S-JEDI for HHMI Data Explorer

Inclusive Data Science Education for Biology Bibliography

Prepared by Dr. Carrie Diaz Eaton, Bates College, for HHMI BioInteractive

Goals:

1. Provide an overview of the landscape of Social Justice, Equity, Diversity, and Inclusion, including definitions and language, the historical context for STEM education, and references for deeper reading.
2. Provide an overview of various frameworks for teaching and learning which center marginalized and underserved learners and references for deeper reading.
3. Provide an overview of various S-JEDI issues in data science/data science education which center marginalized and underserved communities of color and references for deeper reading

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# S-JEDI - Social Justice, Inclusion, Diversity, and Equity

**Big ideas:** Definitions and language, resources for conversations on Social Justice, Equity, Diversity, and Inclusion

## S-JEDI landscape in STEM Education

1. [HHMI Introduction to S-JEDI Principles](https://docs.google.com/presentation/d/1oy9ZUyFtJGYNGXo14yS3dbf1mFl9ZSwgLg_PzgROtJo/edit#slide=id.p) - slideshow introduction and overview to some questions to consider as you build curriculum
2. Seymour, E., & Hunter, A. B. (2019). *Talking about leaving revisited*. New York, NY: Springer.
   1. Culture of STEM is isolating and individualistic - think about encouraging collaboration attentive to power dynamics

## History

1. NAS Report (2011) “Chapter 2: Dimensions of the problem” in *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*. <https://www.nap.edu/read/12984/chapter/5>
   1. Outlines the history of exclusion of now underrepresented groups in STEM
   2. Subsections include Educational Attainment, Education and Workforce, Postsecondary Interest and Completion, and Taking Stock (current assessment of diversity by the numbers)
2. Quick glances at Hollywood explorations of STEM and inclusion
   1. Imitation Game - focuses on Alan Turing, role in code breaking during WWI and his death as a result of his criminalized sexual orientation
   2. Hidden Figures - focuses on Black women Dorothy Vaughan, Mary Jackson, Katherine Johnson and Christine Darden at NASA and their role in mathematical and computational work crucial to the space race & educational and social barriers to that participation (Based on *Hidden Figures* by Margot Lee Shetterly)
3. Belen Tsinnajinnie’s [TMWYF talk](https://www.youtube.com/watch?v=OYrx2tf6cYo)
   1. Discusses the role of education in assimilation of Indigenous peoples, their erasure from contributions, and explores how to embrace and foster Native scientists that doesn’t ask them to leave their culture at the door
4. Kendi, I. X. (2019). *How to be an antiracist*. One world.
   1. Explores definitions of race and racism, but also with respect to biological racism. Explores how money and medicine benefited from the idea of Black people as lesser and the exploitation that facilitated this.

# S-JEDI Pedagogy

**Big ideas:** You must be reflective in your practice, have an open mindset, and be empathetic - this is an ongoing commitment

* A little planning goes a long way
* Think about power and dynamics
* Lots of 5% options (low hanging fruit, low effort), but also a lot of beyond 5% efforts (towards systemic change that benefits multiple individuals)
* Think about asset-based thinking instead of deficit-minded framing

1. Emery NC, Bledsoe EK, Hasley AO, and Diaz Eaton C. (2020). Cultivating inclusive instructional and research environments in ecology and evolutionary science. Ecology and Evolution. 00: 1-12. DOI: <https://doi.org/10.1002/ece3.7062>
2. Harris, P. E., & Winger, A. (2020). Asked and Answered: Dialogues on Advocating for Students of Color in Mathematics. Self-published. ISBN 979-8579682901
   1. This is a nice workbook approach
3. SABER Webinar series A Call to Action: Striving for racial justice in academic biology. <https://saberbio.wildapricot.org/Diversity_Inclusion>

## Math Anxiety

**Big ideas:** Math anxiety is a flurry of electrical activity that overloads brain functioning. Many students (and teachers) that love science and struggle with math anxiety, choose From a cognitive science standpoint, there are interventions that can be used (see BioMAAP) and also contextualizing mathematics so that there is more perceived reward than struggle can help.

