

# An Engineering and Design Approach to Building More Equitable Science Curricula: Challenges, Opportunities, and Cautions

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## Purpose & Background

The purpose of this case study is to explore the efficacy of applying the k2i academy's Inclusive Design Framework (IDF) to the development of resources for Ontario's new grade 9 curriculum. As an act of self-reflection, this case study focuses on the process of curriculum development: was this approach more inclusive of diverse perspectives? Does the resulting curriculum resource have the potential to create a more equitable and inclusive version of grade 9 science?

The IDF considers Critical Theory, Anti-Oppression Theory, and Anti-Racism Education while designing at the individual, instructional and institutional level across the educational system.

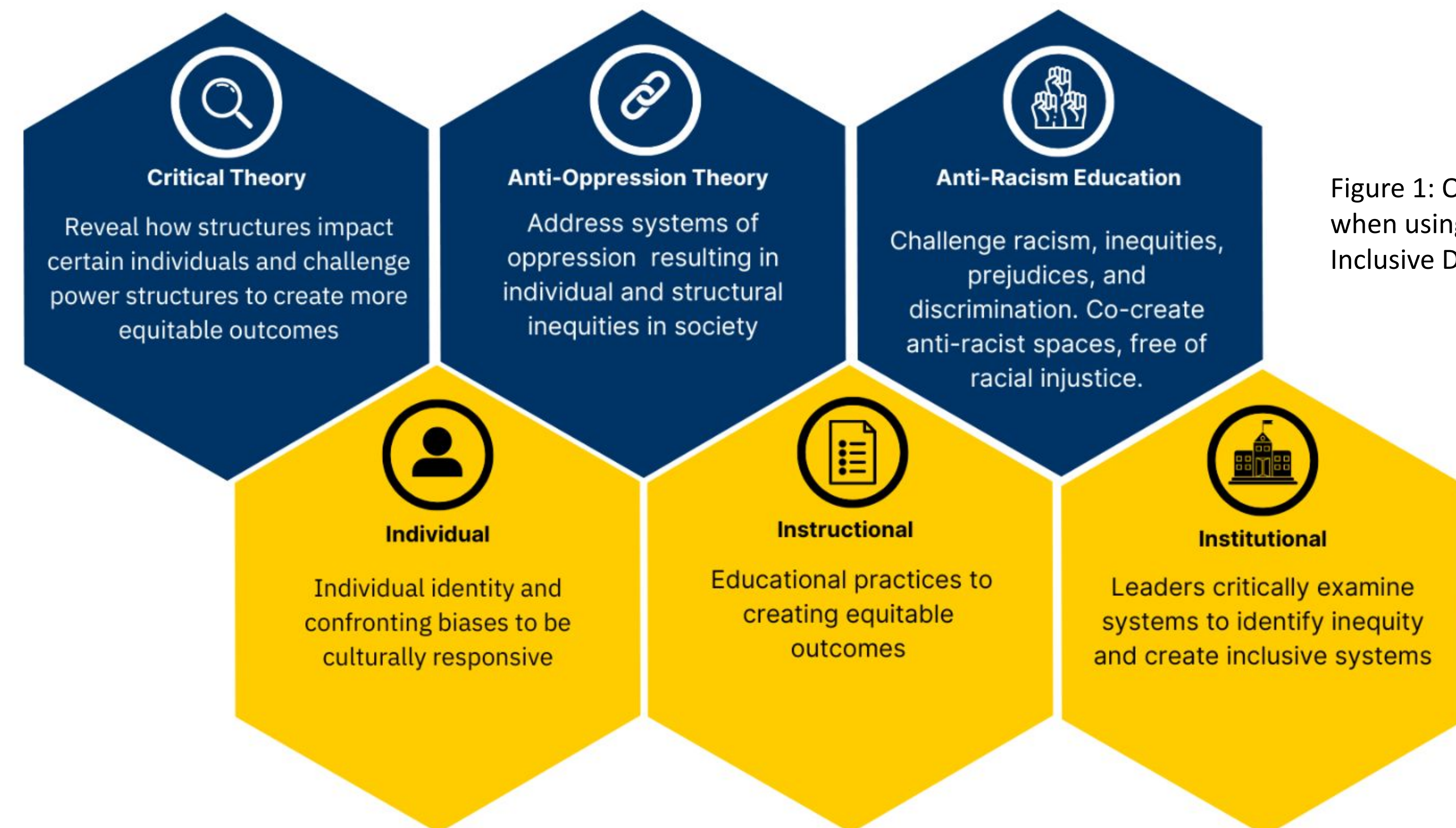


Figure 1: Questions to consider when using the k2i academy Inclusive Design Framework

## Case Study Methodology

This case is bounded by the beginning of the development of the activities (fall 2020) and when the first part of the resource was made available to teachers in fall 2022). The focus is on the process of curriculum development, although the product was analyzed in order to assess the efficacy of that process.

