▲ Uncovering High Park's Pasts and Presents: Storying the Land through Mathematics and Storywork

DAHLIA BENEDIKT
dahliaben@gmail.com

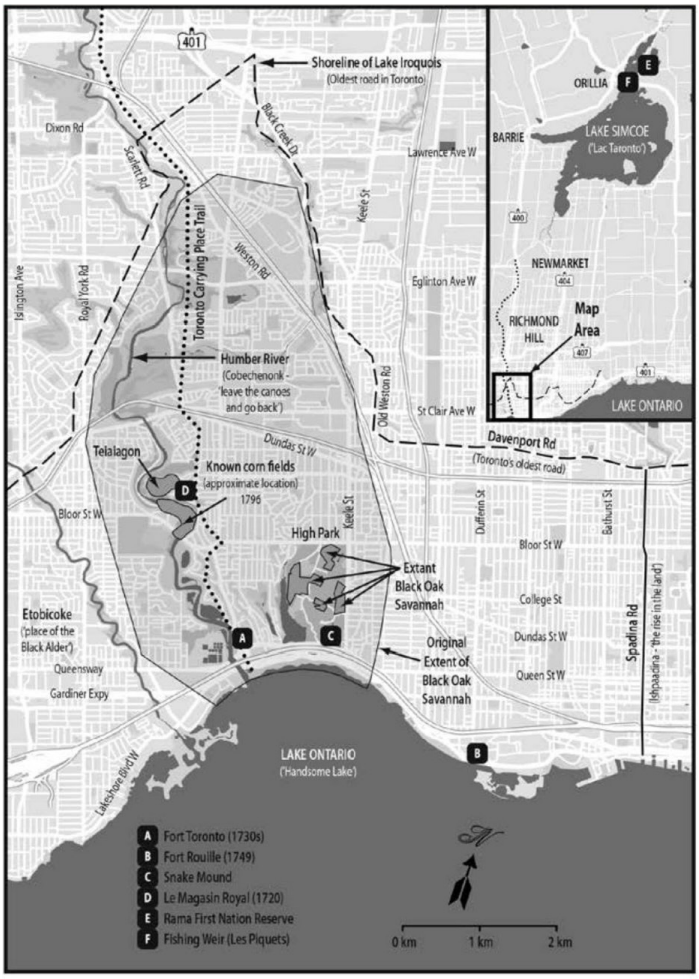
Dahlia is a community-based educator in Toronto. Having been involved in social-movement education since her youth, Dahlia now teaches at Seneca College and supports active teaching and learning at Toronto Metropolitan University. Previously, Dahlia worked as an educational researcher at the Ontario College of Teachers and at the University of Toronto's Centre for Critical Qualitative Health Research. She has an M.A. from the Ontario Institute of Studies in Education (OISE) and is currently completing an M.Ed. in Mathematics Education in Community at the University of British Columbia. Dahlia is committed to changing the way we do education and living up to our land responsibilities.

Introduction

> *"I was just thinking how if a plant has a different angle, then maybe something happened to it. It could be a way to see if something affected its growing, like an animal, or a human."*
> — Rosa, 2023, 14-year-old participant

The sun had already set over High Park in Toronto on a Sunday evening in late February, when a group of six 14-year-olds and two facilitators gathered for their monthly program. A fresh coat of snow blanketed the remains of southern Ontario's Black Oak Savannah as the dispersal of the day's human activity gave way to a bustling network of winter life. The group of youth are affiliated with a Jewish outdoor education organization that runs after-school programs and camps around Jewish nature connection. Last year, these six teens took part in a year-long *b'nei mitzvah* (coming of age) program, where they formed lasting relationships and sought to continue their learning together. Now, they meet for monthly programming in parks and ravines around the city.

My sister, Iris, is the program lead for the group. Iris and I are both Jewish community educators in continual conversation about how our own cultural frameworks may be engaged as collective sources of guidance for how to act



The Toronto Carrying Place Trail (Johnson, 2013)

on our responsibilities as non-Indigenous settlers on Anishinaabe and Haudenosaunee lands. We had recently been discussing mathematics and story, how stories shape how we come to understand our environments, and considered how mathematics might help us reveal elements of story not initially visible. Aligned in our educational philosophies, but with very different relationships with mathematics, Iris invited me as a guest co-facilitator, and together we developed a program that would apply mathematics to further inform the group's ongoing land-based explorations. The central problem that shaped our activity was to investigate how mathematics could be utilized to deepen our understandings of some of the past and present activities of High Park, including those that often get missed or disregarded. Our inquiry questions were:

> *What can we trace about High Park's activities? What stories can we tell?*
>
> *How can mathematics help us to reveal some of the hidden histories of High Park?*
>
> *How does our perspective inform what we find (and what we overlook)?*

As educators devoted to community in the age of global capitalism and climate change, we respond to a reality in which certain stories are privileged over others, and thus, central to our educational work, including this activity, involves unsettling the colonial master-narrative to reveal multitudes of living histories enduring prior, within, against, and beyond it. The activity, which involved traversing from the park's north entrance down the forest trails to Grenadier Pond, was punctuated by text excerpts narrating the history of the park that we sporadically gave participants to read aloud. We started with the official placard of John Howard's benevolent gift of the "wooded resort" to the citizens of Toronto, and was confounded in turn by pre-existing activity of Indigenous peoples along an important Indigenous trade route dating back 11 000 years. These excerpts told just some of the myriad stories that make up the park's past and present.

Forest trail leading down to Grenadier Pond in High Park

Stories are important ways of understanding and orienting us to our sense of place. Sto:lo educator Jo-Ann Archibald Q'um Q'um Xiiem's (2008; 2019) storywork pedagogy outlines seven principles—*respect, reciprocity, reverence, responsibility, holism, interrelatedness,* and *synergy*—to help educators and learners ethically engage in the Indigenous stories and life experiences that make up our environments and guide us in becoming "storywork ready." This essay tells the story of our activity through the lens of mathematical inquiry and the seven storywork principles, focusing on three "math moments" that took place during the activity, to examine how mathematics can be used to reveal hidden stories about the land and help us to become storywork ready.

This paper is written for fellow community-based educators who are interested in exploring how mathematics could be incorporated into community-oriented programming as a way of formulating the world more justly and truthfully, and as another way of looking at social and practical issues. With participants' permission, I audio-recorded segments of our activity. All participant names are pseudonyms.

Math Moment #1: Storying the Land – Animal Tracking and Spatial Imagination

Guiding question: What stories of the land's activity can we trace?

Math concepts: spatial recognition, logical and spatial reasoning, patterning, probability

Rabbit tracks in snow

As we descended off the paved road and into the forest trail, participants were instructed to put on their math tracking glasses and see what they could uncover about the land's activity. The group had been practising animal tracking and identification skills over the last year, but had not considered the range of mathematical strategies they had already been employing in the process. As soon as they looked, the group began spotting evidence of life activity throughout the contours of the snow, counting the segments and examining their arrangements to identify the animal prints with the help of identification guides. Before we could name it as such, I was observing participants employing their mathematical thinking to decipher the prints based on their numbers and shapes, their level of pressure and impact in the snow, and their spatial progression; indicating the size of an animal, how and where it may have been moving, and how its motion might be traced in the surrounding fauna, such as bent or broken branches or trampled debris. The group hovered over sets of four prints along a sequence, two longer parallel prints behind two smaller ones, applying spatial reasoning to gather that the animal was travelling in

a hopping motion, and verifying from its prints to be a kind of rabbit. Another set of prints was said to resemble a canine track, and Iris asked how they might tell the difference between a domesticated dog and wild dog, such as a fox or coyote. She explained that compared to pet dogs, which often walk in a relaxed fashion with their paws spread out, coyotes and foxes walk carefully with their paws more narrowly spaced, and tend to place their back paw in the same spot as their front paw to conserve energy. Participants looked for evidence of these behaviours in the landscape, visualizing the print patterns these strategies would produce. "It's not just about the prints, it's also about the context," Iris reminded, pressing them to consider the probability of their conjectures. The small likelihood of a wolf, for instance, passing through High Park, simultaneously narrowed its plausibility, while indicating that it was still possible.

Using these points of reasoning, we then had participants break off into groups to explore the area and develop stories of animal activity based on what they could trace on the land. Given the low visibility (we were using headlamps and flashlights), we told participants to remain where they were still in earshot of the group, and I thought about how this in itself was a calculation in spatial awareness. By storying the land with possibilities they could trace, we were having participants proliferate the number of stories and interwoven activities conceivably at play across High Park's present and recent past. Placed together, we were constructing a story of stories centred on the wildlife and interplay of ecological forces, to which human narratives merely at times play a part. When we came to listen to each group's stories and examine their evidence, the rest of the group was given the task of responding to the group by suggesting some counter-narratives to the one they presented.