1. BioMAAP: Biology Math Anxiety and Attitudes Program <https://qubeshub.org/community/groups/biomaap/allresources>
   1. Lots of curriculum modules as well as some explanations of the related cognitive science behind them
2. Andrews SE, Aikens ML. Life Science Majors' Math-Biology Task Values Relate to Student Characteristics and Predict the Likelihood of Taking Quantitative Biology Courses. J Microbiol Biol Educ. 2018;19(2):jmbe-19-80. Published 2018 Jul 31. [doi:10.1128/jmbe.v19i2.1589](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6067041/)
3. Aikens, M. L., Eaton, C. D., & Highlander, H. C. (2021). The Case for Biocalculus: Improving Student Understanding of the Utility Value of Mathematics to Biology and Affect toward Mathematics. CBE—Life Sciences Education, 20(1), ar5. <https://www.lifescied.org/doi/full/10.1187/cbe.20-06-0124>
   1. The two Aikens articles aren’t math anxiety persay, but a discussion about how to overcome barriers that students perceive

## Universal Design for Learning

**Big ideas:** We should design with the needs of all learners in mind. UDL comes out of universal design in architecture, which was a framing response to ADA compliance. However some recent work has strove to combine the ideas. In educational materials, one emphasis is Accessibility.

1. Jimes, C., Evans Godwin, A., Fox, S., Karaglani, A., Lobaito, N. (2021). [STEM OER Accessibility Framework and Guidebook](http://dx.doi.org/10.25334/ERXF-AH09). QUBES Educational Resources. [doi:10.25334/ERXF-AH09](http://dx.doi.org/10.25334/ERXF-AH09)
   1. This is a checklist approach to accessibility
2. Hasley, A. O., Orndorf, H. (2020). [UDL Guidelines Workbook](http://dx.doi.org/10.25334/FJDE-KT82). [Universal Design for Learning](https://qubeshub.org/groups/udl), QUBES Educational Resources. [doi:10.25334/FJDE-KT82](http://dx.doi.org/10.25334/FJDE-KT82)
   1. This is a guide to UDL broadly which also includes accessibility
3. Hasley, A. O., Orndorf, H. (2018). [Universal Design for Learning and Accessibility of the Day](http://dx.doi.org/10.25334/Q4FT5J). [Wicked Problems: Investigating real world problems in the biology classroom (SW 2018)](https://qubeshub.org/groups/summer2018), QUBES Educational Resources. [doi:10.25334/Q4FT5J](http://dx.doi.org/10.25334/Q4FT5J)
   1. This can be paired with the above resource
4. Andrew Osborne Hasley (2020). [Actually, Data Science CAN Be Accessible: Barriers to inclusion of people with disabilities in the data science workforce pipeline and ideas for lowering them](http://dx.doi.org/10.25334/VR0N-E805). [EDSIN: Environmental Data Science Inclusion Network](https://qubeshub.org/groups/edsin), (Version 1.1). QUBES Educational Resources. [doi:10.25334/VR0N-E805](http://dx.doi.org/10.25334/VR0N-E805)
   1. Great talk from Drew on what it is like to be blind in academia, and working in bioinformatics - includes barriers and motivation to pursue UDL
5. Orndorf, H., Hasley, A. O. (2020). [STEM Inclusive Teaching Practices Webinar Series: Universal Design for Learning Recording](http://dx.doi.org/10.25334/P8DR-N510). [EDSIN: Environmental Data Science Inclusion Network](https://qubeshub.org/groups/edsin), QUBES Educational Resources. [doi:10.25334/P8DR-N510](http://dx.doi.org/10.25334/P8DR-N510)
   1. Drew and Hayley lay out the whole UDL process/approach using the guides in 1&2

## Open Educational Practices

**Big ideas:** Open Education Resources has the ability to reduce cost for students, increase access. It also opens the avenue for new pedagogy which allows students to freely submit their own work into the open world and are involved in the creation of new knowledge together. As a result, these pedagogies lend themselves to CURE (course-based undergraduate research) and teaching about Open Science and Open Data. Please note the discussion of data sovereignty in another section.

