award.
- Awardees agree to give a talk with their mentees as part of the All-Hands lecture series.

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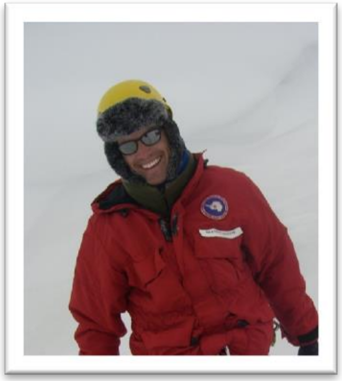
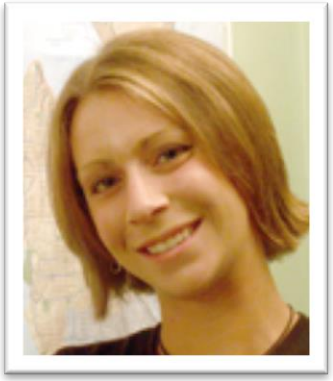
Graduate Student Awardees



Brandon Gillette – Univ. of Kansas
How does precipitation and temperature contribute into the decreasing of glacier mass balance?



Ms. Kristin Poiner – Univ. Washington
Do strain rates determine the spatial density of crevasses on the Greenland Ice Sheet?

Ms. Brooke Medley– Univ. Washington
Developing a method for estimating accumulation rates using CReSIS airborne Snow Radar from West Antarctica

Je'aime Powell- ECSU was awarded the Student Leadership-Graduate Level award during the HBCU Engineering Deans' Power Breakfast.

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CReSIS All-Hands Meetings

Date	Title	Name	Affiliation	External/ Internal
3/26/12	Evidence of meltwater retention within the Greenland Ice Sheet	Dr. Åsa Rennermalm	Rutgers University	External
8/30/12	CReSIS Sustainability	Dr. Prasad Gogineni	Faculty/PI	Internal
9/5/12	Identification and Compenstation of Aircraft Integration Effects in Wing-Mounted Phased Arrays for Ice Sheet Sounding	Emily Arnold	GRA (PhD)	Internal
9/25/12	Methodology of Science and the REU Program	Brandon Gillette	GRA (PhD)	Internal
10/12/13	Potential Paleo Perspectives on Ice Sheet Collapse – Cosmic Ray Produced Nuclides in Subglacial Bedrock	Dr. John Stone	University of Washington	External
10/24/12	Remost Sensing Studies from Space, Air, and Ground: Applications for the Cryosphere in the Western Ross Sea Region	Wolfgang Rack	University of Canterbury	External
11/1/12	Greenland Ice Cores Inform on Past Warm Climate Periods	Dorothe Dahl-Jensen	Faculty	External
11/19/12	Ice Sheet Modeling and Applications to the Past, Present and Future Glaciation of the Earth	Ralf Greve	Hokkaido University	External
2/19/13	CReSIS Collaboration-From the Science to Outreach	Kelsey Leinmiller-Rennick, Steve Foga, Brandon Gillette	Student, GRAs	External
3/6/13	Insights into Ice-Sheet Dynamics from Radar Sounding	Joe MacGregor	University of Texas	External
3/14/13	Garmin Visit to CReSIS	Anita Finn	GARMIN	Internal (CReSIS Students)

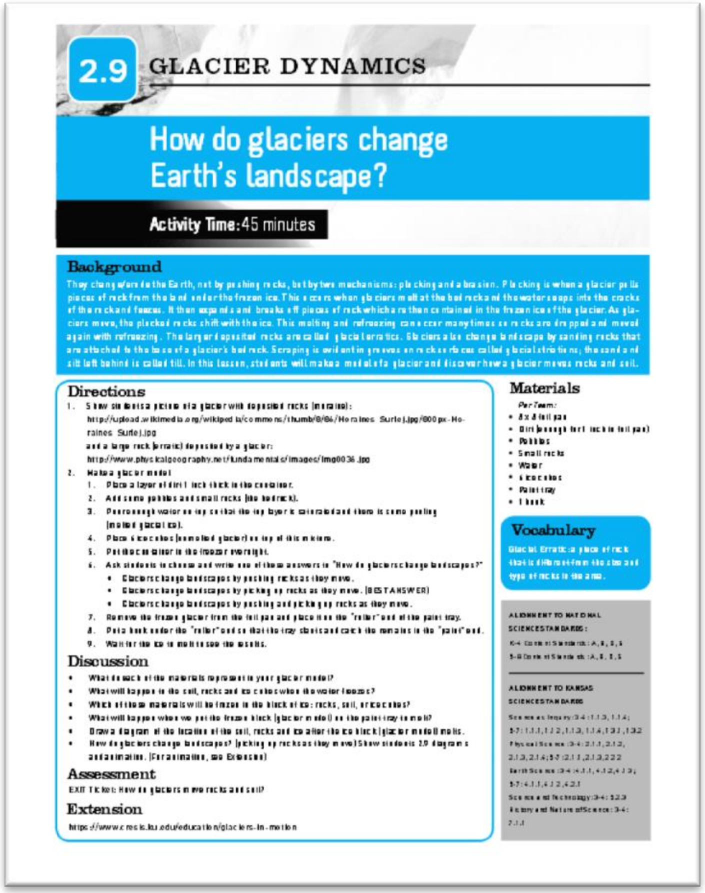
Highlights

The Center has experienced significant success in minority graduate recruitment. Most notably, during Year 8, the percentage of underrepresented minority graduate students was at 30% compared to 7% in Year 2. The underrepresented minority graduate students include both Hispanic and African-American student populations.

Two 2011 REU students (Robin Evans and JerNettie Burney) began graduate studies at Indiana University in September 2012. Three other past REU students have expressed an interest in starting the masters degree program at IU in fall 2013. Jerome Mitchell continues in the PhD program at IU.

The current Education Coordinator has been actively engaged in recruiting students from Haskell Indian Nations University (MSI, TCU). Two Native American Indian students will participate in the 2013 REU program.

New lessons and revised curriculum
For K-8 students


2.9 GLACIER DYNAMICS

How do glaciers change Earth's landscape?

