Teaching at the Bottom of the World

Traveling to the South Pole on a Research Expedition

PolarTREC

PolarTREC (Teacher and Researchers Exploring and Collaborating) is a program in which teachers spend 3-6 weeks participating in a hands-on field research experience in the arctic or antarctic.

The goal of PolarTREC is to “invigorate polar science education and understanding by bringing K-12 educators and polar researchers together.”

Requirements of the program include:

- Daily journals while in the field
- A live virtual event connecting you with classrooms while in the field
- Lessons plans that connect your field experience to the classroom
- Outreach to the broader community

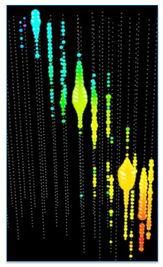
While on expedition, PolarTREC pays for a long-term substitute for your classroom.

ICECUBE NEUTRINO OBSERVATORY

The IceCube Neutrino Observatory is a detector designed to observe the cosmos from deep within the South Pole ice.

Encompassing a cubic kilometer of ice, IceCube searches for nearly massless subatomic particles called neutrinos. These astronomical messengers provide information to probe some of the most violent events in our universe like exploding stars, gamma-ray bursts, and black holes.

Nicknamed the “ghost particle,” neutrinos travel through nearly everything without being detected. Every so often, a neutrino does interact with the nucleus of an atom. When this happens, a new particle is created along with a wave of blue light, called Cherenkov radiation.

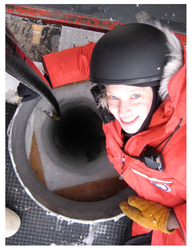


A DOM (Digital Optical Module) detects this blue light, tracing it back to the neutrino interaction. The IceCube array houses over 5000 DOMs, all waiting for the next neutrino to interact.

EXPEDITIONS

2009

Casey helped deploy sensors for IceCube and IceTop, a surface collector of cosmic ray cascade particles.

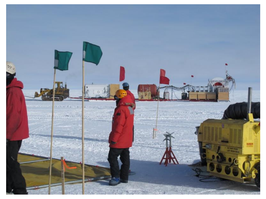


2010

Katey helped deploy the last of the original 86 strings and set up the IceTop cosmic ray detector array.

2012

Liz helped drill holes and deploy strings for the Askaryan Radio Array (ARA), a sister project for IceCube.



2017

Kate observed calibration and stress-tests on the IceCube detector. She also helped lay the foundation for the deployment of two new ARA stations .

RESOURCES FOR TEACHERS

Consider applying to PolarTREC! Visit polartrec.com.

#PolarTREC

To find resources & lesson plans developed by PolarTREC teachers visit polartrec.com/resources.

UPWARD BOUND

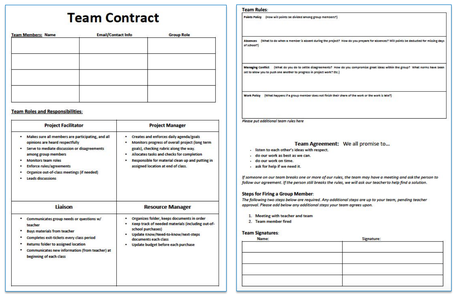
Each summer, PolarTREC teachers assigned to IceCube have the opportunity to travel to River Falls, WI to teach at Upward Bound, a two-week summer camp aimed at increasing college readiness for students from underrepresented populations.

Themes can range from programming Arduinos to seek out light, designing wearable electronics, or mapping stream flow in 3-D.

Students draw connections between the theme and the IceCube Neutrino Observatory, highlighting how various objects can interact with one another just as neutrinos interact in the IceCube detector.

CLASSROOM IMPACT

The IceCube Collaboration is made up of nearly 300 physicists from 48 institutions in 12 countries. Effective collaboration is the cornerstone of the project. To help our students develop similar collaboration skills, we use team contracts to set norms at the beginning of a group project.