1. Lambert, S. R. (2018). Changing our (Dis)Course: A Distinctive Social Justice Aligned Definition of Open Education. Journal of Learning for Development , 5(3). Retrieved from <https://jl4d.org/index.php/ejl4d/article/view/290>
   1. Excellent resource connecting the social justice framework explicitly to OER and showing where OER could improve
2. What is Open Pedagogy <http://openpedagogy.org/open-pedagogy/>
   1. Introduction to Open teaching practices - what do they involve
3. DeRosa, R., & Robison, S. (2017). From OER to open pedagogy: Harnessing the power of open. Open: The philosophy and practices that are revolutionizing education and science, 115-124.
   1. Why we are moving to open pedagogy
4. Crüwell, S., van Doorn, J., Etz, A., Makel, M. C., Moshontz, H., Niebaum, J. C., ... & Schulte-Mecklenbeck, M. (2019). Seven easy steps to open science. Zeitschrift für Psychologie. <https://econtent.hogrefe.com/doi/full/10.1027/2151-2604/a000387>
   1. Quick guide to teaching about open science

## Inclusive Teaching

**Big ideas:** Inclusive teaching asks us to create relationships within classrooms, between students and teachers, and between these teachers and students with the rest of the college community and beyond. Creating these relationships improves PEER student learning, but requires instructors to be reflective in an ongoing journey and to engage the whole person in the classroom experience. Most of the conversation surrounding racial justice in undergraduate biology education uses “inclusive teaching” as the language.

1. Dewsbury, B., & Brame, C. J. (2019). Inclusive teaching. CBE—Life Sciences Education, 18(2), fe2. <https://www.lifescied.org/doi/full/10.1187/cbe.19-01-0021>
2. Dewsbury, B. M. (2017). On faculty development of STEM inclusive teaching practices. FEMS microbiology letters, 364(18).
3. Dewsbury, B. M. (2017). Context determines strategies for ‘activating’ the inclusive classroom. Journal of microbiology & biology education, 18(3). <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5976051/>
   1. 1 is A framework for approaching inclusive teaching. This framework is one of the most predominant in discussions in undergraduate biology education with Dewsbury leading much of the conversation.
4. Tanner, K. D. (2013). Structure matters: twenty-one teaching strategies to promote student engagement and cultivate classroom equity. CBE—Life Sciences Education, 12(3), 322-331.
   1. An older publication, but a great list of teaching strategies for community building and student engagement - which are not necessarily in alignment with inclusive teaching, but there are some relationships.

## Decolonizing and Rehumanizing

**Big ideas:** Decolonizing is a process that works to examine, untangle, and reorganize a society that has benefited from the concept of ownership of land and bodies. The theoretical basis for this is settler colonialism.Like inclusive teaching, rehumanizing is a pedagogical approach to teaching mathematics, which explicitly includes a foundation in decolonizing education. It also draws on feminist theory, Latinx studies, and other areas.

1. Tuck, E., & Yang, K. W. (2012). Decolonization is not a metaphor. Decolonization: Indigeneity, education & society, 1(1). <https://jps.library.utoronto.ca/index.php/des/article/download/18630/15554/>
   1. This really sets the language used in decolonizing studies.
2. Gutiérrez, R. (2018). Introduction: The need to rehumanize mathematics. In Rehumanizing mathematics for Black, Indigenous, and Latinx students. National Council of Teachers of Mathematics.
3. Gutiérrez, R. (2015). Nesting in Nepantla: The importance of maintaining tensions in our work. Interrogating Whiteness and relinquishing power: White faculty’s commitment to racial consciousness in STEM classrooms, 253-282.
   1. This is the predominant philosophy behind inclusive teaching in mathematics. This work draws heavily from Gloria Anzaldúa.

# Data, Algorithms, Power, and Storytelling

## Big Data and Oppression

**Big idea:** The data landscape is marred by the false invocation of data neutrality and the unquestionable power it has in our lives. Most of this work is by Black authors. There is a large body of research, mostly under the umbrella of “critical digital studies” or “society and technology studies” which analyzes how data has become a weapon of the ongoing oppression of Black people.

