

Engaging the Public in Science Learning with the 2019-2020 MOSAiC Arctic Research Expedition

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November 21, 2022

Abstract

Scientific expeditions can be used to engage the public in science learning within an exciting and compelling context, giving insight into the often messy and serendipitous nature of science and the humanness of scientists. The 2019-2020 MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) research expedition allowed scientists from around the world to study all aspects of the Arctic climate system at ground zero for a full seasonal cycle. The German icebreaker *Polarstern* was intentionally frozen in Arctic sea ice and drifted almost continuously across the Arctic Ocean for a year. The *Polarstern* served as the central research observatory for MOSAiC, allowing scientists to study Arctic sea ice, atmospheric processes, and more. Here we present our U.S.-based MOSAiC expedition outreach efforts and the role of MOSAiC scientists in them. By harnessing the public's fascination with the Arctic and the excitement of the expedition, coordinated MOSAiC communication, outreach, and education efforts promoted a broad understanding of the changing Arctic and the societal implications of these changes, hopefully inspiring a future generation of potential scientists. Many MOSAiC scientists were directly engaged in MOSAiC outreach efforts with students, teachers, and the public, and outreach materials were developed that could be accessed and distributed virtually. The expedition was brought to life for learners of all ages by providing them with immersive experiences like VR Google Expeditions and 360-degree videos from the field, opportunities to connect directly with scientists through video calls and an *#askmosaic* question submission campaign, and insight into what day-to-day life on an icebreaker in the remote Arctic is like. Our outreach efforts helped us better understand the importance of providing scientists with diverse outreach opportunities that are fulfilling to them and the power in using scientific expeditions to engage the public.

Connecting students
and scientists can...

Break down barriers between students and science world (Aikenhead, 1996)



Photo credit: Felicia Buitenwerf

Photo: Lianna Nixon, CIRES/CU Boulder



Photo: Lianna Nixon, CIRES/CU Boulder



Photo: Lianna Nixon, CIRES/CU Boulder



Make scientists more approachable and relatable
(Woods-Townsend et al., 2015)



Photo: Anne Gold, CIRES/CU Boulder



Photo: John Cassano, CIRES/CU Boulder



Photo: Christian RohlederAWI

Help students envision how they fit into the science world
(Rahm, 2007)



Image credit: Mike Reddy; From Jarvis (2020)

Improve recall of science concepts and problem
solving abilities
(Hong and Lin Siegler, 2011)

Help scientists improve communication skills
(Clark et al., 2016)

It's valuable for students to see scientists as
fallible human beings
(Hong and Lin Siegler, 2011)