One group hypothesized that the same rabbit they had identified earlier was rushing to have tea with his grandma, breaking a few small branches as he brushed past and up the hill. One participant, Shlomo, challenged the story by questioning its spatial soundness:

Shlomo: Okay so, I think a lot of your story makes sense, except for two key things. First of all, how would an animal go in a straight line here and break this piece of wood in a different direction?

Leah: That's what I was wondering.

All: Hmmm.

Eli: Maybe it fell over.

Leah: If it fell over, then there would be other marks on the ground.

Adina: He wanted a walking stick, so he reaches out, grabs this—

Leah: With what arm?

Adina: His other arm.

Shlomo: Anyways, also, how could it be the animal we saw, because the other animal we saw before had two tracks at a time, 1-2, 1-2, 1-2. And it also wasn't really this shape.

In their decoding of the story being told in the land, the participants employed mathematical reasoning to challenge each other's accounts and refine their understanding of what could conceivably have taken place there. They used spatial vectors to visualize the scope of the animal's dimensional shape and motions, scaffolded with imaginative thinking to help rationalize their findings. Shlomo helped to reveal how the team may have been overlaying their own prior assumptions onto the stories they found, by conjuring a familiar animal and applying it to what they had seen previously. This teaching connected back to an opening text we read by Rabbi Benay Lappe (2014), who quoted Rabbi Lisa Edwards saying, "If donkeys read the Torah, all the donkey stories would jump out at them." It demonstrated how, as we read the world around us, we are often programmed to see our own images in its textual landscapes; that it takes an added layer of awareness to be able to see those stories that do not pertain to us, or that stories may emerge in unfamiliar forms and ways, or that donkeys might also tell their own stories, or that we too may be donkeys. How would these stories differ from the ones humans tell themselves?

Math Moment #2: Age of a Tree – Circles, Rings, and Growth Factor

Guiding question: Can we find out the age of a tree without cutting the tree down?

Math concepts: geometry, spatial reasoning, problem solving, measurement, pattern recognition

Our mathematics continued when we arrived at a landing at the bottom of the trail. We talked about the Black Oak Savannah that once densely covered a large portion of southern Ontario, a rare ecosystem that was maintained by Indigenous peoples through controlled burns that encouraged plant growth and nourished wildlife (Johnson, 2013). This raised a question from Rosa of how old the forest is. Our research told us 4000 years, and that today, as a result of excessive human interference and invasive plants, High Park's Black Oak Savannah represents less than 0.5 percent of what was here previously (Johnson, 2013). Participants began to imagine the swaths of wildlife activity that characterized the past eras of High Park, and

the legacy of the trees as habitats for different forms of wildlife. Following our question about the age of the forest and our reverence for its longevity, we wondered if we could measure the age of a tree.

High Park's Black Oak Savannah in winter

"How do we typically measure the age of a tree?" we asked the group. Participants had heard that the rings of a tree reflect its age in years. But can we do it without cutting the tree down and exposing its rings? "Well, we can see the tree's measurements, sort of," remarked Adina. Participants began to brainstorm ideas, suggesting that they could measure one ring of the tree and apply it to how many times it would fit inside it. They observed that one ring they could access was the outermost ring encompassing the tree's width. However, some participants raised a few problems: first, each ring would be a bit smaller than the last, and second, would the extra layer of the bark create an added distance from the rings inside?

Benny recalled what he had learned in school about circles. He reasoned that if they know the diameter of the tree, they can estimate the distance between each ring and discern the number of rings spanning the diameter. He suggested that they can use the circumference to find the diameter. Participants identified two equations for circumference: $C = 2\pi r$, and $C = \pi d$. We noticed that these were the same because the diameter, d, is equal to twice the radius, r. They worked together to measure the circumference of a large tree nearby, using a string and measuring tape. The group found the circumference to be 99 inches. While Eli used a calculator to divide by π, other group members began to estimate what the diameter would be. Leah used the mathematical habit of generalization (Su, 2020) to guess that it would be around 33 inches because π was a little bit more than 3, and a third of 99 was 33. "So will it be a little bit less or a little bit more?" I asked. Responses varied, but the answer, 31.5 inches, confirmed that it would be a little less. "Oh yeah, because dividing by a higher number will make a smaller number."

