TEACHER GRANT APPLICATION QUESTIONS

APPLICATION DEADLINE: Monday, March 8, 2021 at 5:00 pm

BROOKLINE EDUCATION FOUNDATION

Teacher Grant Application for 2021-2022 Academic Year
Cover Page

APPLICATION MUST BE TYPED

Project Title	**Climate Science in the High Arctic**
Name of Applicant(s)	Mark Goldner
School and Grades/Subjects You Teach	Heath School, 7th and 8th Grade Science
Telephone Number(s)	617-877-4520
Email Address(es)	mark_goldner@psbma.org
Years Teaching in PSB, Total Years Teaching	19 years in PSB, 28 years total
Amount Requested	$3000
Are you applying for the Charlie Baker Legacy Award?	Yes
Please list previous BEF grants (year, title, teacher/collaborative)	2014 Canadian Wildlife Federation Learning Institute (Teacher Grant) 2010 Boston Rocks! (Collaborative Grant) 2017 Raspberry Shakes (IdeaLab Grant) 2015 The Pulse! (IdeaLab Grant)

I understand that, should the Brookline Education Foundation fund my grant application, I am obligated to submit a written evaluation of my project at its completion and present the results of my grant at a BEF sponsored event. Evaluations of projects completed during the summer will be due by December 31, 2021. Evaluations of projects completed during the school year will be due by May 31, 2022. I further understand that only educators employed by the Brookline Public Schools at the time the project is undertaken are eligible to receive funds.

Acknowledgement of Applicant(s): Date: 2/12/2021

For online submissions, please acknowledge that you have read and agreed to the above statement. _MG___

BROOKLINE EDUCATION FOUNDATION
Teacher Grant Application for 2021-2022 Academic Year
Project Description Section

Note to BEF grant reviewers: I first applied for this grant in 2019, and the BEF generously offered to fund me, for which I am very thankful! However, due to an emergency in the lead scientist's family, the research expedition was postponed. I reapplied in 2020 and funding was again granted. The expedition was postponed again due to the COVID pandemic. This year, I am reapplying with a very similar proposal. I am confident that the expedition is finally going to happen this summer; necessary research permits and accommodations have already been secured. Thank you for your consideration of my proposal this year.

1. **Project Summary** (1-3 sentences)

I will join scientists in the Norwegian Arctic during July 2021 as part of a long-term study of how glacier systems respond to climate change, in order to bring authentic science research into the classroom. While in the field and upon my return, I will develop projects for Brookline students around polar and climate sciences.

2. Goal Statement
What are your explicit goals for the project? What would be the best outcome for the work you propose?

The purpose of this grant is to fund my participation with scientists at the Kronebreen Glacier (near Ny Ålesund, Norway at 79°N latitude) studying the long-term effects of climate change on glacier systems. In 2011 I participated in a PolarTREC-funded teacher-researcher collaboration at the Kronebreen Glacier. I have been invited by the lead researcher from that project, Dr. Julie Brigham-Grette from UMASS Amherst, to join her again this July as she, her colleague Dr. Colin Gleason, and some of their students continue research into the response of Arctic glaciers to climate change. Returning to this study site will deepen my knowledge about climate science and will lead to meaningful learning experiences for my students.

The goal of the research is to understand how global warming is affecting the dynamics of a specific fast-moving glacier system on the Svalbard archipelago. Dr. Brigham-Grette returns periodically to this research site to track changes in the glacier system. Understanding how Arctic ice is behaving holds wider relevance for all of us; for example, here in Boston we are beginning to see the effects of melting ice through rising sea-levels and a reduction in snowfall.

For my students, my involvement in this particular research project this July will have tremendous value. Having their teacher participate in a field study project means I will bring back knowledge through hands-on lessons about glaciers, climate change and geology. At the same time, I will be able to infuse large parts of my curriculum with experiences about the nature of science – how experiments are designed, how measurements are taken, and how scientists work with each other to make sense of data.

I teach a looped group of 7th and 8th graders, so my current students will be able to learn about the project before I go, follow me over the summer (through blogging and live video events) and then learn from my experiences over the coming school year. In fact, some students will be able to be directly involved in data analysis as they join me at UMASS in the fall. All of this will provide unique and direct insight into field science – as it is going on in real time.