Photo: Lianna Nixon, CIRES/CU Boulder

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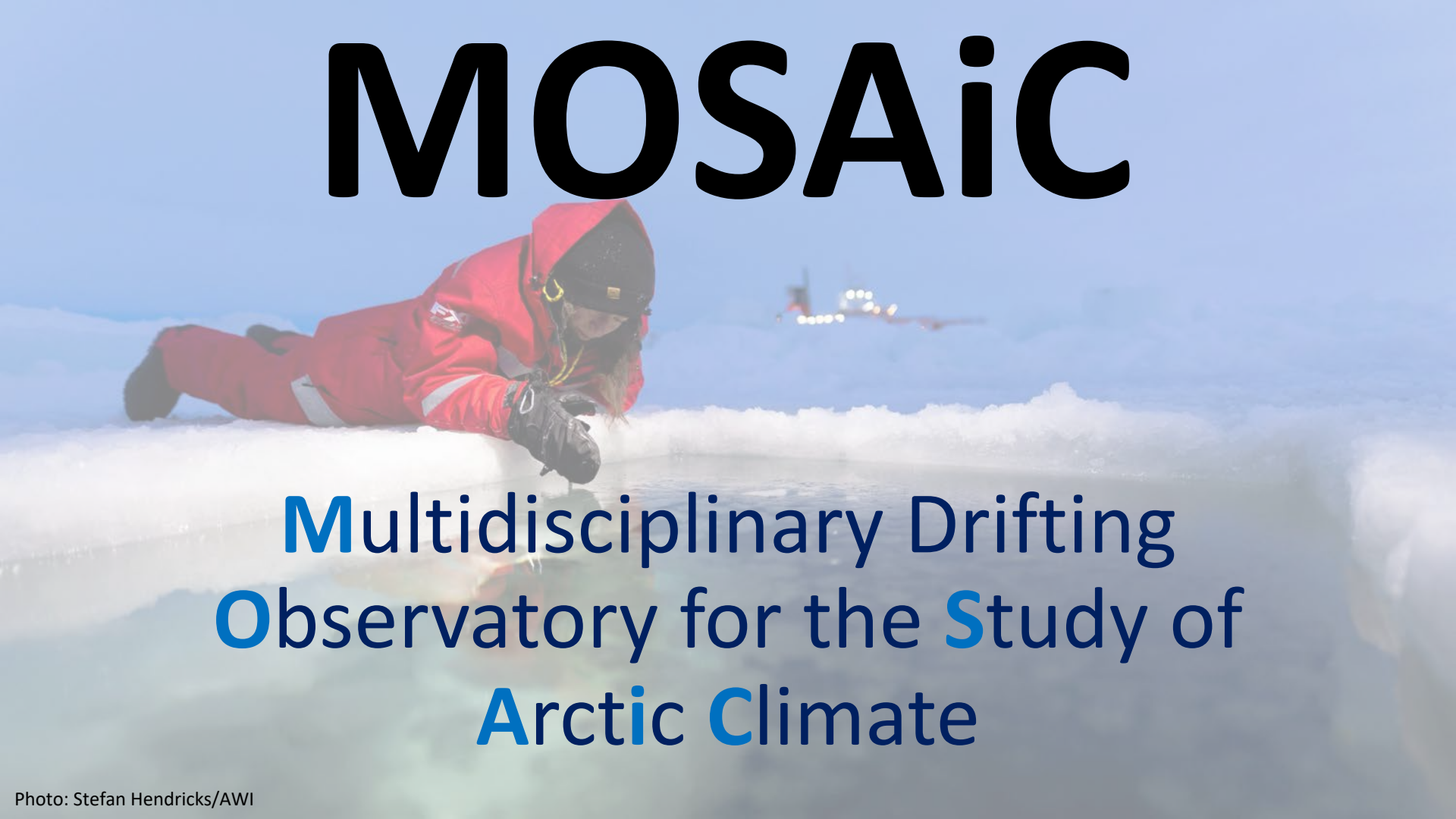
Cooperative Institute for Research in Environmental Sciences at the
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This work is supported by NSF award # OPP 1839104

MOSAiC

A person wearing a red snow suit and a black beanie is kneeling on a thick layer of white ice. They are looking down at something in their hands. In the background, a research vessel with lights is visible on the water under a clear blue sky.