* The digital divide - historical lack of access is exacerbated
* Assumptions - data used and collected is biased by our assumptions
* The black box - data is used to train and inform algorithms, which become unquestionable decision-making powers inferred as neutral and used to reinforce bias

1. O'Neil, C. 2016. [Weapons of math destruction: How big data increases inequality and threatens democracy](https://weaponsofmathdestructionbook.com/). Broadway Books. - Lays out in very accessible terms how power and data
2. <https://www.amstat.org/ASA/Your-Career/Ethical-Guidelines-for-Statistical-Practice.aspx>
3. Benjamin, R. (2019). Race after technology: Abolitionist tools for the new jim code. Social Forces.
4. Noble, S. U. (2018). Algorithms of oppression: How search engines reinforce racism. nyu Press.
5. Raji, I. D., & Buolamwini, J. (2019, January). Actionable auditing: Investigating the impact of publicly naming biased performance results of commercial ai products. In Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society (pp. 429-435).

## Indigenous Data Sovereignty

**Big idea:** To recognize Native nations as sovereign, with the rights to govern themselves. This includes the ability to govern data and stories. To quote from Liz La, and as displayed on the USIDSN website,

“Information, data, and research about our peoples—collected about us, with us, or by us—belong to us and must be cared for by us.”

-Liz La quen náay Kat Saas Medicine Crow

1. [US Indigenous Data Sovereignty Network](https://usindigenousdata.org/) (USIDSN) - Network for awareness, policy and action “USIDSN’s primary function is to provide research information and policy advocacy to safeguard the rights and promote the interests of Indigenous nations and peoples in relation to data.”
2. Anderson J and Christen, K. 2019. [Decolonizing Attribution: Traditions of Exclusion](https://journal.radicallibrarianship.org/index.php/journal/article/view/38), *Journal of Radical Librarianship*. - Attribution and authorship erasure of indigeous works

**Big idea:** There is a very large Indigenous data sovereignty movement specifically within genomics and bioinformatics. The directions and research are very clear.

* Does the data you are using respect principles of Indigenous Data Sovereignty?

1. [Genomic Research Through an Indigenous Lens: Understanding the Expectations](https://www.annualreviews.org/doi/abs/10.1146/annurev-genom-083118-015434) Nanibaa’ A. Garrison, Māui Hudson, Leah L. Ballantyne, Ibrahim Garba, Andrew Martinez, Maile Taualii, Laura Arbour, Nadine R. Caron, Stephanie Carroll Rainie. Annual Review of Genomics and Human Genetics 2019 20:1, 495-517
   1. Lays out ways in which Indigenous Data Sovereignty is disregarded in genomics research: Lack of community engagement, Lack of informed consent for secondary use, Negative representation in publications
   2. Lays out axes of work with indigenous communities: Community engagement, Understanding rights and interests, Ethical and institutional responsibility
   3. Charts the future work: Genomics training for Indigenous peoples, Ethics training for researchers, Indigenous data sovereignty
   4. Includes specific case study examples & resources

## Intersectionality and Data Feminism

**Big ideas:** Data has power and how do we wield it?

* To achieve our future, we need to co-liberate,
* think about to what extent you are rejecting or assuming a binary gender, sexuality or other identity perspectives,
* think about intersectionality in data collection and analysis.

1. Crenshaw, K. (1990). Mapping the margins: Intersectionality, identity politics, and violence against women of color. Stan. L. Rev., 43, 1241.
2. D'Ignazio, C., & Klein, L. F. (2020). [*Data Feminism*](https://mitpress.mit.edu/books/data-feminism). MIT Press.
3. For a book review on the above/quicker summary, see: Whitney, KS (2020). Using Data to End Oppression. *American Scientist* 109 (1): 54 DOI: [10.1511/2021.109.1.54](https://doi.org/10.1511/2021.109.1.54) <https://www.americanscientist.org/article/using-data-to-end-oppression>
4. Buolamwini, J., & Gebru, T. (2018, January). Gender shades: Intersectional accuracy disparities in commercial gender classification. In Conference on fairness, accountability and transparency (pp. 77-91). PMLR.