My experiences in Arctic field research will help me become a better teacher-leader in my school and district. Teaching in a K-8 school affords me opportunities to help support K-6 teachers. Many teachers are reluctant to take their students outside to perform hands-on learning, which is compounded by the fact that most elementary school teachers lack adequate science content knowledge. I would like to help provide resources and support for this type of learning. Just as the expertise I gain from my Arctic field experience will equip me with ways to differentiate my curriculum for my own 7th and 8th graders, it will also help me support other teachers with grade level appropriate materials and lessons around Polar science topics.

3. **Context**
What experiences (inside or outside the classroom) have led you to apply for this grant?

Students learn science best by doing science and being immersed in it. The same can be said for science teachers - if science teachers are able to be actively engaged in science research, their knowledge about and confidence in the subject are greatly increased. Data collected by PolarTREC in their 2016-17 Annual Report underscores the value for students of involving teachers in research. In addition to an increase in self-confidence among teachers who participate in teacher-researcher collaboration, students whose teachers participate in authentic field research report high levels of interest in science themselves.

Throughout my 28-year career as a science educator I have tried to stay informed and involved in current science research. I have participated in research in several different contexts because I believe that science teachers are much more effective when we are immersed in science. These include oceanography research in the Southern Ocean near Antarctica in 2007 (coordinated and funded by the ARMADA Project), glacier research in Svalbard in 2011 (coordinated and funded through PolarTREC), a study trip to Nunavut, Canada in 2013 (coordinated through the Canadian Wildlife Federation, funded by the BEF), and a field study in 2016 in Denali National Park (funded by PolarTREC and the Alaska Geographic Association).

I am excited to rejoin Dr. Brigham-Grette and Dr. Gleason as they continue their research into the response of Arctic glaciers to climate change. Dr. Brigham-Grette has been studying the Kronebreen glacier system for over twelve years and through my prior work with her we have already built a strong personal and professional connection. My collaboration with her has included working with teachers at UMASS around bringing Polar education into the classroom, presenting at NSTA conferences, and participating in scientific conferences.

Returning to Svalbard in the summer of 2021 is indeed a unique opportunity - one which has great benefits for my students as well as for my own professional development. My previous research experiences have all been short-term involvements, and here is a chance for me to continue my participation in a long-term project. Often the work of science - particularly climate science - involves slow, patient work over time. I am eager to see and learn about the changes that have occurred to the Kronebreen glacier since I was there ten years ago, and what broader implications this has for global climate. For students to learn through my experiences will be invaluable.

4. **Project Description**

Describe the structure of this grant. What is your time frame? When and where will you be working? With whom will you work? You may include copies of supporting material (e.g., conference brochure, tour itinerary). Links to websites may be used for supporting materials and are preferred, if available.

Understanding the present climate crisis and predicting the future relies heavily on the ability to reconstruct past environments. Because of the limited amount of direct observational data (e.g., we don't have direct temperature measurements before about 200 years ago), scientists must rely on proxy data to understand past climate. Such proxies include studying pollen, diatoms and isotope ratios in sediment and ice cores. These proxies can be used to reconstruct the past history of a specific location - and, by extension, global processes. The Svalbard glacier research relies on analyzing a number of proxies preserved in ice and ocean sediment.

During the month of July 2021, working alongside Dr. Brigham-Grette, Dr. Gleason and a few of their students, I will be immersed in a study of the dynamics of the Kronebreen glacier system and how it is responding to global climate change.

On a daily basis I will have responsibilities such as data collection and analysis (including ocean sediment cores, water samples, tide pressure gauge signals, sonar mapping of the sea floor, drone aerial surveillance mapping, among others), assisting in the technical details of moving equipment to and from the study site, designing experimental protocols and troubleshooting equipment. I am familiar with the protocols and equipment, and I will be given direct responsibilities with regard to the scientific activities. Because of my existing close connection with Dr. Brigham-Grette, my role will be carefully planned out ahead of the research field experience.

As a summer resident of the Ny Alesund international scientific research station, I will also be able to interact with and learn from other scientific groups - from all over the world - who are in the middle of active field research. These may include ornithologists, marine biologists, climatologists or astronomers. I will be able to bring back to my students what I will learn from other scientists at the research station.