Activity Time: 45 minutes

Background

Directions

Materials

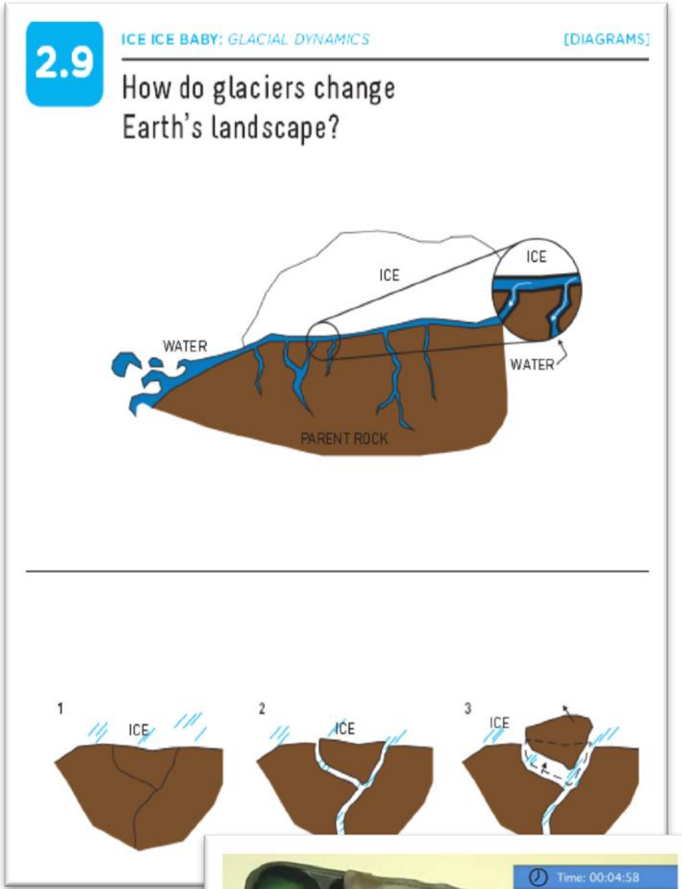
Per Team:

Vocabulary

Discussion

Assessment

Extension


2.9 ICE ICE BABY: GLACIAL DYNAMICS [DIAGRAMS]

How do glaciers change Earth's landscape?

New Animations

http://youtu.be/xyivMIghJsQ

http://people.ku.edu/~k557h516/CReSIS/SummerGame.html

Glacier Goo and YOU

ICE ICE BABY!

New interactive book for ages 6-10

Coming soon!
eBook and
iPad application

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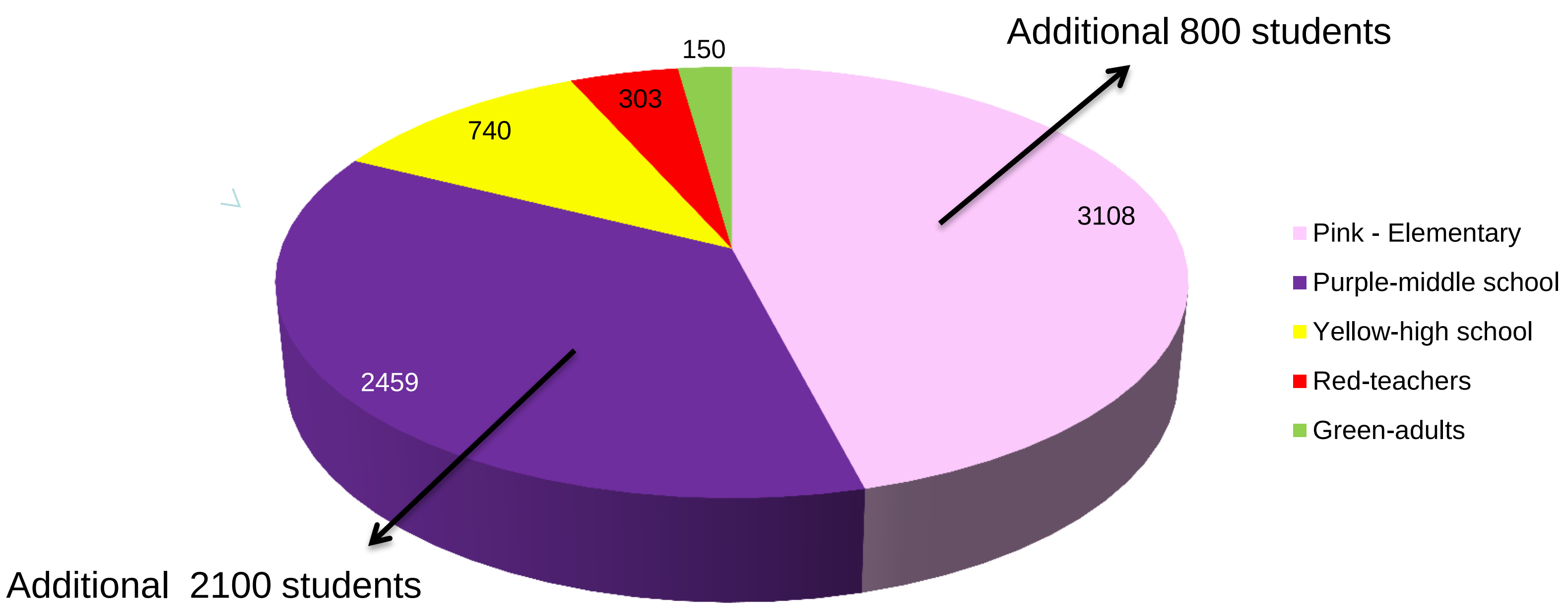
New strategies – Train the Trainers!



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Scientists as Trainers

TIPS AND TRICKS

KEYS TO COMMUNICATING YOUR SCIENCE:
SIMPLE STRATEGIES FOR SCIENTISTS

TIPS AND TRICKS "TO GO" PRINCIPLES FOR SCIENCE PRESENTATIONS

- Learn all you can from the event organizer ahead of time.
- Know your audience. How many students? What are their ages? How much do they already know?
- Plan using "backward design". Decide what you want them to know at the end of your presentation before you plan it.
- Before you go, tell the organizer if you need technical equipment!
- Computer-generated presentations are a nice aide, but do not use too many words or graphs. Remember not to use red and green!
- Hook 'em with a good story, a strange or startling fact or a tool or artifact for them to touch.
- Use props!
- Engage them with activities and questions.
- Leave while there is still high interest! Do not overstay.
- Stay in touch. Tell them to follow your blog or send additional questions.

