



Where Were We: Science Teacher Professional Development Under The Night Sky.

Hechter, Richard¹, Kasbia, Gursevak², McNabb, Cameron³

1 University of Manitoba, Canada

2 University of Manitoba, Canada

3 University of Manitoba, Canada

Abstract

The constellations shine bright over the prairie landscape at our free and public space named “Oodena Celebration Circle”^[1] located in Winnipeg, Manitoba, Canada at the fork of the Assiniboine River and Red River. Developed in 1993 as a local collaborative endeavour, Oodena is designed to be, “a gathering place that evokes spirituality without reference to culture-specific symbols, by directing our attention to the beauty of the sun on the horizon, the wonder of starry nights, the serenity of winter bonfires and the drama of spring flooding – experiences, and presumably responses, which we share and thus, experiences which unite us as human beings.”^[2] It is situated here, while gazing under the awe of the night sky, that our story of inservice science teacher development begins. In this experiential-based session, we will describe how our visit to Oodena became an inspiring context for re-envisioning astronomy education found in the Grade 9 curriculum to emphasize that the sky belongs to everyone. Moreover, with the sky being interpreted differently through cultural lenses, it is an opportune moment to teach broader ideas of social justice, inclusion, and empathy through ethnoastronomy. Using the 5E model^[3] as a framework, we will describe our journey of meeting at, and introducing the underlying tenets of Oodena, through the elements of engagement, exploration, explanation, elaboration, and evaluation. In short, we gazed upon asterisms and learned stories of their origins and teachings emanating from local and global cultural knowledge. Together we noted the parallels of constellation constituents and marvelled at the unique starlore passed down from generations of oral history cultures. We identified places for these stories to find their way into our teaching and learning of astronomy. For us, this activity resulted in a collective re-envisioning of curriculum and pedagogical changes to be implemented in Grade 9 classrooms in Manitoba. At its heart, our re-imagining of how to teach and learn introductory astronomical concepts and phenomena can be an opportunity to connect scientific and cultural knowledge. This approach provides a greater richness of studying astronomy that more fully reflects the nature, dynamics, and multiculturalism of our curriculum and classrooms.

Keywords: Ethnoastronomy, Science Teacher Education, Science Teacher Professional Development, Astronomy Education

1. Introduction

Grounded in our desire to create a professional development (PD) opportunity that could bring together culture and science in complementary ways, we began with a common experience for all participants. We gathered at the Oodena Celebration Circle, a free, public space in our local community, to implement the following PD for teachers to develop new teaching and learning experiences that provide students with a more holistic science education. Articulated below through the tenets of the 5E model^[3], we share with readers the PD event that we designed and invited inservice teachers to participate in.

2. Engage

“Where are we?” was the opening question posed to the large group of inservice science teachers (n=12) as we arrived at Oodena Celebration Circle. The purpose of this question was to capture the curiosity of this professional development experience being held outdoors under the clear-sky revealing flickering stars on the dark canopy overhead. Prior to arriving at the learning site for our session, participants were asked to digitally visit curated online media to help generate questions and insights about both the overt and subtle reasons for our location.

The activating pieces were:

- Top Ancient Sites to Stargaze^[4]



- Ask an Elder What does the winter solstice mean in the Cree tradition? ^[5]
- Indigenous Perspectives on the Solar Eclipse ^[6]

With these resources in mind, we sat in a circle on the grass and began a group discussion intended to raise questions about Oodena, and elicit new and long-held ideas about the sky belonging to everyone. With targeted questions about each of the activating pieces, participant responses meandered through descriptions of our physical location towards insights into the purpose and relevance of Oodena in our city, and country. Interestingly, this opening discussion merged into discussing the absence of multicultural perspectives in our science curriculum that go beyond a cursory comparison. The culmination of this opening activity arrived wondering if there were areas within our provincial wide science curriculum where ethnoastronomy^[7] could be introduced. With our cell phones in hand for both its text and photo capabilities, it was time to explore Oodena.

3. Explore

The first aspect of this part of the session was an open invitation for participants to explore the grounds freely in a small group without any direct instruction. The purpose of this aspect was simply to begin to understand the physical layout and organization of Oodena such that it would serve as the context for our learning. A paper copy of the Oodena map ^[8] was provided to participants, and a digital copy was sent to them via email. While participants were exploring, our role as leaders in this activity was to casually join the groups to listen to participant interactions and ask probing questions as relevant opportunities arose. Further, our role also included assistance for logistical inquiries about the nature and layout of Oodena, and as consultants for more specific ethnoastronomy questions. Students were asked to record their observations, insights, and questions emanating from their exploration for further discussion later on in our session.

The second aspect of the Explore aspect was a teacher-guided inquiry ^[9] based on a jigsaw structure where groups studied one star formation, and then shared their insights with the larger group. Each group was provided introductory information ^[10,11] about one constellation, and they were to use their devices to research a cultural interpretation of that star formation. After identifying one, the following guiding questions were used as prompts:

- *What is the significance of the star formation for those peoples?*
- *Is there a story connected to each variant of the constellation within that culture?*
- *What lesson may accompany the story? What does the story reveal about the culture; what background information did you research to guide your perception?*

Groups shared their findings, mostly in the form of the star stories, in a large group discussion later on in the session.