A major goal of mine is to communicate with my students and the wider community while in the field. Through my ongoing connections with PolarTREC, I will have access to a robust set of blogging and video conferencing tools (including a satellite phone). Although PolarTREC cannot fund my project directly (having done so fully in 2011), they are happy to allow me use of their existing internet and social media infrastructure and technical support.

The science of climate change is sophisticated but it is important and valuable for students to be exposed to it. While in the field, and upon my return to the states, I plan to develop lessons based on my experiences. These will include lessons on glacier systems, Arctic wildlife and, perhaps most importantly, understanding the dramatic changes that high latitudes are experiencing as a result of a warming atmosphere.

One curriculum goal I have is to develop a project for middle school students in which they collect proxy data about past environmental conditions (as we study the science of climate change). We will model the kinds of data collection methods that the Svalbard researchers use; for example, students could study the sediment deposited at the bottom of a local pond and observe tree ring patterns. This kind of immersive, real-world scientific experience is motivating for students and encourages deep analytical thinking. The summer research experience will give me the knowledge and confidence to create this or a similar project. I will have access to highly acclaimed scientists – both who have worked extensively with teachers in the past – to provide additional expertise in developing this curriculum.

In addition to developing lessons for middle school students, I will also work on developing lessons around Polar sciences for younger grades, in an effort to help connect younger students with the beauty of this region and the challenges facing the Arctic.

I hope to use this experience to develop my skills as a teacher-leader, both in my school and beyond. As an alumni of PolarTREC, I have been serving as a mentor to the new PolarTREC educators. Some of them will be in the field at the same time as me; I will use my own experiences to assist them as they navigate, for the first time, being engaged in field science and working through the technical challenges of blogging and video conferencing.

Finally, I also hope to strengthen my existing partnerships between scientists and the classroom. Having the opportunity to interact intensively with scientists from all over the world means developing connections that can be applied in the classroom later. For example, I can envision video chats between bird researchers and 5th grade students in my school district during their unit on birds.

5. **Impact**

a. Describe as specifically as possible the impact of the work you propose:

- On Yourself - How do you expect this project will change you as an educator? How might this work impact future professional activity?

Climate change is a very complex problem. Understanding what is happening to our climate is also a multi-disciplinary venture. When I participated in the 2011 research study I was given a glimpse of the problem as it existed in one summer. Now I have the chance to see longer-term trends and data and to strengthen my own knowledge of geology and climate science. Both scientists I will be working with are leaders in the fields of glacial geology, climate science and remote sensing; it will be an amazing learning opportunity to spend a month with these scientist-educators, completely immersed in field research.

Both scientists have been involved in STEM education, and I have worked with Dr. Brigham-Grette on curriculum activities in the past such as teaching about glaciers and collecting sediment cores with students. In addition to being a fellow researcher for the summer, I look forward to learning from their expertise as science educators.

Being immersed in an international research community means that I will get a chance to interact with a broad range of research projects. For example, I may get to learn from researchers studying changing bird migration patterns. Perhaps I will be able to learn from teams studying marine mammals in the Arctic. Or maybe I will get to learn from atmospheric scientists monitoring CO_2 levels in the air. I am very excited about the prospect of seeing many interdisciplinary projects at work.

Through immersion in field research I will learn a great deal about geologic and atmospheric processes that have shaped – and continue to shape – our natural world. Through a month of daily interactions with accomplished scientists my understanding of climate science will deepen considerably. And I am sure I will gain many new insights into how scientists conduct research in the field. All of this new learning will translate easily into learning experiences for my students, and I will have ample opportunities to include other educators in the development of these experiences.

While I am at the Arctic research site, there will be time to discuss curriculum ideas with the community of scientists at the research station. I will have time to create drafts of projects and activities over the summer and then to

implement these - and continue to refine them - during the school year. Again, having the ongoing connection with scientists (and their graduate students) means that I will continue to have their expertise and advice well beyond the time we are together in Svalbard.

- On Your Colleagues - What impact will your project have on your professional community, either directly or indirectly?

I have wonderful collaborators at my school, including classroom teachers and specialists. They are interested in collaborating with me on the development of the activities outlined above. They plan to follow my experiences over the summer and we plan to meet regularly in the coming school year.