TIPS AND TRICKS FOR PRESENTING INCLUSIVELY TO ALL AUDIENCE MEMBERS

- Speak clearly and face your audience.
- Make text clear by using larger fonts with greater spaces between words and lines.
- Use short key phrases as bullet points instead of single words to help with context.
- Color blindness causes difficulty in distinguishing between red, orange, yellow, yellow-green and green, also between blue and violet.
- Reading words with high contrast (black on white) is difficult. Use black text on light pastel shades of blue, yellow or green.
- Bring a few copies of your presentation for those who need them for their disability.
- Use props, video clips and sounds to help maintain focus for your audience.
- Provide clear signposts, targets and summaries to reinforce understanding of your key points.
- Glossaries of key words are helpful for those who have reading or spelling difficulties.

TIPS AND TRICKS FOR PRESENTING TO COMMUNITIES

- Successful community-based outreach is best when personal contact such as face to face meeting or a phone call is the first contact. Continue to follow up with emails or messages.
- Encourage questions at any time during the presentation to keep the audience engaged.
- Show the relevance of your research by putting using examples of changes in their own community ecosystems (less fishing due to sea ice melt, for example).

Polar Science and Global Climate, An International Resource for Education and Outreach
Editor Bettina Kaiser, 2010

KEYS TO COMMUNICATING YOUR SCIENCE:
HANDS-ON HOOKS FOR SCIENTISTS TO USE

HANDS-ON HOOKS

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What Makes a Glacier Slip?

https://www.cresis.ku.edu/sites/default/files/2011_Ice_Ice_Baby/2.8-IIB_lesson.pdf

ANDRILL

When Ice Meets the Sea

www.andrill.org/education

ICE Ice Drilling Program Office Climate Expeditions

What Could Have Caused a Year Without Summer?

http://www.climate-expeditions.org/educators/Polar_Detectives_Activity.pdf

ANDRILL

What if the Ice Shelves Melted?

www.andrill.org/flexhibit

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How Does a Topographic Map Show Sea Level Rise?

https://www.cresis.ku.edu/sites/default/files/2011_Ice_Ice_Baby/1.3-IIB_lesson.pdf

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Teachers as Trainers

Polar Explorers Grant –
Lawrence Public Schools

First interdisciplinary unit
developed with CReSIS education-

Dr. Leuschen at Sunflower Elementary

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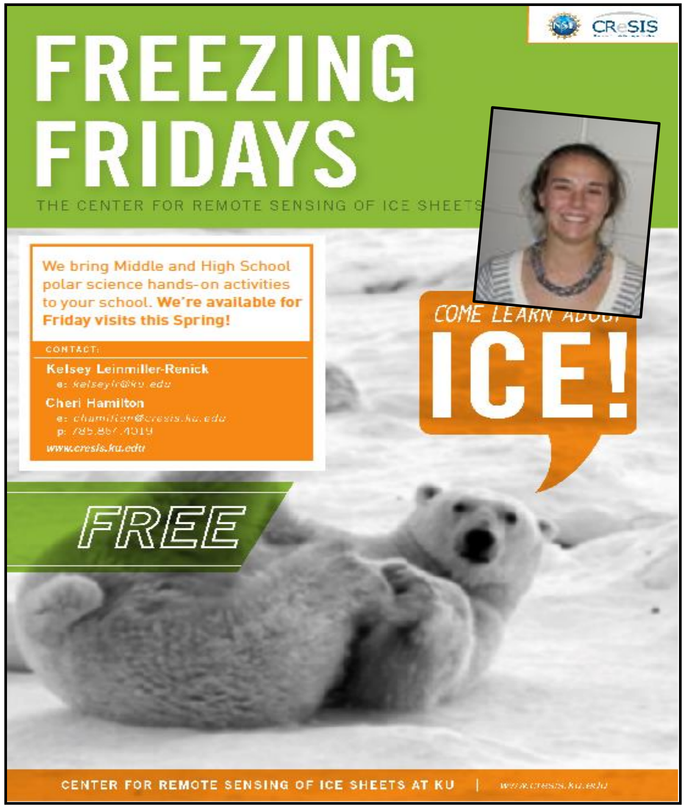
Students as Trainers

REU student Malcolm McConner – Ice, Ice Baby lesson during the Celebration of Women in Mathematics at ECSU.

IU Ph.D. student Jerome Mitchell – taught robotics lesson to high school students.

CReSIS High School Robotics – mentoring elementary school students.



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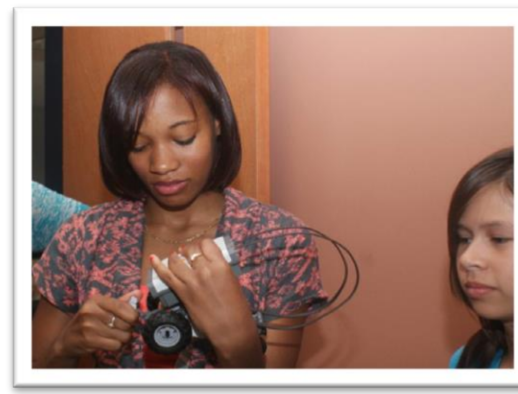
ECSU Mathematics Education majors conducted measurement workshops for the CReSIS middle school workshop.



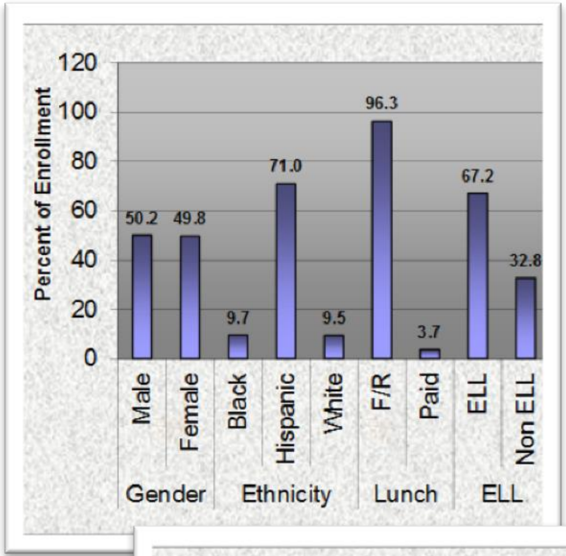
CReSIS REU students conducted College and Career Lunch and Robotics Seminars for the middle school students.