4. Explain

Before we began this section, we reminded participants that these star stories belonged to the cultures from which they exist, and that care and respect were needed when sharing. Moreover, while the three of us are from different cultural backgrounds, we did not pretend to belong to any background other than our own. We used this moment to initiate a conversation about tokenism, cultural appropriation, and the relationship between western modern science and cultural science.

In a large group setting, participants listened to other groups' presentations and constructed questions about their star formations and stories. Comments and inquiries ranged from learning from the star stories, to determining what time during the year were the constellations visible at the Oodena site. As leaders, we encouraged participants to identify personal resonance in the star stories. This activity allowed the participants to experience the learning as their students will, and gain insight into the possible questions and connections their students may bring up for discussion. Together, we developed a structure for a star formation journal participants would create that included notes, descriptions, diagrams, explanations, and relevant cultural connections emanating from our experience at Oodena.



5. Elaborate

After a break, and with work on participants' star formation journals beginning to take shape, we began the fourth part of the session. Here we extended the conversation to center on the pedagogical reasons for being at Oodena. Our focus was positioned on two independent streams. First, participants explored the provincial science curriculum to locate areas in astronomy education that would serve as places to integrate the knowledge learned at Oodena. Results of this focussed mostly on Grade 9, "Exploring the Universe" cluster^[12], and the specific learning outcomes below:

- 9-4-3 Investigate how various cultures used knowledge of the position and motion of visible celestial objects for navigation.
- 9-4-4 Compare and contrast historical perspectives on the relationship between Earth and space. Include: geocentric model, heliocentric model.
- 9-4-7 Compare and contrast scientific and cultural perspectives on the origin and evolution of the universe.

The second stream was a more concentrated discussion about the role of introducing cultural science into the curriculum. We guided participants to generate large-scale questions about how this work has the potential to mitigate racism, build empathy, and create a sense of inclusion and safety for others in our classrooms. The richness of the conversation cannot be overstated. As this topic can extend to many pathways, it was critical for us to guide the conversation back to the tenets of effective and meaningful pedagogy. This section ended on a hopeful sentiment that we can teach science as a more inclusive discipline, and despite the magnitude of the issues discussed, there are actions we can take in the classroom to enact the change we advocate for.

6: Evaluate

In this concluding aspect of our session, participants worked in pairs to collate their new knowledge, insights, and ideas into generating learning plans for their classrooms. We chose pairs to reduce the vulnerability of sharing with PD facilitators for critical feedback as it became a small group conversation rather than a spotlight on their individual understanding of integrating cultural knowledge into science curricula. This also created a professional learning community for participants to connect with post-PD when enacting this in their class. This was designed to extend the learning beyond this session. In doing so, participants would use their new observations, evidence, and explanations in concert with their pedagogical knowledge to develop new teaching and learning experiences. While we did not formally evaluate the activities, we did provide critical feedback in a conversational and supportive manner aimed at strengthening each activity.

7. Conclusion

This professional development experience was grounded in the premise that the sky belongs to everyone^[13] but our science curriculum only presents one perspective. This is very myopic. As such, we should be emphasizing the plurality of perspective in our classrooms where our students arrive from diverse cultural backgrounds. Hopefully this professional development activity helped demonstrate that like sky, our classrooms belong to everyone. In answering the question, "where were we", we unpacked concepts ranging from our place in the universe, to how we teach for inclusion and social justice in science. As teachers, we need to create a safe space for everyone to feel included and shine like the stars we saw that night at Oodena.

8. References

- [1] Forks North Portage Corporation. "Oodena Celebration Circle." <https://www.theforks.com/attractions/oodena-celebration-circle> n.d.
- [2] https://www.theforks.com/uploads/public/files/attractions/oodena_info.pdf
- [3] Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. "The BSCS 5E instructional model: Origins and effectiveness." Colorado Springs, Co: BSCS, 2006, 5, 88-98.
- [4] National Geographic. "Top ancient sites for stargazing." <https://www.nationalgeographic.com/travel/top-10/top-ancient-sites-stargazing/> 2016.
- [5] CBC. "Ask an Elder: Winter solstice in the Cree tradition." <http://www.cbc.ca/player/play/1121866307957/> 2018.



- [6] Rousseau-Nepton, L. "Indigenous Perspectives on Solar Eclipse".
<https://youtu.be/474HOSOcM6M> 2017.
- [7] Lankford, G. E. "Reachable stars: Patterns in the ethnoastronomy of eastern North America.": Tuscaloosa, AL: University of Alabama Press, 2007
- [8] https://www.theforks.com/uploads/public/files/_attractions/oodena_constellations.pdf
- [9] Llewellyn, D. "Teaching high school science through inquiry: A case study approach." Corwin Press, 2005.
- [10] The Forks Market. "Oodena Celebration Circle: Observing the stars."
<https://www.theforks.com/blog/85/oodena-celebration-circle-observing> 2016.
- [11] Bremer, N. "Figures in the Sky." http://www.datasketch.es/may/code/nadieh/#_sky-cultures 2018.
- [12] Manitoba Education and Training. "Senior 1 Specific Learning Outcomes".
<https://www.edu.gov.mb.ca/k12/cur/science/outcomes/s1/outcomes.pdf> 2000.
- [13] Hechter, R.P. "The Giant, the wintermaker, or the hunter: Contextual ethnoastronomy towards cultivating empathy." Physics Education, 2019, 55(1), 015025.