From there, the group considered how the diameter would reveal the number of rings in their tree. They recalled their idea to estimate the distance between the rings and use division to determine the number. By this point, a shared mental picture of the tree's circular cross-section was informing the group's thinking. Benny then pointed out that the diameter would cross each ring not once, but twice, indicating that what they needed was in fact the radius, not the diameter. They used mental math to determine that the radius would be 15.75 inches. But how would they estimate the distance between the rings? Leah correctly surmised that the distance between rings may differ based on the kind of tree, and Shlomo pointed out that they may vary even within a single tree as a result of changes in the weather and climate.

Tree Species	Growth Factor
Red Maple	4.5
Linden	3.0
Austrian Pine	4.5
White Birch	5.0

Table of growth factors (excerpt)

That's when I introduced the concept of *growth factor*: an index of tree growth rates based on species. I handed them a table of growth factors for about 50 tree species, and the next task of the group was to identify what kind of tree theirs was. The group observed the tree's winter needles, branching patterns, and distinctly high canopy; they noticed the texture and colour of the bark, and what looked like sap running down the trunk. Based on the smell of the sap, the group guessed it to be a pine, but not a white pine, because they had recently made tea with a white pine and noted them to be shorter. They guessed their tree to be an Austrian pine based on the darker needles

Diameter (in.) x Growth Factor = Approximate Tree Age (years)

and how high they were growing. They found the Austrian pine's growth factor on the table to be 4.5. From there, they could calculate the estimated age of the tree by multiplying the growth factor with the diameter. Benny paused. Didn't we say it was the radius? We thought about it. Adina suggested, "Is the growth factor already doubled… or half?" We rationalized that the equation of the age of a tree, using the growth factor, must already account for the extra step of dividing for the radius.

Based on their calculation, the age of the tree was estimated to be around 142 years old. Did that seem believable? The group found it to be probable. Using more mental math, they calculated that the tree would have been born in the 1880's. We wondered together: what was happening here in the 1880's? What surroundings must have propagated the birth of this tree? What lifetimes of activity has this tree borne home and witness to? Was this a native tree? If not, how did it get here? The name, "Austrian pine," is suggestive of the tree's origins; at the same time, as Eli noted, "Lots of people get credit for something that isn't theirs." We talked about the tree's longevity as a reminder of the significance of old-growth trees and their role in the surrounding ecosystem, that a planted sapling was not the ecological equivalent of a felled tree. I wondered how further dwelling on the perspective of the tree was helping us to turn our focus to the more-than-human inhabitants as the subjects and overseers of the forest, who have maintained and sustained the land over thousands of years, and who have increasingly come under threat by anthropogenic primacy.

Math Moment #3: Claims to Land and Truth – Value, Ratio, and Sacred Sites

Guiding questions: How does power shape the stories we focus on? What does it feel like to not be believed?

Math concepts: value, ratio, relativity, number sense, economic reasoning

The group proceeded further down the forest trail and settled in a circle at the north point of Grenadier Pond. We explained that in 1805, the City of Toronto purchased the land from the Mississaugas of the Credit for 10 shillings and a small handful of provisions. This is known as Treaty 13. We examined a map of the Toronto Purchase, the scale of which made High Park too small to locate. Some participants had learned about the Toronto Purchase beforehand, recalling that officials had taped the signatures of Indigenous peoples onto the agreement, and that the document was written in English, meaning Indigenous peoples were likely excluded from reading it. Treaty 13 is surveyed to be 250 830 acres—now probably worth billions of dollars, Rosa observed.

We continued: thirty years later, in 1836, John Howard purchased High Park's 160 acres from the City of Toronto for $1000. The math task was clear: participants immediately began to think through the land and monetary value transfers of the two purchases, and consider the relative worth placed on each transaction. The first question they asked was, "How much was a shilling worth?" I told them that from what we could find in our research, one shilling was about a day's work for a labourer. Shlomo suggested that this would be equivalent to $40. Rosa responded, "It might not even be that, because a lot of labourers at the time were really underpaid." Leah added, "I researched this one time. It's not that much." They postulated that a day's work might be closer to $10 at that time. Following this math, they concluded that the City would have paid the Mississaugas around $100, their estimated equivalent of 10 shillings. By comparison, the group noted that the City of Toronto received ten times as much from John Howard, totalling $1000, for the purchase of High Park. Using a calculator, they calculated 160 acres out of 250 830 acres to determine that High Park encompassed about 0.06 percent of the land of the Toronto Purchase. Participants digested the reality of these numbers: that the City of Toronto profited from *less than one-thousandth* of the land by tenfold what they had purchased it for. We asked them to imagine how much would have been paid to the Mississaugas had the land been valued at this price point. "How much is Toronto worth?" Rosa rephrased. Unfortunately, we did not have time to verify the calculation. Benny indicated probably over a million dollars; Leah suggested two million. We considered the relative worth of that amount of money in today's terms. We asked, "Why do you think the City of Toronto placed such little value on the treaty with the Mississaugas of the Credit, compared to the purchase from John Howard?" "Racism," Adina suggested. "Profit," declared Benny.