Grades K – 5 Outreach

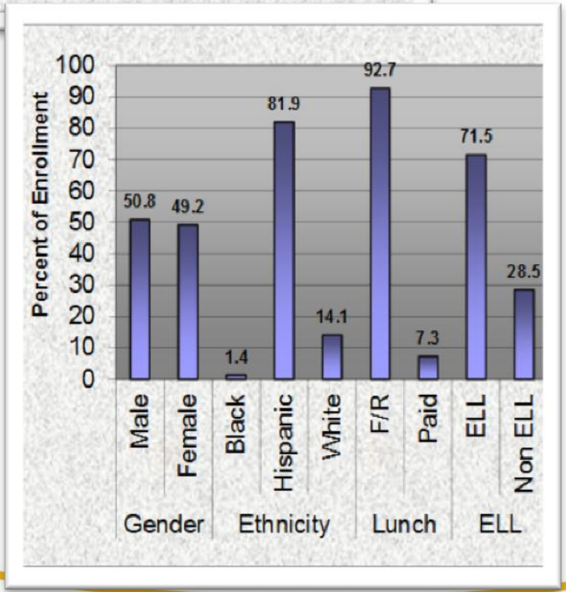
Monthly classroom instruction provides:

- best practice in science instruction
- 45 minute activity with notebook journaling/assessment
- 1 class lesson for teacher
- 1 take-home student lesson

Whittier



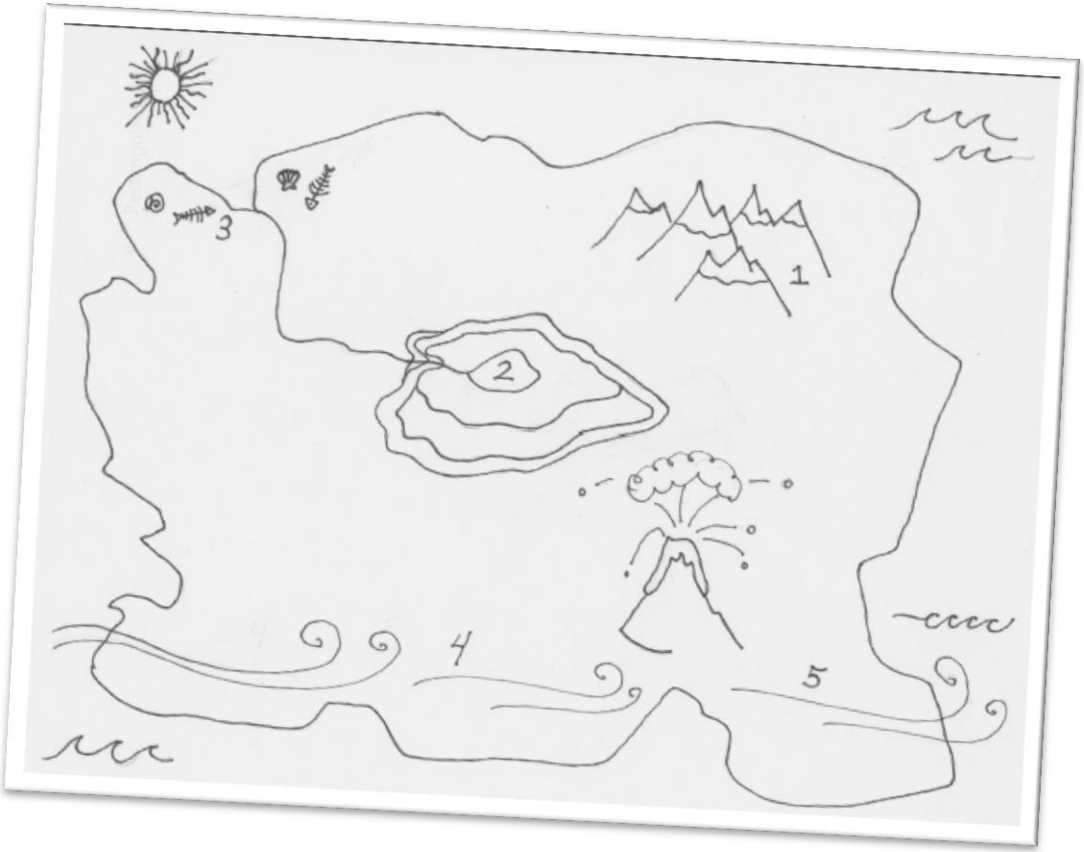
John Fiske



Shake, Rattle, and Rocks!

An Ice Core as a Time Capsule

Peter Burkett (PSU), designed an activity for 75 5th graders demonstrating the history contained in ice cores.



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ECSU Middle School Workshop

Freezer BURN

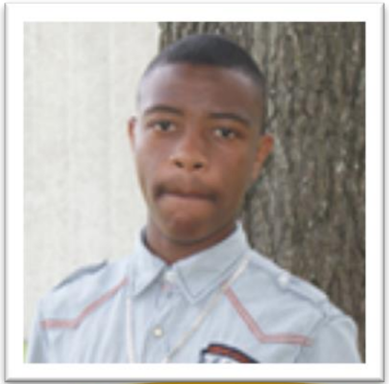
Darius Dunton
LaMont Winslow Jr.
Shabazz Foreman

Science Question: Does a glacier go faster with a bed of rock or a bed of water?

Hypothesis: We think the water will help the goo move faster.

:: 2012 CReSIS Middle School Program

http://cerser.ecsu.edu/cresis/cmsp2012/



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Results:

The goo/glacier moved faster when on top of a water bed.

Finished product
Description: what it looked like when it was finished.

Goo hitting the rock
Description: this is what happened in one of our tests

Grades 9 – 12 Outreach

- Classroom presentations
- Graphing calculator training
- Science Olympiad Event Sponsor

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High School Robotics – Ten students at I.C. Norcom High School in Portsmouth, Virginia

- Explored the use of autonomous robotics in industry and research
- Used the engineering design cycle and the fundamentals of robot design, analysis and robot prototyping
- Tested their robot design

Community Outreach

- Topeka Discovery Center
- Science Buzz Kiosk at KU Natural History Museum
- Family Science Nights at K-12 Schools
- Johnson County Science Cafe

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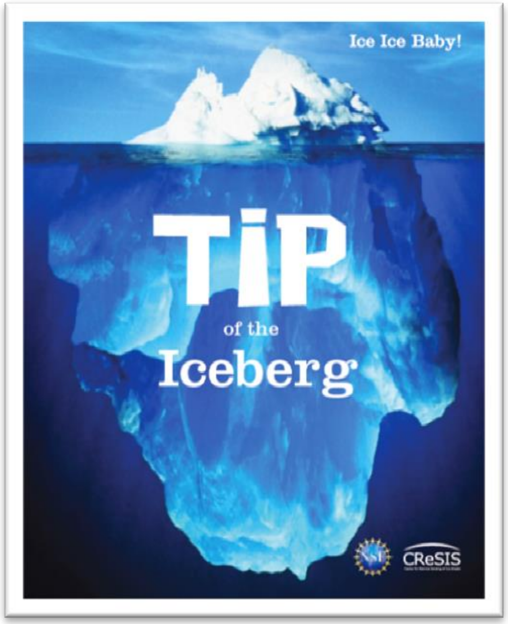
Teacher Professional Development