I plan to invite other middle school science teachers in the district to join me in the development of this curriculum. We have monthly meetings at which we share ideas and are given time to collaborate; I hope to use some of that time to work with other interested teachers on doing similar projects.

I will also invite other students and teachers in the school and district to follow along with my "research adventure" as it unfolds this summer. This will be easy to do using the PolarTREC blogging and video conferencing tools. I hope to present to groups of students, parents and community members before I leave and after I return.

- On Your Students - How will your students benefit from this project in the short or long term?

Although I teach in an affluent neighborhood, many of our students are from low income families and underserved communities. Many of these students cannot afford to participate in enrichment programs throughout the year and during the summer. This contributes to the achievement gap between white and non-white, affluent and non-affluent, and between those with and without learning disabilities.

Since students are naturally curious about science, real-world projects can motivate students, and also provide rich opportunities for differentiation (for example, such projects can easily include a variety of hands-on tasks and places where students can access the learning at differing levels of quantitative depth). Through my experience with this summer's Arctic research, my knowledge and confidence will increase and I will be more successful in teaching science to all students.

In addition to the atmospheric science that is at play with the melting of glaciers, there are many fundamental science concepts that can be addressed through this lens. For example, in our 7th grade curriculum students learn about geologic processes that shaped the New England region. Since New England was shaped in large part by Ice Age glaciers, being in an Arctic region where these processes are still ongoing will help me better convey these processes so students can visualize them.

Other examples of fundamental science at play are changes of state, density and salinity as they apply to ocean water currents around melting ice; the relationship between ocean and atmosphere; basic Earth-Sun dynamics, visible in the 24 hour-daylight I will be experiencing; and survival/adaptation strategies for plants and animals in extreme cold. Each of these topics - and many others - have direct connections that I will be able to bring back to my students.

Most importantly, perhaps, is the ability for students to see the nature of science firsthand. Too often as science teachers we focus on *what we know* rather than on *how we know it*. Science gets distilled into chunks of knowledge that seem to fall neatly into place. What is often missing from our instruction is that science can involve data that is inconclusive and hard to interpret, as well as experiments that fail. Through this messiness, however, is the sheer joy of pursuing a fuller understanding of the world. Curiosity drives science, and sharing this mindset with students opens them up to being more curious about the world – and, hopefully, becoming more interested in pursuing science themselves.

I am hoping to bring data we collect in the Arctic into classrooms - where students get to be included in the data analysis. Because of my ongoing connection with the research team (and the relatively close proximity of UMASS to my school), I will be able to frequently visit the UMASS lab as the data is analyzed. My students will also get the chance to join me in these lab visits. I am excited about the prospect of my students getting the chance to literally see and touch the samples we collected in the Arctic as they are analyzed.

I look forward to developing a pond sediment project as a proxy for past environmental events. I have piloted some work with this topic, but I am hoping that by returning to the Arctic and engaging in the almost daily collection of sediment cores, I will further develop this into a meaningful project for my students - one in which they get the experience of collecting hands-on, real-world data.

I hope to bring students to do this field study sometime next fall. Students who join me at the UMASS lab will see a direct connection between the Arctic research I participated in and the pond sediment data they collect. I hope to use my experiences in the field to develop activities in which students learn how to quantify field data they collect. For example, are there easy ways to estimate the date of different sediment layers, or at least to model the process by which scientists would do the same?

A powerful element of the pond sediment proxy project is the ability to engage students at many different levels. As we go out and do the field work, there will be several concrete, hands-on tasks that will be interesting and fun for all students. These will include going into the water to collect the sediment, drawing and photographing the area around the pond, and helping to label and store samples. When we return to school, students can participate fully regardless of their abilities. Some students will be challenged by the task of making careful qualitative observations of the samples, while others might be able to do quantitative analysis of color and texture changes in the samples.

The project will include many opportunities for scientific writing, which is a major goal of mine and which will further help to improve the skills of struggling students. Students will be challenged to defend their claims with evidence and reasoning, and throughout the process there will be ample occasions for students to reflect on their experiences. A final piece of the project will be to construct a plausible story of past environmental events based on proxy data they collect.

Collaboration is another important set of skills that students will practice through this project. Students will learn from each other as they work through the various aspects of the field study; I hope to set up a dynamic where students become dependent upon each others' knowledge.

