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Arctic ice in cross-disciplinary undergraduate education: Experiences across natural science, social science, international policy, and public writing

Michelle Koutnik¹, Nadine Fabbi², Elizabeth Wessells³, Ellen Ahlness⁴, Max Showalter⁵, Dan Mandeville⁶, Jason Young⁷, and Hans Christian Steen-Larsen⁸

¹University of Washington, Earth and Space Sciences, Seattle, WA, U.S.A. (mkoutnik@uw.edu)

²University of Washington, Canadian Studies Center, Henry M. Jackson School of International Studies, Seattle, WA, U.S.A.

³University of Washington, Archaeology, Seattle, WA, U.S.A.

⁴University of Washington, Political Science, Seattle, WA, U.S.A.

⁵University of Washington, School of Oceanography, Seattle, WA, U.S.A.

⁶University of Washington, Linguistics, Seattle, WA, U.S.A.

⁷University of Washington, Information School, Seattle, WA, U.S.A.

⁸University of Bergen, Geophysical Institute, Bergen, Norway

With the Arctic currently warming at a rate at least twice that of the global average, the coupled Arctic ecosystem is losing ice. This includes significant land-ice loss from the Greenland Ice Sheet and Arctic ice caps and glaciers, reduction in extent and thickness of Arctic sea ice, and thawing permafrost. This scale of environmental change significantly affects Arctic people, wildlife, infrastructure, transportation, and access. Societal response to these changes relies on advances in and application of research spanning multiple scientific disciplines, with policy-making done in partnership with Indigenous people, governments, private agencies, multinational corporations, and other interested groups. Everyone will interface with outcomes due to a changing climate and the challenge is mounting for the next generation of leaders. The cross-disciplinary nature of the challenge of Arctic ice loss and climate change must be met by cross-disciplinary undergraduate education. While higher education aims for disciplinary training in natural sciences and social sciences, there is an increasing responsibility to integrate topics and immerse students in real-world issues. And, in our experience the undergraduates we teach are eager for courses that can do this well.

What is immersive undergraduate education? We consider this as either immersing students in a focused topic in the classroom, immersing students in a place (especially while abroad), or combining the two through targeted lectures, informed discussions, travel, and writing. With regard to the Arctic, it is necessary to bring scientific understanding to learning activities otherwise focused on societal impacts, policy making, and knowledge exchange through public writing.

We share from our practical experience teaching Arctic-focused courses to classes each with 10-30 students with majors from across the University of Washington (UW) campus (total undergraduate

student body of 32,000). Three recent activities that integrate the state of science with impacts on society in undergraduate courses include: 1) a four-week study abroad course to Greenland and Denmark focusing on changes in the Greenland Ice Sheet and sea-level rise, 2) a 10-week Task Force course in Arctic Sea Ice and International Policy in partnership with the UW International Policy Institute at the Henry M. Jackson School of International Studies that includes one-week in Ottawa where students develop a mock Arctic sea ice policy for Canada consistent with Inuit priorities, and 3) a 10-week seminar in public writing where students write mock newspaper articles, book reviews, and policy summaries about ice in a changing climate. These courses were designed to include a similar subset of earth science, atmospheric science, and oceanography, but the distinct structure and application of the science in these three separate courses led to distinct learning outcomes. In addition, we present how the academic minor in Arctic Studies at the University of Washington has allowed students to design their own integrated understanding of Indigenous and nation-state Arctic geopolitics, Arctic environmental change, and policy by taking a selection of courses and engaging in research and report writing.