Multidisciplinary Drifting
Observatory for the **S**tudy of
Arctic **C**limate



RV Polarstern



Greenland

Tromsø, Norway



Photo: Stefan Hedricks/AWI



Photo: Lianna Nixon, CIRES/CU Boulder



Photo: Manuel Ernst/Dieter Sturmer

Annual J-D

L-OTI(°C) Change 1960-2019

1.01

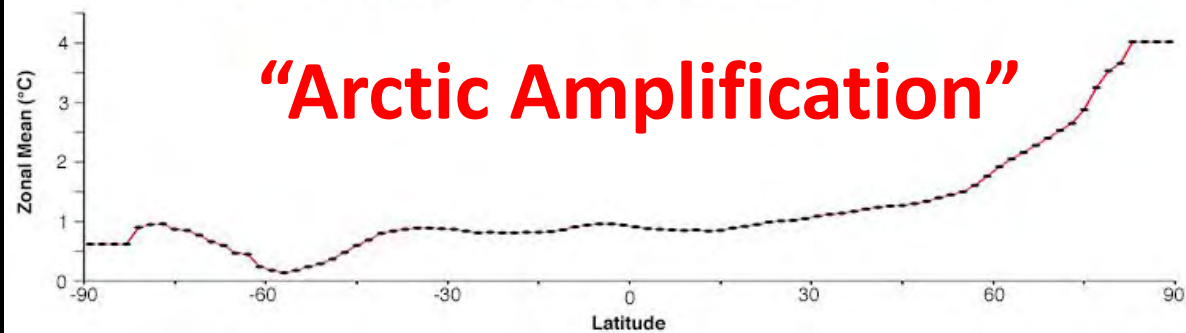
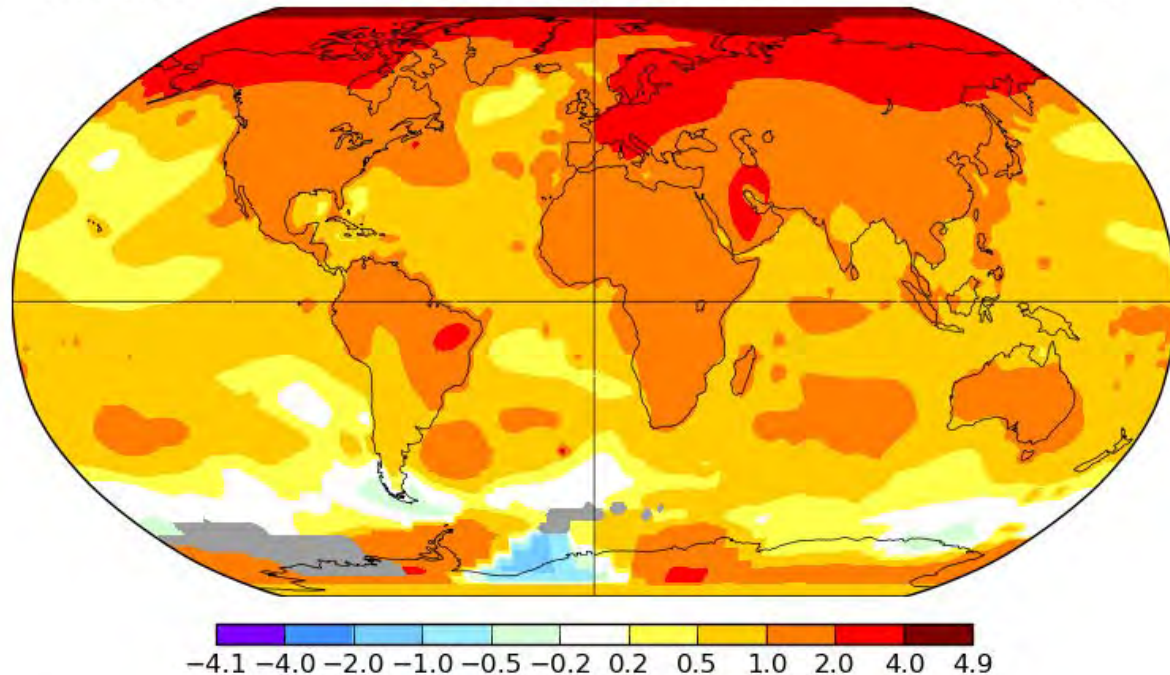




Photo: Esther Horvath/AWI



Photo: Dave Costa, CIRES/NOAA



Photo: Lianna Nixon, CIRES/CU Boulder



NEWS • 24 APRIL 2020

Coronavirus shutdown forces research ship to break out of Arctic ice

MOSaIC mission will return to its frozen-in platform, but disruption caused by team changeover will create a gap in its unique climate data set.

Shannon Hall



Photo: Joachim Hofmann

Photo: Lianna Nixon, CIRES/CU Boulder



A horizontal band featuring a microscopic image of cells, possibly from a tissue sample, with various shapes and colors (pink, blue, and white) visible.

#askmosaic

You ask, MOSAiC scientists and
crew answer!



#askmosaic



#askmosaic

What's making the Arctic get warmer?

-Tay'Vion from McKinley STEMM Academy

Do you miss your family?

-Brooklyn from Middleton Middle School

What types of supplies did you bring on board the ship?

-Billy from Seneca Falls Middle School

Life in the Central Arctic

Climb on board the 2019-2020 MOSAiC expedition to learn how a changing climate is impacting Arctic ecosystems

Created by the CIRES MOSAiC Education & Outreach Team | October 26, 2020

<https://bit.ly/Life-in-Central-Arctic>

Adaptations to the Arctic

Unlike most plants, sea ice algae can grow with very little sunlight. This adaptation allows the sea ice algae to start growing early in the Arctic spring in lower Arctic latitudes.

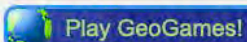
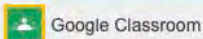
Image: A phytoplankton bloom in the Barents Sea turned surface waters a milky blue in July 2016. Image credit: Jeff Schmaltz and Joshua Stevens, LANCE/EOSDIS Rapid Response, NASA



MOSAIC Expedition to the Arctic Ocean



Travelers' Bios



MOSAIC Expedition to the Arctic Ocean

Current Location

Aboard Polarstern, Central Arctic

Join the most extensive Central Arctic research expedition in history! Connect with MOSAIC's international team of researchers, as they return from the top of the globe and share their experiences.

Logbooks

[Adventures in the Arctic Summer](#)

MOSAIC expedition co-coordinator Dr. Matthew Shupe gives an update from the Arctic, sharing what it's like to experience the changing seasons and a sun that never fully sets.



Journals

[Rebuilding the MOSAIC Central Observatory Ice Camp](#)

The MOSAIC Expedition faced many challenges and every leg of the trip was different. Let's take a closer look at how we learned to rebuild the MOSAIC Central Observatory Ice Camp during Leg 4.