I am excited about the prospect of bringing students with me to the UMASS geology lab. What a great opportunity this will be for students who traditionally don't have access to this kind of enrichment, or who don't think of themselves as "good at science".

I hope my students will more fully understand the mechanisms of climate change – be able to describe how evidence is collected and used to explain the current conditions; have a deeper understanding of the nature of science because they will have been involved in authentic research; and be able to communicate their experiences and ideas effectively to a wider audience.

The topic of climate change is complex and often it is a challenge to help students understand it in a concrete way. I am confident that my participation in such a research experience will help me develop many ways to understand this topic. I am particularly interested in how my most struggling students - those with learning disabilities - can access complex scientific information through hands-on activities.

At the same time, it is critical that as we teach students about climate change we don't leave them feeling overwhelmed and despairing. We need to instill in students that while the climate crisis is urgent, there are solutions still within our grasp. It is also critical that students come away feeling empowered because they understand the problem as fully as possible.

The Arctic is a beautiful, remote place. Few have the chance to visit this incredible landscape, and yet, because of the habits of industrialized nations, the Arctic is changing fast. These changes will have a dramatic effect on the rest of the planet through sea level rise and other changes in the ocean and atmosphere. I want to share with my students experiences of wonder about the beauty of the Arctic, while they begin to understand the dramatic changes that are occurring to that fragile region. I want them to see the connections between our daily activities and what is happening to the Arctic. From this they will develop ideas for how they can change their own habits, the habits of their community and those of society at large that will begin to solve the climate crisis.

b. How will you **evaluate** the success of this project?

I envision the students presenting their experiences to the school community. As part of this exhibition they will also include connections to Arctic research. I hope that they will make strong connections between the physical changes happening to our world and changes to the living world and human societies. Finally, I hope that they will present plans for how they and their community can combat climate change.

This final exhibition also provides many ways that students of different abilities can be successful and develop their scientific and communication skills. I envision students using a multi-media approach with their presentations, so students will learn about effective communication using a variety of modes. This will be a great authentic assessment of student learning and of the effectiveness of the project.

Other ways I will evaluate the success of the project may include keeping track of student engagement in my research activities and a survey at the end of the project.

6. Dissemination

How will you share your learning with others in your school and district community? For example, will you share it departmental or school meetings, in an online format, or design other forms of dissemination of your project?

Having the research experience in the Arctic will provide an immediate motivation for my students this year and in years to come. Seeing their teacher doing authentic research, and having the unique chance to return to a site where I was several years ago, will be a motivating factor for students as they embark on their own field study and plans for combating global warming. Students, parents, teachers and others in the community will be invited to follow along with me over the summer through my online blog, video conferencing and other social media. The PolarTREC tools allow for active engagement by asking questions or posting comments that I (or others scientists in the field) can respond to.

Helping students develop personal, as well as school-based goals for combating global warming is important to me. This will start with our local pond field study, from which students will analyze data and construct a story of past local environmental change. They will present their findings along with proposals for what they can do as a school community to address these problems. These presentations will be done publicly - to parents and others in the community.

Parents will be enlisted throughout the process to volunteer in the classroom and during the field study. I will also work with younger grade teachers to develop smaller lessons that will help lead up to the work they will eventually do in the 8th grade.

Students will have the chance to join me at lab visits to the UMASS laboratory where sediment will be analyzed. These students will come back and report their experiences to their peers and to the school. Spending several hours involved in this research, interacting with scientists and graduate students, will be powerful – not only for the students who go to UMASS, but also for other students who hear about what the experience was like to spend a day in a geology lab.

I hope to help inspire other teachers to do similar activities through department meetings and professional development workshops. I also hope to present this work at the NSTA National Conference in Houston in April 2022.