A camp set up among BMX bicycle jumps to protect ancient native burial grounds in May 2011 (Red Power Media, 2016)

At this point, we turned our attention to the place where we had been sitting. The next recited quotation read that in

1921, during roadside construction, the remains of ten Algonquin people were discovered in a burial site at the north ridge of Grenadier Pond (Donaldson & Wortner, 1995). In the years since, there have been estimates of 57 ancient Haudenosaunee burial mounds said to remain throughout the park, dating back 3000 years (Johnson, 2013; Red Power Media, 2016). Despite the 1921 evidence, whose current whereabouts is unknown, city officials and archeologists have not formally recognized the presence of ancestral remains. In recent years, the area began to be used as a BMX bike course, and an Indigenous-led group began lobbying for the preservation of sacred sites in High Park, whose ancestral remains and ecologically sensitive nature were potentially being disturbed (Red Power, 2016; Jackson, 2011). Following community pressure, the City of Toronto eventually conducted an archeological assessment, concluding that no archeological remains were found, and clearing the site of further archeological concern (Robertson et al., 2009).

As they processed these events, participants recognized what was required for the City of Toronto to believe the accounts of Indigenous peoples: hard evidence of human remains via excavation that they noted was likely disrespectful and potentially damaging. We prompted participants to reflect on cultural practices in our own Jewish tradition around death and the burial sites of our loved ones. "Do not unearth dead people," Eli asserted. Others noted customs of putting stones on graves, stepping around rather than over graves, saying prayers, showing respect, wishing them well. The absence of "evidence" to corroborate the sacredness of High Park has been used to justify the area's mistreatment, and to dismiss Indigenous claims as stories unfounded by history. I reflected aloud: how do our beliefs inform what is deemed worth protecting?

A City of Toronto sign at the edge of the site with a handwritten addition (Photo by Nick Kozak)

As we headed quietly back up the hill, we asked group members to think about times when they weren't believed, as well as times when they may have contributed to the disbelief of others. In the closing circle, participants drew on their tracking knowledge as they critically analyzed the situation: "It's not all about proof. It's also about context. What does the City of Toronto have to gain by not believing it? And what would the Indigenous peoples have to gain by lying?" Shlomo remarked. I added, "The stories we find will often be the ones we look for. Either we will find the ones that benefit us, or we can have the humility to notice that there is more going on; the ecosystems that are here, the many histories that have come through here, the trees that have been witnesses here." Iris closed us off with a reminder of Rabbi Lappe and the donkeys who read the Torah. "Tracking is a bit of a judgment. And the City of Toronto made a judgment based on their capacity to track. They didn't look from a different perspective. They didn't look from the donkey's perspective, nor from Indigenous peoples' perspectives. They didn't look from the land's perspective."

Discussion

Guided by Archibald's (2019) storywork principles, this activity sought to explore how uncovering and utilizing mathematics as a way of storying the land can help to disrupt the colonial master-narrative and expose hidden histories that guide us in becoming storywork ready. Participants' passions effortlessly fuelled the inquiry and their desire to do the math to uncover more. As we explored the storied landscapes of the park, we (as educators and participants) had opportunities to deepen our understandings of the storywork principles and how they orient us both explicitly and implicitly. For instance, learning about the Indigenous histories that predated High Park's founding garnered our **respect** for them as the cultural context upon which colonial narratives were oppositionally imposed. Indigenous stewardship practices of controlled burning deepened understandings about **reciprocity** and mutually beneficial relationships that maintain the health and integrity of the ecosystems that sustain them. Uncovering a range of land activity through mathematics ignited the group's **responsibility** as shomrei adama (guardians of the Earth) to pay attention to the stories shared, and opened opportunities for continuing conversations around their reciprocal responsibilities to protect, to steward, to advocate, to respond to colonial imposition, to show solidarity with land protectors, and to keep alive the stories of the land.