### Data Sources

- Notes and observations from curriculum designers (L. Cole and V. Ironside)
- Iterations of the resource
- Comments from collaborators

### Data Analysis

After documenting the process by which k2i academy designed the curriculum resource, we noted the characteristics and social categories of the educators who were consulted throughout. We also tracked the suggestions and edits (via google docs) and mapped how suggestions and edits were ultimately integrated into the finished resource. Finally, we asked ourselves how social position and demographic factors may have affected the process.

## Collaborators

Jane Goodyear, Dean, Lassonde School of Engineering, York University; Michelle Tsui-Woods, Associate Director of Operations and Development, k2i academy; Bryan Bellefeuille, W.C. Eaket Secondary School; Salvatore Paneduro, Director, Lassonde Education Innovation Studio; Tanveer Bhimani, Instructional and Learning Designer, Lassonde Education Innovation Studio; Sairam Chinnam, Senior eLearning Developer; Toronto District School Board; York Region District School Board; Peel District School Board; Algoma District School Board; Faine Briscoe,; Tram Nguyen Pham; Claire Zuliani; Dr. Jeff Harris; Dr. Alvine Boaye Belle; Dr. Satinder Brar; Dr. Sarah Barrett; Dr. Darren Hoeg; Dr. Vidya Shah; Sayema Chowdhury; Jocelyn Shih; Brian Beauchamp; Dian Baker; Martyn Beckett; Andrew McConnell; Dr. Jean-Jacques Rousseau; Moses Velasco; Chris Stewart; Andrew Hann; Sean Clark; Marguerite Fleming; Jason Trinh; Dr. Mojgan A. Jadidi; Dr. Molade Osibodu; Dr. Lorraine Otoide; Jane Kennedy; Sultan Rana; Laura Galbraith; Cathay Scragg; Carolyn Tsai; Isabella Liu; Tigist Amdemichael; Karen La.

