

The SPACE Lens at Dawson College. J. Trudeau¹, ¹Dept. of Physics, Dawson College Montreal, Canada H3Z 1A4 (jtrudeau@dawsoncollege.qc.ca).

Introduction: Interdisciplinary education frameworks such as *STEAM* (Sciences, Technology, Engineering, Arts, and Mathematics), *STS* (Science, Technology and Society) that aim to integrate the sciences with the arts and humanities are being developed as approaches to help students thrive as our society enters the Fourth Industrial Revolution. This era will be marked by the impact of Artificial Intelligence, climate change, biotechnology and genomics, and other complex global problems. In preparing the next generation of young people for the challenges and opportunities these developments pose, it has been widely recognized that reinforcing the connections between disciplines will have an indispensable role to play. Yet, specifically integrating the sciences, arts, humanities and social sciences in post-secondary education has been a persistent challenge.

The *SPACE* (Sciences Participating with Arts and Culture in Education) initiative at Dawson College has been working to take on this challenge by developing pedagogical and support practices that encourage the integration of program disciplines among students and faculty. In addition, *SPACE* has created and maintains a number of co-curricular venues and activities - a website, conferences, exhibitions, hackathons, competitions - where students can share work and apply knowledge and skills that emerge from their participation.

SPACE is situated in the framework of Learning Communities at Dawson College. It has the goal of supporting the development and delivery of interdisciplinary teaching and integrative learning. Integrative learning is a process by which students connect knowledge and skills from multiple sources and experiences, understand issues contextually, apply knowledge and skills in varied settings, and analyze diverse points of view. Such learning engages and further develops students' critical and creative thinking as well as their communication skills while allowing them to follow diverse pathways towards a goal that is intrinsically motivating to them.

This is the broader context for the involvement of a number of Dawson College students in the 1st Workshop on Ices in the Solar System: A Volatile-Excursion from Mercury and the Moon to the Kuiper Belt and Beyond.

Breadth and depth in STEM Education: Guiding students within this broader context provides opportunities for students to situate knowledge and examine questions from many perspectives. This can be beneficial to the challenges of deeper disciplinary explorations. In the *STEM* disciplines, students learn that a core concern for the advancement of science is the well-posed

problem which if properly formulated can be reasonably guaranteed a solution at some definite future time. In standard textbook treatments of *STEM* fundamentals, students are presented with the definiteness of well-posed problems and their outcomes. This partial view tends to undervalue reformulations and discarded hypotheses as important precursors to resolvable propositions, and as critical process elements needed to tackle open-ended problems. *SPACE* annually explores this aspect of creative problem solving in an active learning context. In this way students are encouraged to practice formulating well-posed problems and to gain perspective on how scientific knowledge progresses.

Experiential Learning and Research: *SPACE* channels students into unique learning situations and tasks. Students are often engaged in self-directed, exploratory and investigative activities. These activities are mentored by faculty. Students and faculty from numerous pre-university and technical programs and many different departments also work in teams, on joint projects, and on developing research. Outcomes are then shared within the *SPACE* Learning Community and through the supported venues. With respect to Ices in the Solar System, learning activities have been designed to engage students in a process of discovery in order to better understand questions under investigation by the research community, to spark personal interest, and to generate project ideas for further exploration after the Workshop experience.

The sequence of activities expose students to multiple topics in planetary science, guide their preparation in order to be active workshop participants, and scaffold learning outcomes that will lead to future projects. In particular, the group of 24 participating students will

- Identify solar system segments of interest to them, search for abstracts from the Ices Workshop or any recent Conferences of the LPI with the goal of identifying and summarise key questions being asked by researchers in the domain;
- Complete reflections related to one or more conference topics;
- Take part in post-workshop group sessions to share experiences and propose topics for further investigation.

Group cohesion and collaboration is encouraged by providing volunteer tasks to aid the organizers and by also guiding students to realize that they can be contributors to research in planetary science. Notably, a team of Dawson students have already demonstrated

this by submitting an abstract conveying hypotheses related to the unexpected geological activity observed on Pluto. A further goal is to guide other keen students as they take up their own research questions with mentorship and support through *SPACE*.

Conclusion: Exposure to scientific research practice and culture for young students can be formative. It is hoped that the experience will engender confidence that they can engage with frontier topics in ways that inspire and that will be of benefit in future academic pursuits.

References: [1] Sciences Participating with Arts and Culture in Education (*SPACE*), https://space.dawsoncollege.qc.ca/projects/summary/nasa_guide

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