Field Notes

[Cold-Loving Critters: Animals of the Central Arctic](#)

The Central Arctic has some of the most extreme weather on Earth. Yet, it's home to many different types of animals ranging from microscopic algae to polar bears. How do they survive? Let's find out!



Albums

[Safety and Polar Bears \(Recorded\)](#)

Meet Laura Schmidt, safety and logistics expert with the MOSAIC Expedition. What does it take to keep scientists safe in a place that is loaded with danger? Let's ask her!





EXPLORING BY THE SEAT OF YOUR PANTS

<https://www.exploringbytheseat.com>



Matthew D. Shupe



Eileen LaTorre Our 5th graders are asking about the food supply on the boat. Do you filter the salt water in the Arctic or did you bring enough water?



Maggie Kane Several of my students are interested in doing this kind of science in the future. What advice to you have for them?



Patrick Martens What kinds of things do you do on the expedition ship when you are not doing science experiments?



Eileen LaTorre Thank you so much for this opportunity! We had 70 students glued to the Smartboard!



Sharron Huxley



Carolynn Harris

Institution(s) * Montana State
University

PhD Student



Sara Morris

CIRES, NOAA

U.S. Coordinator



Taneil Uttal

NOAA

Atmosphere Team Coordinator
on Leg 2 (maybe Leg 5). YOPP
Liaison. Federal Co-I on
Communications Project



Jackson Osborn

CIRES

Engineering Support



Laura Schmidt

AlpArctica

Safety and Logistic



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Applied Mathematics PhD
student



Radiance Calmer, PhD

University of Colorado

Postdoc in atmospheric science



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Engineer



Katie Gavenus

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Research scientist



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CIRES, University of Colorado
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Amy Richman

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University
PhD Student

- 16 MOSAiC scientists and team members
- >1000 students around the U.S. and Canada



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co-coordinator of MOSAIC



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- Watch recorded video chats on the Reach the World MOSAIC program page (<https://www.reachtheworld.org/mosaic-expedition-arctic-ocean>) or at <https://mosaic.colorado.edu/media>

Matthew Shupe's Blog from the *Polarstern*

<https://blogs.agu.org/thefield/category/polarstern/>



Photo: Amy Richman, CIRES/CU Boulder

“Already feeling a sense of loss, a sense of melancholy. Am I happy to go home? Perhaps. Would I prefer to stay? Perhaps.”