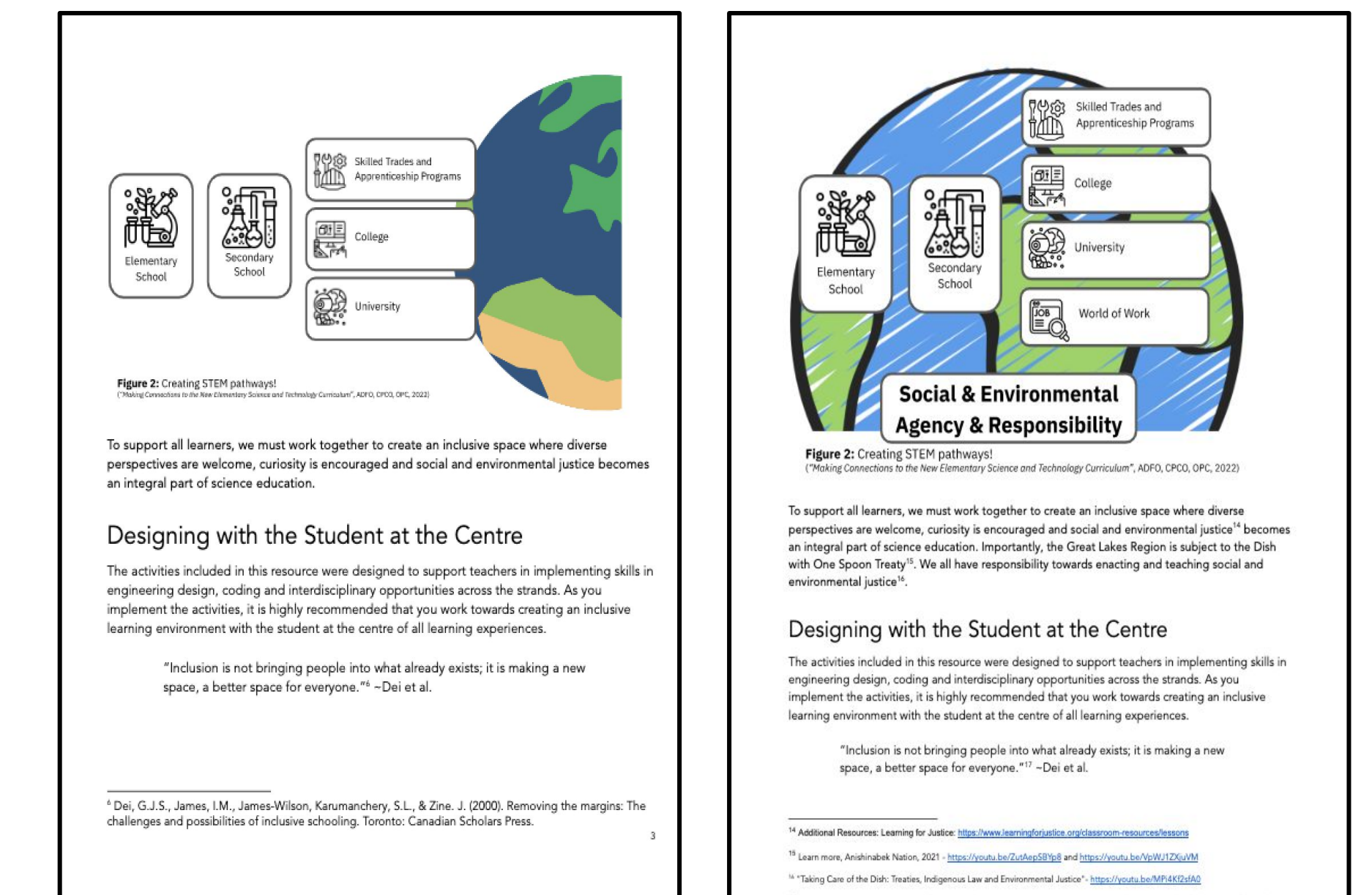
## Findings

The k2i academy utilized an inclusive design approach to teacher resource development. Figure 2 illustrates the process and highlights some of the considerations used to create the *Grade 9 De-streamed Science Teacher Resource*.



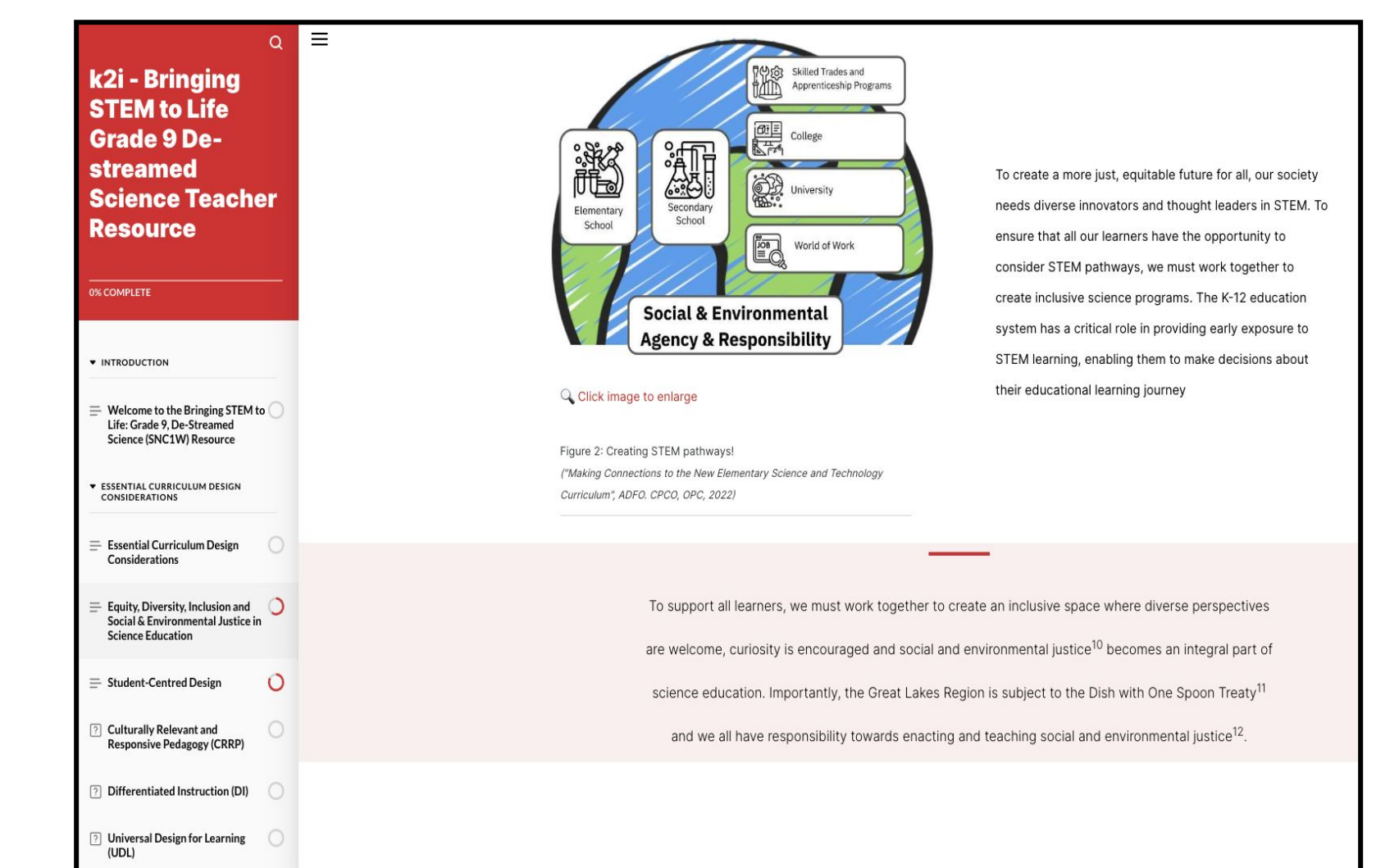
Figure 2: *Grade 9 De-streamed Science Teacher Resource* Development Process by k2i academy