The activity embodied holism by engaging the land as a **holistic** text for multiplicities of experience; connecting the physical (spatial tracking and mathematics), the intellectual

(storying and extrapolating), the emotional (response to disbelief and hidden truths), and the spiritual (relations to the dead). Learning about High Park's burial sites brought the group to pay reverence to the dead and to sacred rituals, connecting their own cultural practices to honour and respect Indigenous protocols, and recognizing the more-than-human elements contained in the land. Participants reflected on the **interrelatedness** between their own connections to the dead and those buried in High Park, and sacred cultural practices that tend to the spirit world. Overall, the activity's progressive deepening of the stories of High Park sought to spark moments of **synergy** and new understanding about the power of story and of mathematics, and the implications of colonial authority on life forces. Mathematics offered another story into the extent of these different histories, and their connectedness when it comes to the ways that the land is treated. For Iris and myself, being guided by these principles as educators taught us the value and meaning of orienting our pedagogies around storywork as a continuous process.

Conclusion

When the group had first gathered at the park that night, we had asked them to check in by sharing their current relationships with mathematics. Their responses were to be expected; a mixed bag, largely centred on their math performance and experiences with specific teachers. In the closing circle, a new appreciation was expressed for mathematics as participants highlighted mathematical patterns they had not seen before in the land, and Iris and I reflected on math's ability to bring communities together around matters of importance. American Mathematician Francis Su (2020) talks about the love and community that is built among people through mathematics. He quotes mathematician Simone Weil, writing, "The soul empties itself of all its own contents in order to receive into itself the being it is looking at, just as he is, in all his truth [sic]" (p. 212). We ended off our activity in this spirit with a closing song by queer Jewish songwriter Batya Levine, singing,

> *May I be empty, and open to receive the light. May I be empty, and open to receive.*
>
> *May I be full, and open to receive the light. May I be full, and open to receive.*

As the youth dispersed to their guardians waiting at the park gates, the opening words we read of Rabbi Lappe now resounded with new meaning, as they saw mathematics too in a new light:

> *All the donkey stories, they'd see. All the donkey stories that we completely missed. When I began to learn Talmud, all the donkey stories, my donkey stories, started jumping out at me. And when I connected the dots, I saw a tradition that was smarter, more sophisticated, more courageous, compassionate, bolder, and more radical than anything I could've imagined. And I fell in love.*

References

Archibald, J. (2008). Storywork pedagogy. *Indigenous storywork: Educating the heart, mind, body, and spirit* (pp. 129–141). UBC Press.

Archibald, J. (2019). *Dr. Jo-Ann Archibald on Indigenous storytelling* [Video]. YouTube. www.youtube.com/watch?v=5rSHifM35i4

Donaldson, W.S., & Wortner, S. (1995). The hind site and the glacial kame burial complex in Ontario. *Ontario Archeology, 59*, 5–95. www.ontarioarchaeology.org/wp-content/uploads/oa059-02_donaldson.pdf

Jackson, L.K. (2011, November 7). Snake mound: Community works against Toronto council to protect burial mounds. *Rabble*. www.rabble.ca/anti-racism/snake-mound-community-works-against-toronto-council-protect-burial-mounds/

Johnson, J. (2013). The Indigenous environmental history of Toronto, "the meeting place." In L.A. Sandberg, S. Bocking, & K. Cruikshank (Eds.), *Urban explorations: Environmental histories of the Toronto region* (pp. 59–71). Wilson Institute for Canadian History.

Lappe, R.B. (2014). *An unrecognizable Jewish future: A queer Talmudic take* [Video]. ELI Talks. www.myjewishlearning.com/eli-talks/an-unrecognizable-jewish-future-a-queer-talmudic-take/

Red Power Media. (2016, April 21). Reclaiming ancient Iroquois burial grounds in Toronto's High Park. www.redpowermedia.wordpress.com/2015/05/16/the-reclaiming-of-ancient-iroquoian-burial-grounds-in-torontos-high-park/

Robertson, D., Steiss, D., Carnevale, A., & Narhi, B. (2009). Stage 1-2 archeological resource assessment of the "bike pit" and picnic area 7, High Park, City of Toronto, Ontario. *Archeological Services INC, Planning Division.* www.cbc.ca/toronto/news/pdf/ara-bike-pit.pdf

Su, F. (2020). *Mathematics for human flourishing*. Yale University Press. ▲

Fun With Fonts

This "2" looks a little wonky. Suppose you could change one equation and its connections on each end, what would you alter?

Use colour to show which segments include endpoints and which don't. Is the boundary continuous or are there points missing?