- Haskell Indian University Teacher Pre-service Courses
- Teacher Resource Day at UMKC (University of Missouri – Kansas City)
- Kansas City, KS Science Teachers In-service Presentations
- Webinars with Fort Hayes State and Polar Educators International
- KATS Kamp (Kansas Association of Teachers of Science)
- *Science Scope* and *The Science Teacher* articles

Dec. 2012; "Explorations of our Frozen Planet"

Feb. 2013; "Reading the Ice:
Using Remote Sensing to Analyze Radar Data"



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K-12 Educational Outreach

External Evaluation

Recommendations:

- Refine survey items to strengthen clarity and relevancy
- Revise survey scales to ensure accuracy
- Improve the reliability and validity of surveys by applying the Instrument Inventory Matrix especially designed for CReSIS surveys

Resulting in revisions in:

- Ice, Ice Baby pre-and post-survey(2012-2013)
- Ice, Ice Baby teacher evaluation survey(2012-2013)
- Glacier animation survey(2012-2013)
- Freezing Friday evaluation survey(2012-2013)

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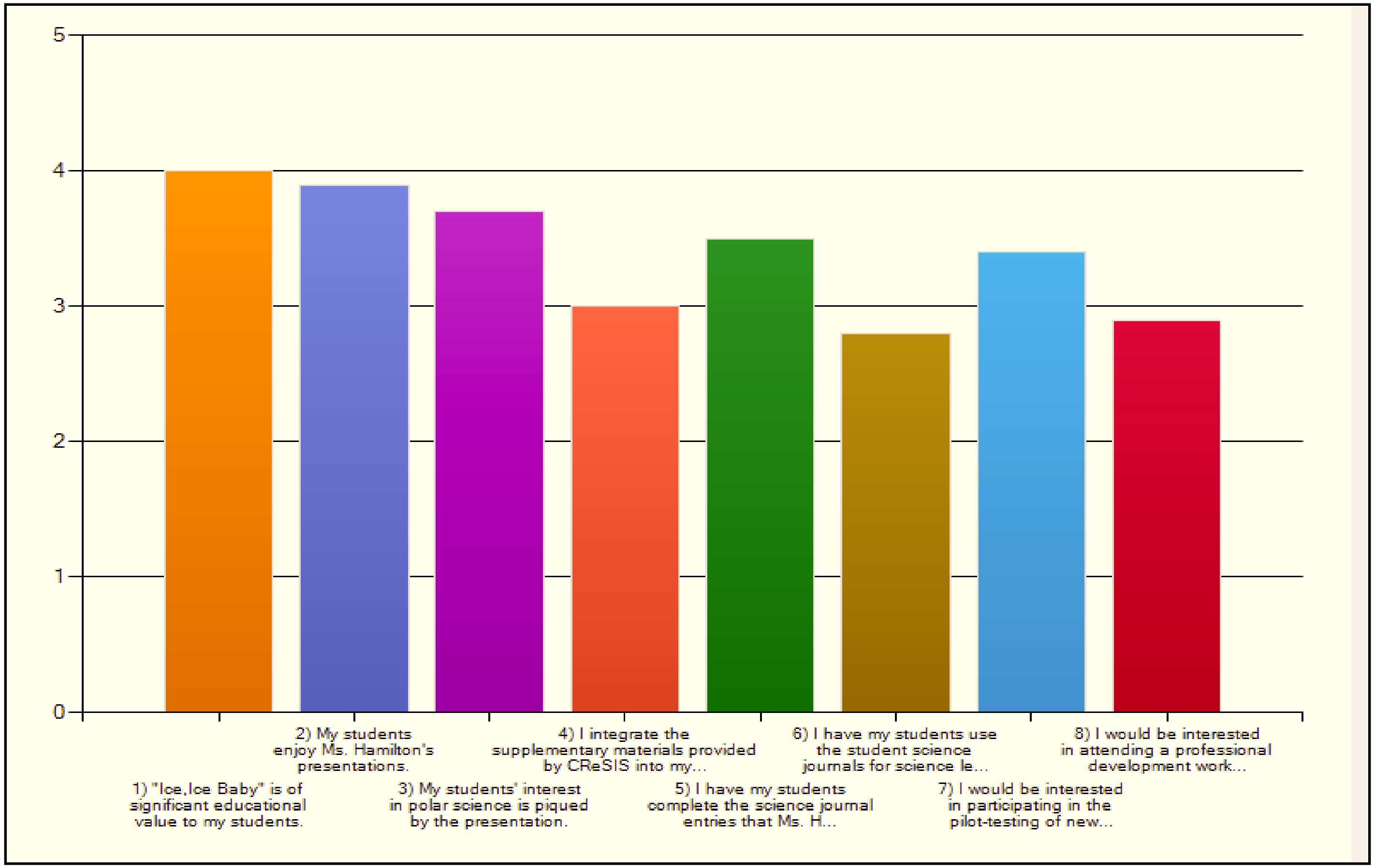
2011 – 2012 Ice, Ice Baby

Teacher Evaluation



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Future Outreach

Future Trainers?

- Glacier modeling activity for high school
- Survival lesson for grades 4-8
- New animation featuring echograms
- New Ice, Ice Baby videos and pictures
- NSTA STEM Conference Presentations in May 2013

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CReSIS RET Student

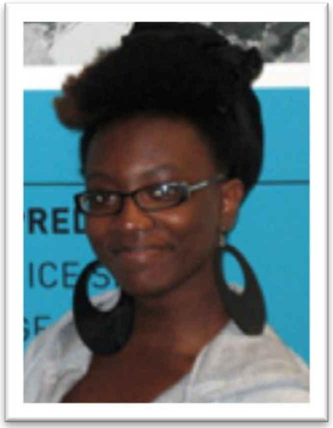
- Introduction
- CReSIS RET Program
- Science Connections
- *The Science Teacher*
- ‘Reading the Ice’
- Collaboration and Writing Process

REU/RET Program

- Expanded in 2011 to include pre-service teachers
- 2 RET participants in 2011; 3 RET participants in 2012

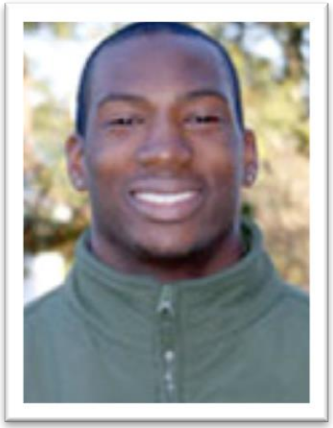
Research Experience for Pre-service Teachers RET Pilot Program

RET interns were assigned to specifically-designed research teams led by members of the CReSIS Education staff. Their projects included curriculum development efforts to integrate CReSIS science and data into the K-12 classroom, and *Utilizing ARCGIS in Education to Map a Glacier and its Changes Over Time* . Students on the RET teams were undergraduate students with a major Mathematics Education.