Team Contract

Team Members: Name | Email/Contact Info | Group Role

Team Roles and Responsibilities:

Project Facilitator	Project Manager
• Makes sure all members are participating, and all opinions are heard respectfully • Serve to mediate discussion or disagreements among group members • Keeps group on task • Enforces rules/agreements • Organizes out-of-class meetings (if needed) • Leads discussions	• Creates and enforces daily agenda/goals • Monitors progress of overall project (long term goals), checking rubric along the way. • Allocates tasks and checks for completion • Assigns roles for each meeting/class and putting its assigned location at end of class
Liaison	**Resource Manager**
• Communicates group needs or questions w/ teacher • Gets materials from teacher • Completes exit tickets every class period • Returns folder to assigned location • Communicates new information (from teacher) at beginning of each class	• Organizes folder, keeps documents in order • Keep track of needed materials (including out-of-school purchases). • Updates Vision/Need-to-Know/next-steps documents each class • Updates budget before each purchase

Team Rules:

Fables Pledge (Grow will points no dickies among group members!!)

Agreement: (What to do when a member is absent during the project? How do you prepare for absences? Will points be deducted for missing days of class?)

Managing Conflict: (What do you do to solve disagreements? How do you compromise given ideas within the group? What norms have been set to allow you to push one another to progress in project work? Etc.)

Work Pledge: (What happens if a group member does not finish their share of the work or the work is late?)

Please put additional team rules here

Team Agreement: We all promise to...

- listen to each other's ideas with respect.
- do our work as best as we can.
- be on time to class.
- ask for help if we need it.

If someone on our team breaks one or more of our rules, the team may have a meeting and ask the person to follow our agreement. If the person still breaks the rules, we will ask our teacher to help find a solution.

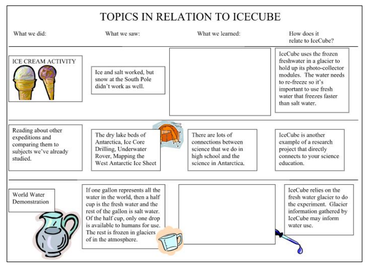
Steps for Firing a Group Member:

The following two steps below are required. Any additional steps are up to your team, pending teacher approval. Please add below any additional steps your team agrees upon.

1. Meeting with teacher and team
2. Team member fired

Team Signatures:

Many classroom topics relate to IceCube explicitly and tangentially. Teachers traveling with PolarTREC seek to make those connections clear and apparent for students.



TOPICS IN RELATION TO ICECUBE

What we did: | What we saw: | What we learned: | How does it relate to IceCube?

ICE CREAM ACTIVITY

Ice and salt worked, but snow at the South Pole didn't work as well.

IceCube uses the frozen freshwater in a glacier to hold up its photo-collector modules. The water needs to re-freeze so it's important to use fresh water that freezes faster than salt water.

Reading about other expeditions and comparing them to subjects we've already studied.

The dry lake beds of Antarctica, Ice Core Drilling, Underwater Rover, Mapping the West Antarctic Ice Sheet

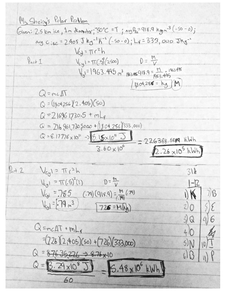
There are lots of connections between science that we do in high school and the science in Antarctica.

IceCube is another example of a research project that directly connects to your science education.

World Water Demonstration

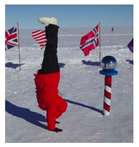
If one gallon represents all the water in the world, then a half cup is the fresh water and the rest of the gallon is salt water. Of the half cup, only one drop is available to humans for use. The rest is frozen in glaciers of in the atmosphere.

IceCube relies on the fresh water glacier to do the experiment. Glacier information gathered by IceCube may inform water use.



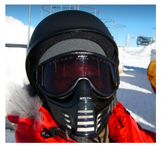
Knowles TEACHER INITIATIVE

POLAR TREC

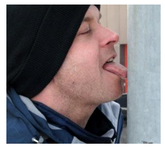


Kate Miller
2012 Fellow
PolarTREC 2016

Liz Ratliff
Senior Fellow
PolarTREC 2012



Katey Shirey
Senior Fellow
PolarTREC 2010



Casey O'Hara
Senior Fellow
PolarTREC 2009

All photos courtesy of ARCUS and the IceCube Collaboration