Differences in versions arose due to the iterative nature of the development process.



September 2022 Version

December 2022 Version



March 2023 Version

The collaborative approach resulted in content that evolved over time to include more diverse perspectives, additional supports for teachers, and recommendations that further anticipates the needs of diverse teachers across Ontario.

The differences between the first draft to the online version today include modifications to address scientific misconceptions, inclusion of diverse perspectives and people in STEM, resources to support assessment and evaluation practices, an extensive background information document for the teacher, and an intentional focus on the importance of equity, diversity and inclusion in STEM teaching and learning spaces.

## Conclusion

We found that IDF resulted in a more inclusive curriculum development process but external forces impeded its efficacy. Ongoing reflective practice by the k2i academy team and all its collaborators enables us to shift, adapt, and change to respond to challenges while also suggesting new emerging practices and innovative programs; however this work was done in an environment where there is an expectation of finished products and finalized plans. Additionally, we note that creating equitable and inclusive curriculum is a deeply cultural practice and, therefore, simply translating English resources into French does not necessarily create resources that are true to Francophone cultures. Recognizing that the goal of creating more equitable and inclusive grade 9 science courses depends on multiple factors, we believe that the curriculum developed through IDF can form a strong foundation to those efforts.

## References

- Arnebeck, E., & Jämte, J. (2022). How to Counteract Racism in Education -- A Typology of Teachers' Anti-Racist Actions. *Race, Ethnicity and Education*, 25(2), 192-211. <https://doi-org.ezproxy.library.yorku.ca/10.1080/13613324.2021.1890566>
- Cole, L., Goodyear, J., & Ironside, V. (2022). k2i academy: An innovative ecosystem addressing system barriers in STEM from kindergarten to industry Proceedings 2022 Canadian Engineering Education Association Conference, Toronto, Ontario, Canada.
- DeJong, K., & Love, B. J. (2015). Youth Oppression as a Technology of Colonialism: Conceptual Frameworks and Possibilities for Social Justice Education Praxis. *Equity & Excellence in Education*, 48(3), 489-508. <https://doi.org/10.1080/10665684.2015.1057086>
- Kelly, D. M., & Brandes, G. M. (2008). Equitable Classroom Assessment: Promoting Self-Development and Self-Determination. *Interchange: A Quarterly Review of Education*, 39(1), 49-76. <https://doi.org/10.1007/s10780-008-9041-8>
- Koole, M., & Squires, V. (2020). The Education System of Canada: ICT and STEM Balancing Economics with Social Justice. In S. Jornitz & M. Parreira do Amaral (Eds.), *The Education Systems of the Americas* (pp. 1-22). Springer International Publishing. [https://doi.org/10.1007/978-3-319-93443-3\\_39-1](https://doi.org/10.1007/978-3-319-93443-3_39-1)
- Pinto, L. E. (2012). Curriculum reform in Ontario 'common sense' policy processes and democratic possibilities. University of Toronto Press.
- Wells, M. A., Williams, M., Corrigan, E., & Davidson, V. (2018, December 14). Closing the Gender Gap in Engineering and Physics - The Role of High School Physics. Retrieved from <http://www.onwie.ca/wp-content/uploads/2019/02/White-Paper-Final-Draft.pdf>