Erica Petersen Fr - MATHED - MVSU

Marvin Elder JR - MATHED - MVSU



Malcolm McConner SR - MATHED - ECSU

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RET Experience

Goals for Program:

- Increase knowledge base about research and technologies that advance understanding of ice-sheet and glacier dynamics.
- Understand the role of CReSIS in the development of reliable models to predict future sea level rise in a changing climate.
- Use new knowledge and teaching experience to create lesson plans for middle and high school students that incorporate CReSIS research and polar science.

Experiences at CReSIS

- Attended presentations by CReSIS scientists and engineers about current research and state-of-the-art technologies.
- Created a lesson mapping sea level rise for the K-8 *Ice, Ice, Baby!* curriculum.
- Developed lesson plans based on the remote sensing technology used in CReSIS research.

Science Connections

- **K-12 Outreach**
  - Freezing Fridays
- **Educator Education**
  - KATS KAMP
  - Teacher Resource Day, Science Pioneers
- **Curriculum Development**
  - Online Data Portal
  - Journal Publications

Facilitating teachers through CReSIS education material at KATS KAMP, April 2012
Photo by Carol Williamson

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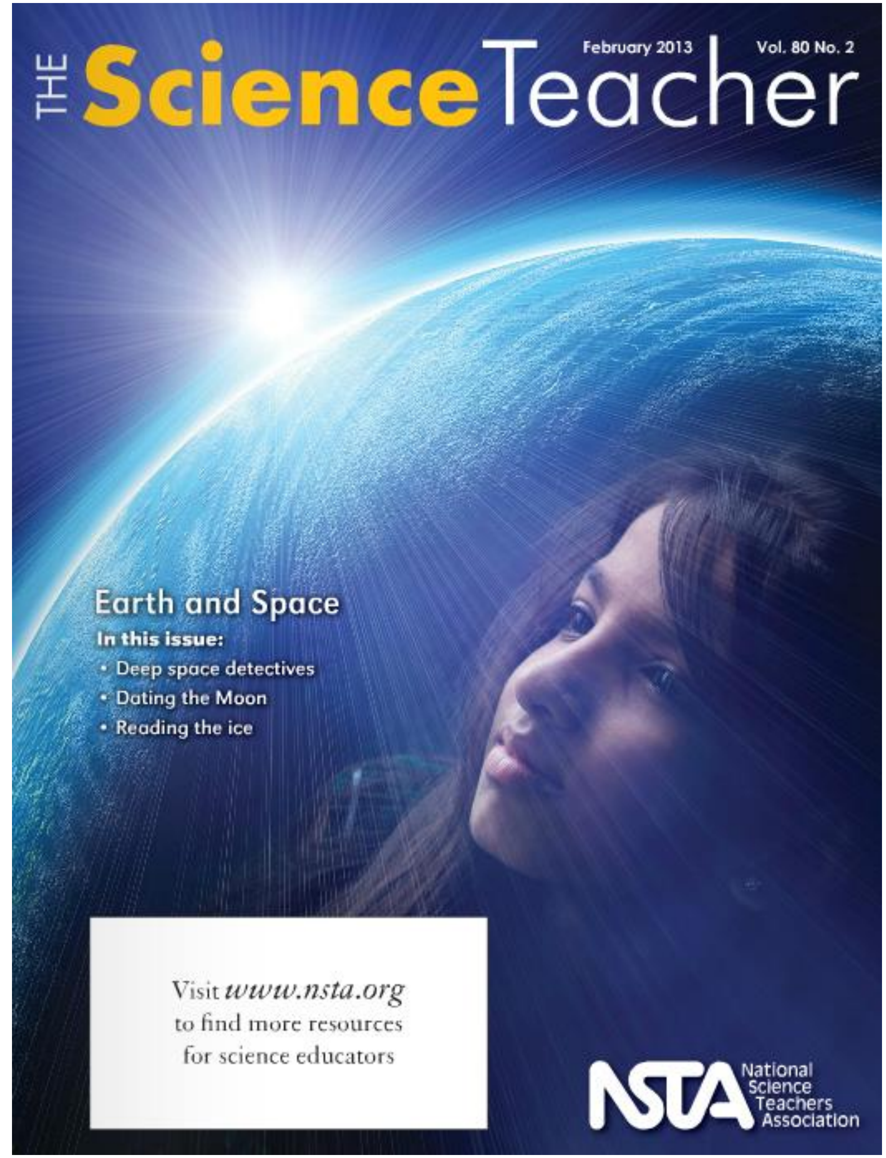

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SCILINKS

Keywords: Earth Science
at www.scilinks.org
Enter code: TST021301

READING THE ICE

USING REMOTE SENSING TO ANALYZE RADAR DATA

Brandon Gillette, Kelsey Leinmiller-Renick, and Steve Foga

Understanding the behavior of ice sheets (thick, continent-size ice masses) and glaciers (smaller, flowing masses of ice) is increasingly important as our climate changes, particularly in the Polar Regions. This article describes two lessons, based on the 5E (engage, explore, explain, elaborate, and evaluate) model, that help students practice scientific data collection and introduce them to remote sensing. Using actual data and images from the Center for Remote Sensing of Ice Sheets (CReSIS), a National Science Foundation (NSF)–funded science and technology center that works to improve the next generation of ice sheet models, students accurately represent the physical processes that occur on Earth.

The two lessons presented here center on CReSIS radar data, collected via radar attached to the wings or belly of an aircraft, from the Polar Regions. As the aircraft flies over the ice surface, the radar transmits pulses of electromagnetic waves that are reflected by different boundaries within an ice sheet or glacier (i.e., snow surface, different layers of snow accumulation below the surface, bedrock). The signals are processed to produce a two-dimensional image, or echogram. Students identify a glacier's grounding line—the boundary between the floating ice shelf and the grounded ice that rests on bedrock—from radar collections from 2003 and 2007 and then compare the grounding lines' locations in the different years. The ice thickness lesson allows students to identify the time it takes a radar signal to return from various boundaries in the ice sheet or glacier and calculate ice thickness using this data. Teachers can combine these lessons into a two-day lesson, or each can stand alone.

