



**PolarTREC Public Science Report**  
**Lauren Watel**  
**Microbial Changes in Arctic Freshwater**  
**Toolik Field Station, Alaska, 2014**





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Janet Warburton and Sarah Bartholow  
Education Project Managers  
Arctic Research Consortium of the US (ARCUS)  
3535 College Rd. Suite 101  
Fairbanks, AK 99709  
(907) 474-1600  
info@polartrec.com  
www.polartrec.com

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## **Why should a teacher go on a research expedition?**

I feel a teacher should always be pushing the boundaries of the classroom walls. So often we find ourselves focused on what happens within our own walls that we forget to pay attention to what is happening out in the world. Sure, progressive educators are constantly reading articles, going to professional development workshops and digesting emails regarding the new ideas in pedagogy and trying to keep current in their classroom. This is important, however it is one thing to read about these changes, it is another thing to get out and push yourself as an individual and do the groundbreaking thinking and actions.

Educators often integrate their personal experiences into their classrooms and lessons, even a trip to the grocery store, or museum make it into illustrative examples or as a jumping off point for a new way to approach a lesson. This is where the importance of involving a teacher in a research expedition that will not only stimulate their own personal growth, but has a distinct link to their classroom will provide them with many lesson ideas, and personal illustrative examples. Teachers are responsible for conveying ideas and concepts to students, often they don't have direct personal experience with these concepts, but participation in research exposes them to the concepts first hand.

Teachers are generally a group of people who love to learn. They are responsible for ensuring learning happens, but they also love to learn themselves, and if they could forever be a student, many would. When involving them in research you are practically guaranteed to get a focused and engaged audience, who will ask thoughtful questions and attempt to soak up the experience for all that it is worth. Even at the simplest level without additional expectations teachers are guaranteed to talk about their experiences with their peers and students; many would independently choose to develop curriculum around the experience.

Everything to this point is regarding the reasons a teacher should participate in the research expedition and what they and their classrooms will glean from the experience. While there is much for the teacher to gain, there are also benefits for the researcher. From a teacher's perspective, the researcher will have someone join their expedition that is more than willing to support them in any way they can. Whether it is washing and prepping sample bottles, recording data, or documenting the experience teachers can help out in a variety of facets. They think about how to communicate and relay the information and purpose of the research to a lay audience, and may develop perspectives and/or questions that the researcher might not normally think of. Having a teacher join the expedition will inevitably impact how the researcher thinks about communicating their research and the questions they are posing, and it will also ensure that their research finds a broader audience than it may normally.

## **Description of your activities.**

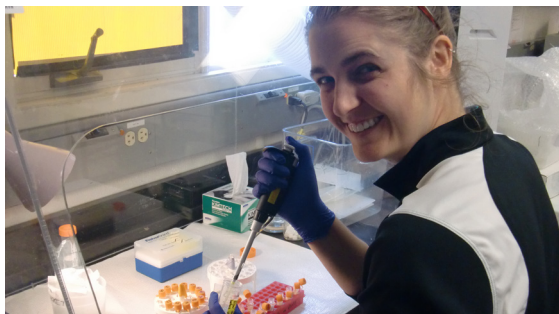
While in the field I truly felt as though I was a part of the research team. Byron worked to ensure that Sarah (his graduate student and field assistant) had the skills necessary to collect the season's samples, as he did this I learned alongside Sarah.



*We trekked, drove, boated and flew around the tundra to get from field site to field site.*

I took an active role in sample collection by filtering and preparing samples in the field and lab. There was a lot of teamwork to ensure that samples were collected, prepared and analyzed in an efficient manner, while being sure to maintain and follow collection protocols.

Through my time in the field I was able to see first hand some of the changes going on in the Arctic and understand why they were a concern and how they could have global impacts in the future.



*Working to perform DNA extractions to isolate the DNA and prepare it to be sent back to Oregon State University for analysis.*

Finally, during meals and throughout the expedition I was a part of the discussions about why the science was important, what the results had been to this point, and deliberated potential future questions for new investigations. As a group we had many a conversation about the state of education at various levels (primary/secondary/undergraduate/graduate), as well as teaching techniques and challenges that we all faced when working with students of any level.