Gina Jozef's Blog from the *Polarstern*

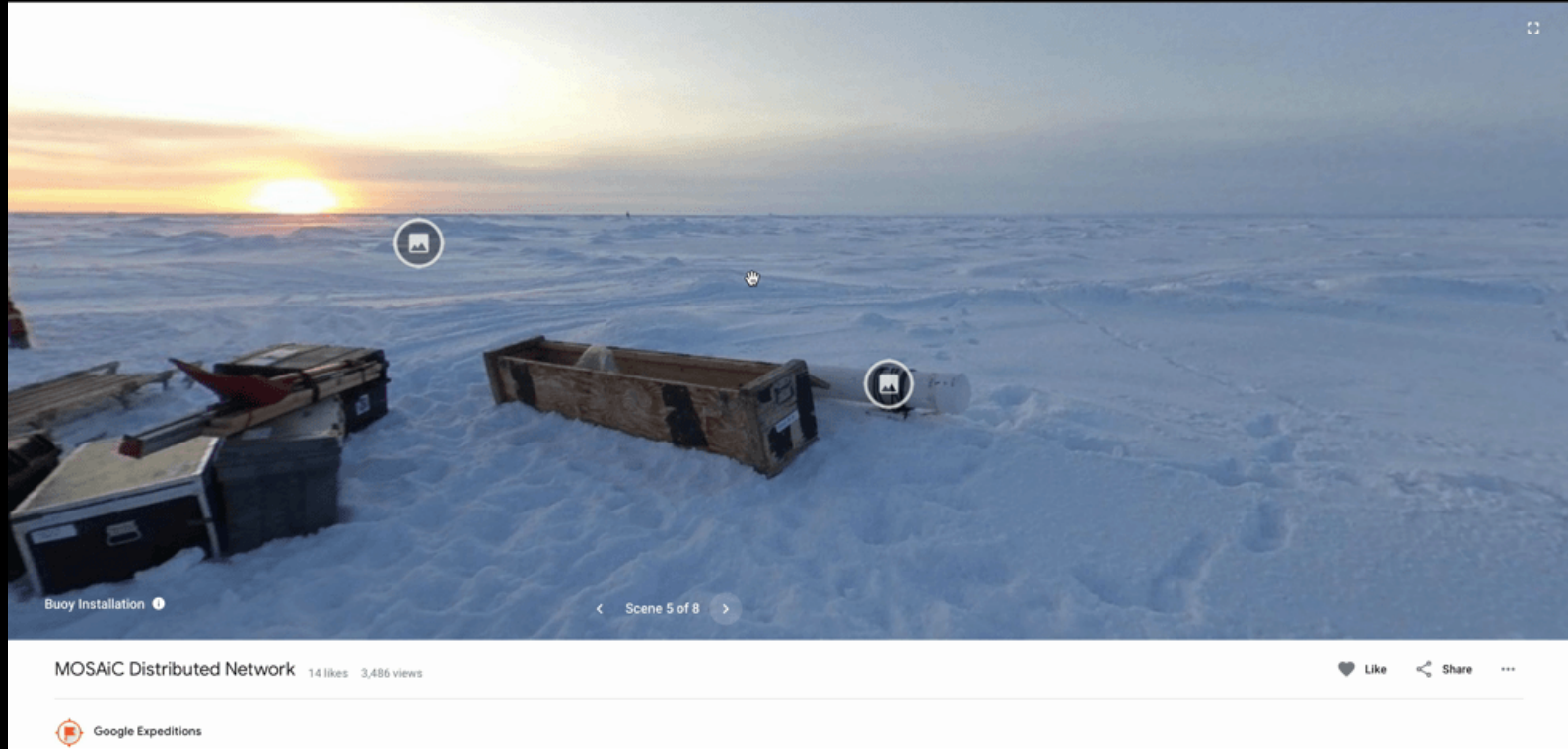
<https://mosaic.colorado.edu/blogs>



“There were times when I wanted to just quit....it was too much to handle.

But in these moments, I just had to step away for a moment, sometimes have a cry, or just do something to take my mind off of it, and I would come back ready to focus again, and find the solution to whatever was going wrong.”

Immersive Virtual Reality Experiences



<https://mosaic.colorado.edu/mosaic-virtual-expeditions>

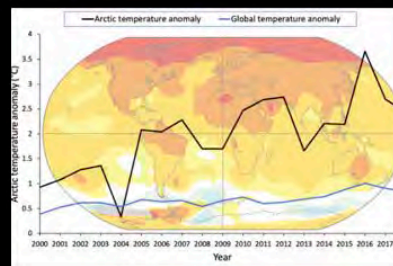
Browse our full
collection of
resources:
[mosaic.colorado.edu/
education](https://mosaic.colorado.edu/education)



MOSAIC Monday

Check in weekly for updates from the ship and short engagements for your classroom.

[Learn More →](#)



Arctic and MOSAIC Curricula

Check out our New & Old Arctic and Arctic Feedback units exploring MOSAIC and the Arctic climate system!

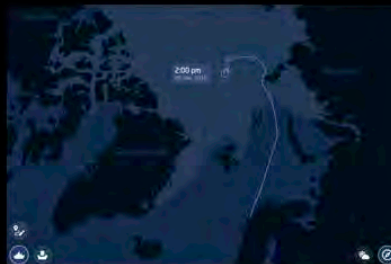
[Learn More →](#)



MOSAIC ArcGIS StoryMaps

Learn more about MOSAIC through immersive and visually-compelling StoryMaps. More coming soon!

[Learn More →](#)



Where's the Polarstern?

Track the Polarstern in real time with this MOSAIC web app.

[Learn More →](#)



MOSAIC VR Experiences

Immersive yourself in the 2019 MOSAIC and 1893 Fram expeditions with these 360 degree virtual experiences.

[Learn More →](#)



#askmosaic

Have questions about the Arctic and MOSAIC expedition? We have answers.

[Learn More →](#)



Thank you!



This work is supported by NSF award # OPP 1839104

References

Aikenhead, G.S. (1996) Science education: Border crossing into the subculture of science. *Studies in Science Education* 27: 1-52.

Clark G. et al. (2016) Science Educational Outreach Programs That Benefit Students and Scientists. *PLoS Biol* 14(2): e1002368.

Hong, H. and Lin Siegler, X. (2012) How Learning About Scientists' Struggles Influences Students' Interest and Learning in Physics. *Journal of Educational Psychology* May 2012: 1-16.

Rahm, J. (2007) Youths' and scientists' authoring of and positioning within science and scientists' work. *Cultural Studies of Science Education* 1(3): 517–544

Woods-Townsend, K. et al. (2004) Meet the Scientist: The Value of Short Interactions Between Scientists and Students. *International Journal of Science Education* 6(1): 89-113.

