

Open Science: Reproducibility & Transparency in Undergraduate Biology

Jason Pither, Associate Professor, Biology
 Mathew Vis-Dunbar, Data and Digital Scholarship Librarian

Background

Open Science (OS) describes science that is reproducible, transparent, and inclusive. Reproducibility ensures a level of trust in scientific findings, transparency reveals biases—systemic, personal, statistical—and inclusion ensures the questions that science addresses meaningfully include those impacted by the research. Globally, science communities have acknowledged they must do better at fostering and upholding the principles and practices of OS¹, and that meaningful progress will require systemic change, particularly to training programs². We are addressing this challenge by piloting the integration of OS principles and practices throughout an undergraduate science curriculum³.

Objectives

Using the UBCO Biology curriculum as a test bed, our work aims to streamline how principles of OS can be integrated into, and connected across, courses in undergraduate science curricula. Existing readings, lab manuals, and assignments are updated to explicitly address reproducibility, transparency, and inclusion in the conduct of science. This work also allows for the discrete networking of concepts between courses.

Methods

Faculty, lab managers, students and librarians collectively review syllabi, lab manuals, and assignments, linking concepts, harmonizing language and suggesting revisions to address scaffolding of OS principles and practices between years and across courses. To enable persistent connections, learning materials are migrated to an open online platform accessible to students throughout their studies.

Work Completed to Date

Five courses — BIOL116, 125, 202, 205, and 228 — have trialed a variety of approaches to increasing integrations of principles and practices of OS. This began with the creation of two stand-alone modules on Open Science (OS 101 and 102) and has since grown into a much more comprehensive integration of these principles and practices into course assignments and evaluation. For instance:

- In Intro to Biostatistics (BIOL202) students learn how to implement reproducible research workflows (including literate programming in R Markdown), and subsequent lab-based courses reinforce these practices.
- A Procedures and Guidelines document fosters consistency across the curriculum and relieves instructor burden by providing guidance on a variety of OS-related topics including research data management, file naming, version control, citations, data tidying etc.

Looking Forward

To date, ALT 2040 has allowed deeper integrations - BIOL 205 - and expanded summer offerings - BIOL 116 and 125. Looking forward, we're building supports into upper level courses, and enhancing tools for students and instructors to connect themes across the program. Longer term goals include:

- Finalize supports for students to implement best practices within Honours Theses or URA projects.
- Release all materials as adaptable OERs.
- Establish certification for students.
- Develop a visualization tool to connect principles of OS and learning outcomes across the curriculum.

Bigger Picture

Among global OS training efforts, our undergraduate-focused project is unique, and complements broader **Fostering OS @ UBC** efforts aimed at effecting a culture change among researchers. Relevant links provided below.

References

- Nosek, B.A., Ebersole, C.R., DeHaven, A.C. & Mellor, D.T. (2018). The preregistration revolution. *Proc. Natl. Acad. Sci. U.S.A.*, 115, 2600–2606.
- Azevedo, F., Liu, M., Pennington, C.R., Pownall, M., Evans, T.R., Parsons, S., et al. (2022). Towards a culture of open scholarship: the role of pedagogical communities. *BMC Res Notes*, 15, 75.
- Hanna, S., Pither, J. & Vis-Dunbar, M. (2021). Implementation of an Open Science Instruction Program for Undergraduates. *Data Intelligence*, 3, 150–161.

Collaborators

- Sharon Hanna, lead author of OS 101 & 102
- Dr. Tristyn Hay, lab manager BIOL116 and 125
- Dr. Tyler Donner, lab manager BIOL 228
- Dr. Robin Young 1st year Biology instructor
- Clerissa Copeland, graduate of UBCO Biology program
- Jordan Katchen, undergrad with UBCO Biology program
- Liam Johnson, UBCO Biology graduate student

Acknowledgements

We would like to thank Dr. Eric Eich for his support in getting this work off the ground. In addition, Fostering OS @ UBC and our work with the undergraduate Biology curriculum has been supported by a number of grants over the years including UBC Excellence Funds, a UBCO OER Grant, and a Faculty of Sciences Curricular Innovation Award.

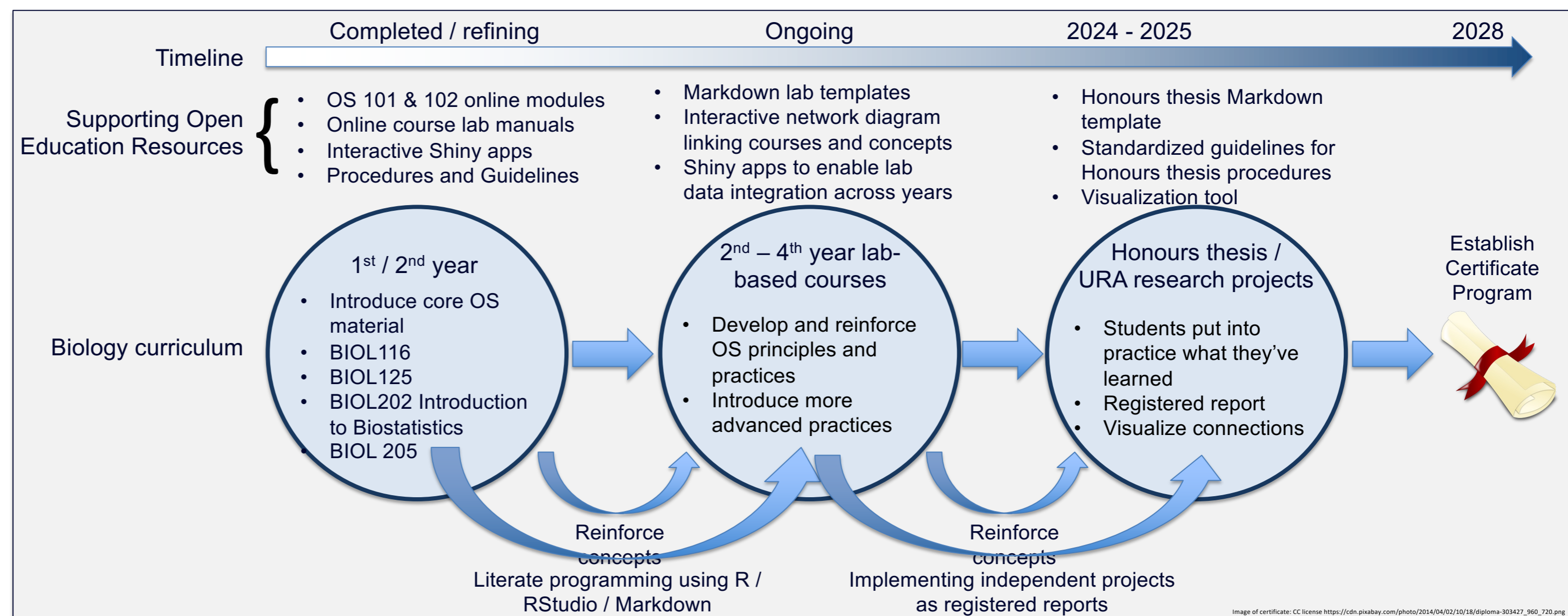


Image of certificate: CC license https://cdn.pixabay.com/photo/2014/04/02/10/18/diploma-303427_960_720.png