**How are you going to link this back to your classroom? Refer to the classroom strategy and needs assessment.**



*Working to filter a sample of water to trap microbes in the filter attached to the end of the syringe. These were then treated and returned to lab.*

I have several plans of how to link this experience back to my classroom. I have found that students really engage when I discuss my personal experience and tie in with the material we are covering. So first and foremost, I will talk about my experiences from day one in the classroom with my students. As we encounter topics, such as prokaryotic vs. eukaryotic cells I will integrate the material from our expedition. The aspects that I plan on utilizing as some of the most central are examining the roles of microbes in ecosystems particularly around nutrient cycling and how biodiversity is crucial on all scales, and how the community composition can shift due to environmental influences. When my introductory biology classes are learning about DNA and genetics I plan on utilizing simple DNA extraction techniques from fruit and some basic gel electrophoresis so that they can begin to grasp some of the protocols used to understand these microscopic molecules. I intend to work to try and make the unfamiliar Arctic regions more intriguing and familiar to students so they understand and appreciate the importance of these ecosystems and the research



*Melting permafrost exposes previously frozen organic materials to biological organisms and sunlight, the full extent of the impacts of these features is still being investigated.*

that goes on there.

**From your needs assessment, what are three to five things you expected to learn from your experience? Did you learn them? Why or why not?**

1. *“How to facilitate and make fieldwork effective (may not be an outright explanation, but something I would like to understand if I am going to try to take on ongoing monitoring projects)”*

I felt that I learned pieces of this from Byron and the other researchers. The calendar and planning of who would be sampling where and when was something critical to their planning and success. While I wasn't a part of seeing that develop I saw the implementation of the planning and witnessed how it supported efficient field work. I also really began to see how key flexibility and collaboration became both in the field and in discussing the research.

2. *“How to extract DNA”*

I learned this, and got hands on experience with the technique! Byron walked through the protocol with me and then allowed me to take on various steps on my own. It was similar though certainly not exact to protocols that I had used for DNA extraction in college. I plan to utilize the photographs, videos and experience I gained to engage students in the process when we perform a fruit DNA extraction.

3. *“Critical parameters in measuring ecosystem/microbial diversity functioning”*

I learned pieces of this, again by understanding the other data that the team was gathering I began to see the different factors that play a role in the ecosystems. I think that this is also one of the pieces that the team is still very much working on understanding.

4. *“More about alpha and beta diversity of microbes”*

We had discussions about this, and while I understand the basic parameters of alpha vs beta diversity, this wasn't something we focused our discussion around. If I had asked more specifically I am sure we would have delved deeper into this particular concept, though there were plenty of other concepts that weren't predicted that we delved into in greater depth.

**From your needs assessment, what are three to five things concepts you would like to teach “better”, or differently? How does this impact your students?**

1. *“Diversity of an ecosystem”*

I think that I can achieve this, and help students better understand the foundational role that microbes play in an ecosystem. I am always striving to help them appreciate biodiversity, though I have not explicitly tied in microbial diversity to those concepts, we have previously only thought of microbes as a large group. Now when I discuss microbial diversity I can integrate examples from Byron's studies examining how the microbial communities change throughout the watershed, and over the seasons.

2. *“Biogeochemical cycling (focus more directly on roles of bacteria in the nitrogen cycle, might help students understand that cycle more in APES)”*

I believe that this will be very intentionally achieved through lesson development and integration, particularly with the nitrogen and carbon cycles. Hopefully I can really help students appreciate and understand the key roles that microbes (and light) play in these cycles.

3. *“Role of evolution of prokaryotes in an ecosystem”*

I am not sure that this will be integrated, it is something I initially thought about, but over the course of our expedition we didn't really address this, nor is it something that I am sure would be key to teach.

4. *“Implementation of biotechnology and field work in the field of science”*

This is something I plan on integrating through some simple DNA extractions and gel electrophoresis in by introductory biology classes. We will also do various water quality monitoring experiments to examine some of the other abiotic factors that control ecosystem functioning.

**From your outreach plan, are there any activities that you will pursue, post-expedition that the public should know about? Other ideas on how you'll share this experience with the public and/or your peers?**



I plan on sharing my experience with my school community through assemblies for the students, teachers, and parents. I hope that this may even spur some additional interest or connections to find additional audiences. I have a date scheduled to give a short 15 minute talk to the lower school students and parents in February and discuss the experience. As things get rolling in the high school and middle school I will find dates to address these audiences as well.

At this point I also have contacted the Denver Zoo and may be doing a talk with their docent training about arctic ecosystems and field research.

I hope to continue work with our team and develop lessons and telescoped curriculum about the role of carbon cycling in the Arctic, we have preliminary plans and discussions in place and this may be something that we can present later at AGU or another conference.

There is an article about my expedition that is to be published in the Loretto Earth Network (a publication by the Sisters of Loretto <http://www.lorettocommunity.org/lorettoearthnetwork/>). It is written by one of the Sisters who followed the expedition journals.