Lesson 1: Grounding lines

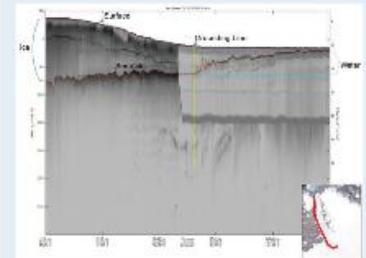
Engage

In the first lesson, students not only learn how to interpret an echogram, but they also study glacier processes and use data to understand why Greenland glaciers behave a certain way. They first use Google Earth to plot the location of the grounding line from two different years and analyze how the grounding line position has changed. Students then work in groups, using the internet to answer the following questions about topics such as glacial formation and movement:

1. Sketch a glacier and label several parts.
2. What is a grounding line? Why is it important?
3. What part of a glacier do you think flows the fastest? What may cause a glacier to speed up?
4. Give an example of a method or technology that researchers use to collect data about glaciers.

FIGURE 1

Radar signals are processed to produce a two-dimensional image, or echogram.



ALL IMAGES COURTESY OF CRESIS

After their research, student groups discuss their answers with the class. They discover that the major parts of a glacier include the accumulation zones (where snow accumulates), ablation zones (where snow melts), and crevasses (large cracks in the ice). Glaciers may vary in speed, with faster speeds resulting from increased surface slope caused by higher accumulation rates and increased water due to melting, drainage from a subglacial lake, or increased pressure as the ice flows over bumps or large rocks beneath the glacier. Glaciers flow their fastest once they cross the grounding line because of a lack of friction from bedrock under the ice. Researchers use GPS and radar to understand what happens below the glacier surface.

Explain

Teachers can check students' understanding of the echogram (Figure 1) by asking students to use Google Earth to plot each grounding line's location. These points can indicate the aircraft's flight path and help students determine how the grounding line's location changes. For example, if the latitude decreases from 81.159 to 80.468, students know the aircraft is flying south.

While interpreting the echogram, students discuss the following questions as a class:

1. What characteristics of a glacier do you see in this echogram?
2. How can you identify each characteristic?
3. Estimate the latitude and longitude of the grounding line.
4. In what direction is the radar flown?

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The Lessons

- Real-world applications are used to learn science concepts. Students are engaged in hands-on inquiry that investigates questions involving real-world problems.

- Uses the 5E Model lesson plan format (engage, explore, explain, elaborate, and evaluate).

- Lessons correlate to National Science Education Standards.

Grounding Line Location

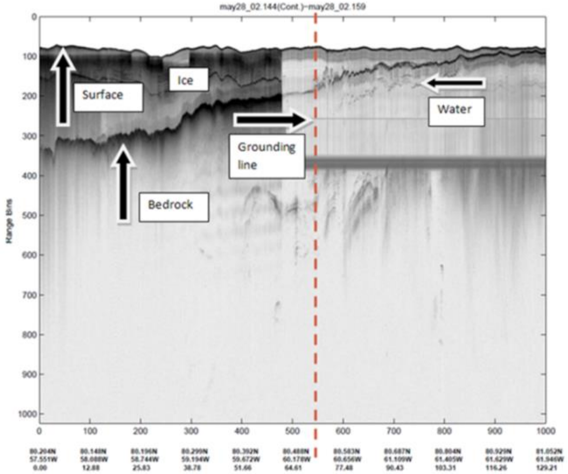
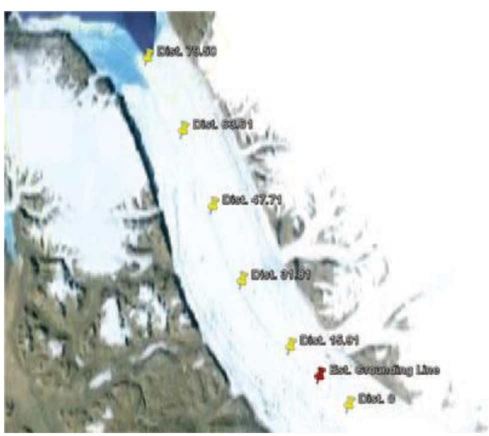


Figure 1: Echogram courtesy of CReSIS data from 2002. PDF 20020528 slide 28. https://www.cresis.ku.edu/data/greenland.



Objectives: The students will be able to…

- Identify glacier grounding lines using several years of data
- Understand reasons for the change in grounding line location over time
- Plot data that is collected from echograms
- Interpret flight lines using latitude and longitude

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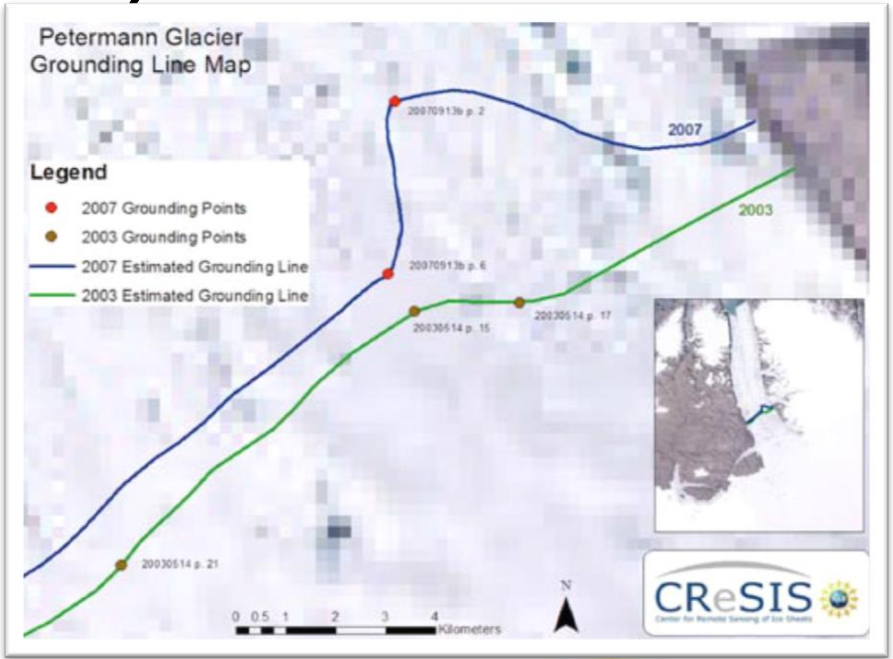
What made this lesson fun (and a more compelling lesson for teachers) was…

Working with Steve!