BROOKLINE EDUCATION FOUNDATION
Teacher Grant Application for 2021-2022 Academic Year
Budget and Finances Section

Expense	Purpose	Cost
Consultant		
Materials and Supplies		
Travel and Accommodations* *please include applicable taxes.*	- Round trip airfare - Oslo to Longyearbyen *(from Google Flights list here)* - Round trip airfare - Longyearbyen to Ny Ålesund - Room and Board for ten days at Ny Ålesund (~$150/night. I will be billed at the "scientist" rate for room and board) *(Airfare to Ny Ålesund and Room and Board can be found on this price list put out by Kings Bay which operates the science station and flights. My costs are estimated based on the current exchange rate between Norway and the US.)*	$400 $850 $1500
Conference Fee		
Other	Safety Training and Gear Rental *(A requirement of all personnel staying at Ny Ålesund is mandatory safety training, which includes boat and Polar Bear safety. The cost can be found on this Kings Bay price list.)*	$250 - safety training
Substitutes**(please indicate days/hours needed)		
TOTAL		$3000

*** Single rooms are acceptable, if preferred by the applicant.**
****The BEF's ability to pay for subs is limited; requests will be considered on a case-by-case basis.**

Please be as specific as possible.

Finances

a. Will there be additional funding from other sources? Please describe.

The total cost of the expedition, which includes room and board at the Ny Ålesund science station for a month, exceeds the $3000 BEF grant, so I am seeking funds from other sources. I have been awarded a $2000 a NEA Learning and Leadership Grant to fund an additional two weeks of room and board at Ny Ålesund. In addition, I

have already received a PolarTREC Alumni Grant to pay for the roundtrip airfare from Boston to Oslo. Finally, I will be seeking a Heath PTO grant to fund travel from Brookline to UMASS Amherst to bring students to the geology lab there in the fall of 2021.

b. Are resources needed to continue the work of the project after BEF funding ends? If yes, please describe how these resources will be obtained. If no, please describe how the work of the project will be funded or continued after completion of funding by the BEF.

N/A

c. Do you foresee any potential challenges /obstacles and, if so, what is your strategy for dealing with them should they occur?

N/A

d. Will you be able to complete the project if only partial funding is available? ___Yes _X__No
If only partial funding is available, would you be able to redesign the project? ___Yes _X__No
Please explain:

e. For groups of three or more educators applying together: If the BEF can fund only a subset of your group, is there a reason this would pose a problem for you? ___Yes ___No
Please explain:

BROOKLINE EDUCATION FOUNDATION
Teacher Grant Application for 2021-2022 Academic Year
Charlie Baker Legacy Award Section

Charlie Baker Legacy Award If you are applying for the Charlie Baker Legacy Award (fully described in the Call for Proposals), please indicate how the additional $1,000 funding would extend and/or enrich your project. Please limit your response to one page.

The global climate crisis requires an understanding of the connection between science, geography, and public policy. Through my participation in the summer research project, I will be helping students make these connections. An extra $1000 from the Charlie Baker Legacy Award would help me do this even more effectively, by funding an extra week in Norway to learn about the human impacts of climate change.

The extra $1000 from the Charlie Baker Legacy Award would allow me to spend 5-7 more days in Northern Norway broadening my own understanding of how climate change is affecting the Arctic. For example, I would be able to spend a day visiting the city of Longyearbyen, where the famous “seed vault” is housed. This city has become a center of learning about how the Arctic - and the world - are adapting to a new climate regime. I could visit the city of Tromsø to learn about how a changing climate is affecting not only the environment of the Arctic, but also how lifestyle and culture are changing (such as among the Sami people).

Many of my students - and other students in the school district - will have the opportunity to follow my experiences as they happen, through reading my blog, participating in video conferences, and following me on social media. Connecting directly to a teacher in the field in a remote location will help strengthen their understanding of the Arctic environment and how scientists operate in remote locations. This kind of learning can only help strengthen student understanding of several of the big themes in geography, including location, place and human-environment interactions.

Upon my return, students will learn from activities I create around my experiences in the Arctic. They will be able to connect their own science research in the pond study to the effects of climate change on people around the world. For example, we may learn about how the way of life for Norwegian Sami reindeer herders is being upended by the climate crisis. My vision would be that stories that I come back with will strengthen student interest and passion for concrete steps students can take in mitigating climate change in their own community. Sometimes issues like this can be abstract and analytical - by attaching real human experiences to this crisis I hope that students will understand the issues in a much more tangible way.

By adding a cultural component to my research experience, I will be able to help make stronger connections for my students between the activities of humans and the physical environment. In 2013, through the BEF, I was able to learn about the impact of climate change on the Inuit people of Northern Canada; I would love to be able to compare those experiences with the experiences of the Sami people and others living in Northern Norway.