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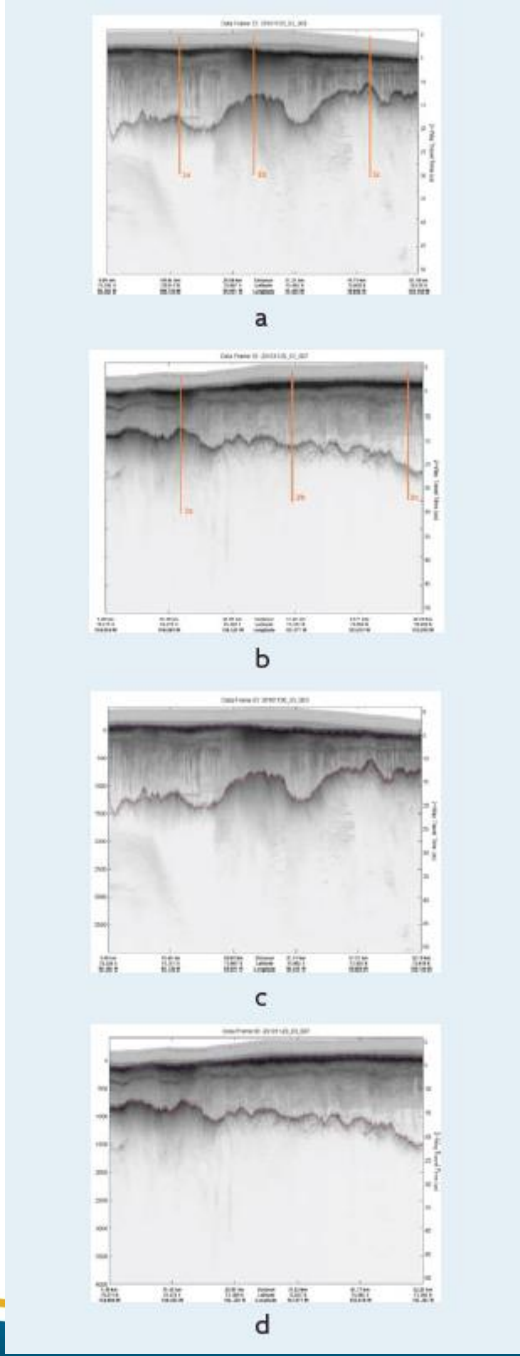
Calculating Ice Depth

With the help of John Paden!

Objectives: The students will be able to…

- Interpret echograms
- Calculate the depth of the ice sheet
- Create a depth scale for an echogram

$$T = \frac{(t_{bed} - t_{surface})}{2} \times \frac{c}{\eta_{ice}}$$

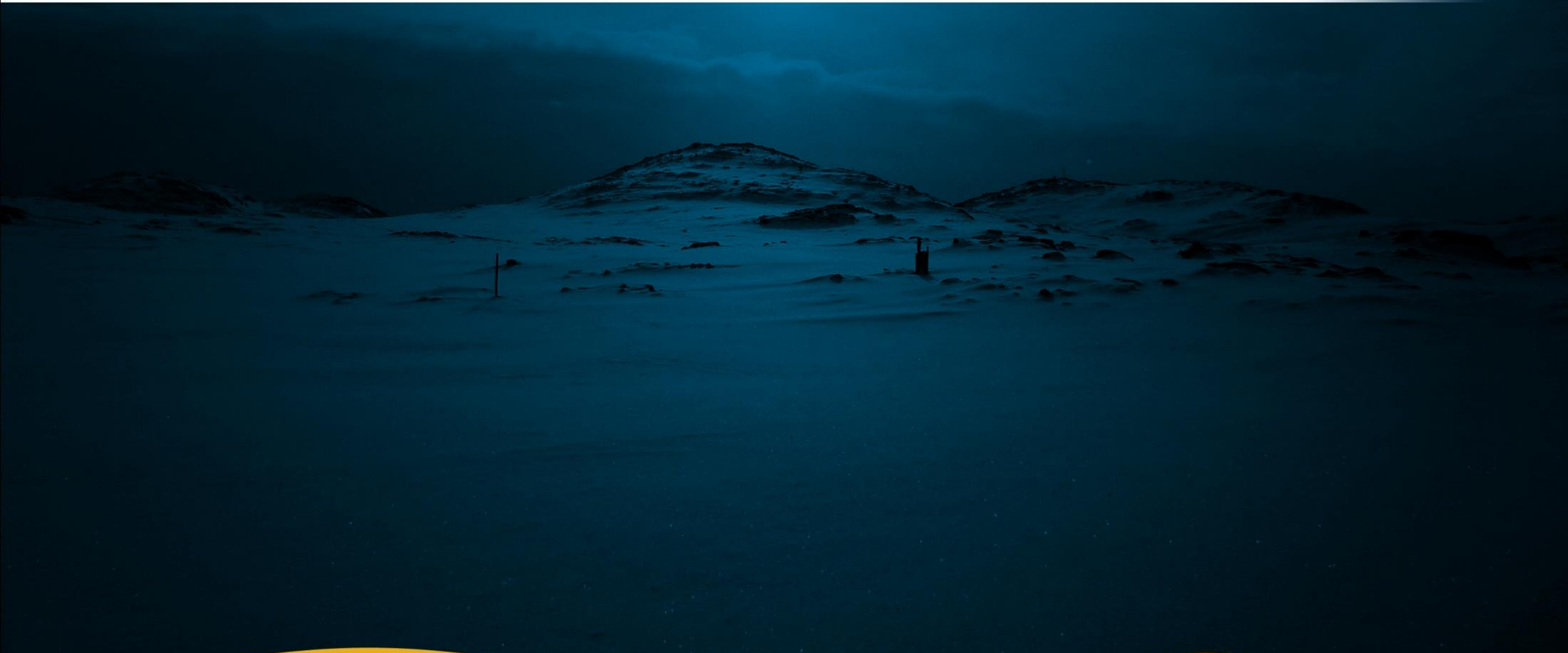


Collaboration

- General ideas for lessons from education team
- Data and realistic connection to CReSIS came from the collaboration with CReSIS researchers
- Through these connections, the science is brought to life

Writing Process

- Rewriting RET lessons into an article that reads and flows together well
- Going through the peer review and editing process



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