

Course Transformation: From Antibiotics to Chemotherapy

A CURE in Drug Discovery

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Backward Design

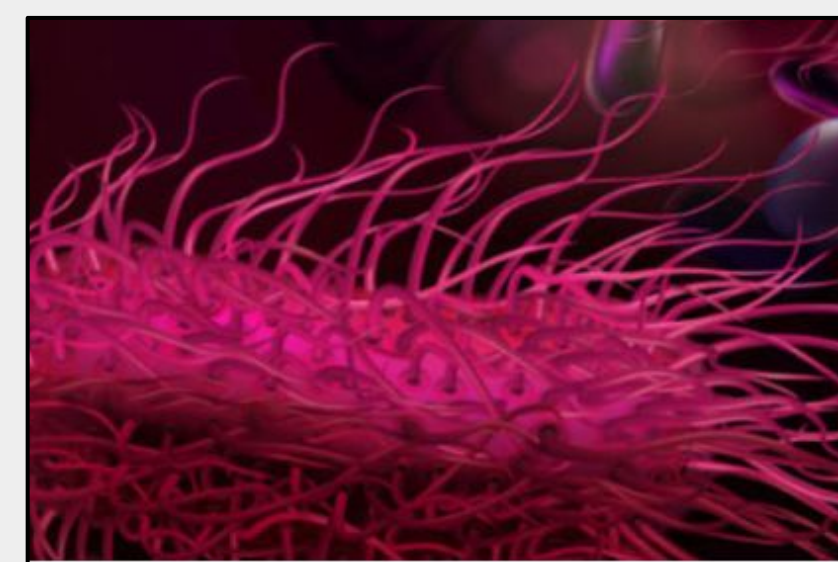
The Students as Pedagogical Partners program made us increasingly aware of the Understanding by Design framework, which uses backward design. To develop our new course, we focused first on carefully selecting learning outcomes and objectives, both overarching and lesson-specific.

Then, we focused on the assessment piece which is largely the same for both courses: a manuscript, three content exams, and a symposium presentation.

Finally, we developed learning activities to support those learning outcomes that are aligned with the assessments, and sufficiently prepare students for them.¹

Real-Life Purposes

Antibiotic Resistance



SafeFood.com

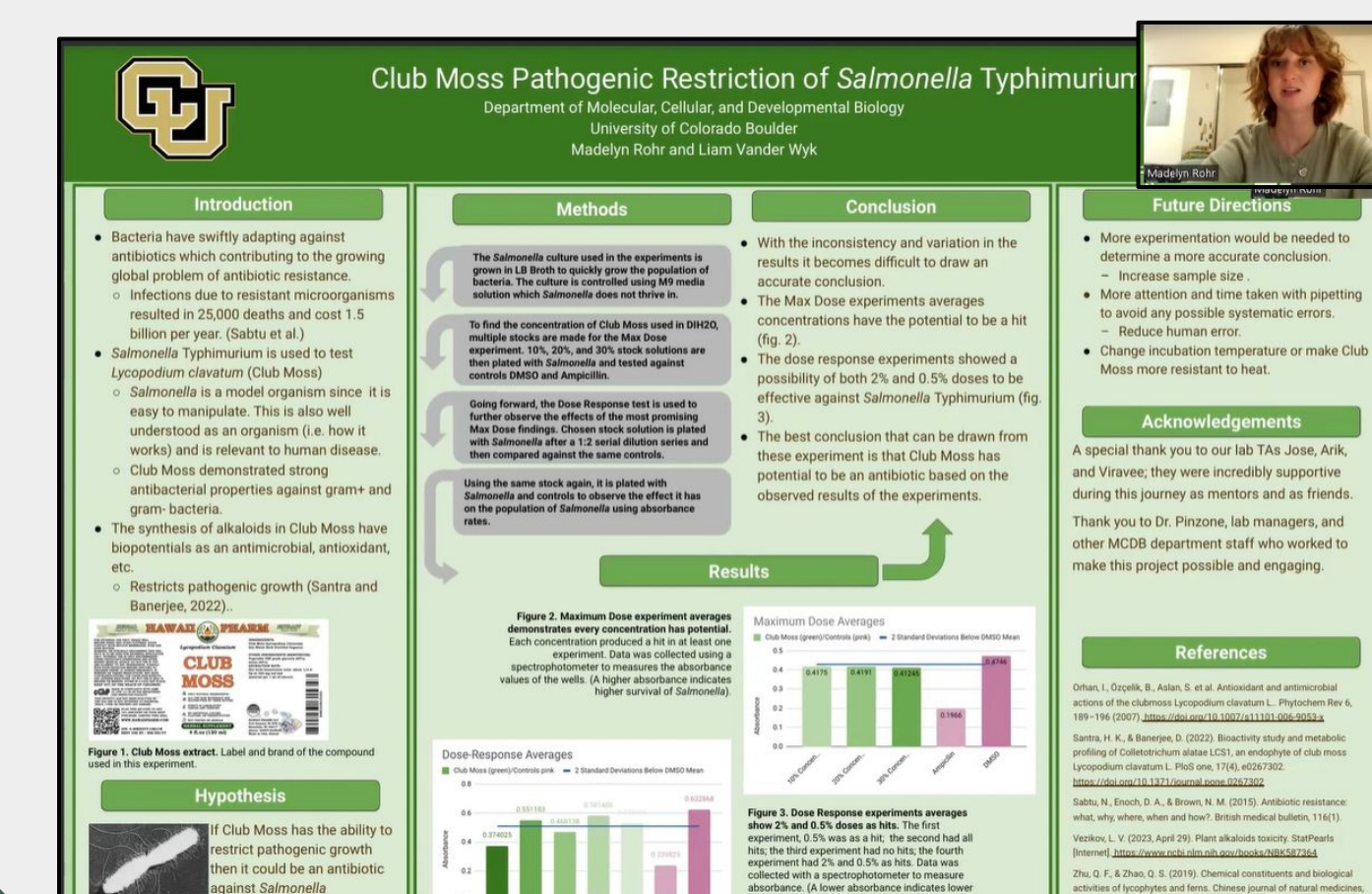
Cancer



MD Andersen Cancer Center

Assessment and Scaffolding

CURE Symposium



event.fourwaves.com/CureSymposium24

Worksheets

Critiquing-

Introductions

Methods

Results

Entire Poster

Students compare “good” and “bad” example posters, in sections then in entirety using the **same rubric** they will be evaluated with.

Use of Generative AI

Custom ChatGPT

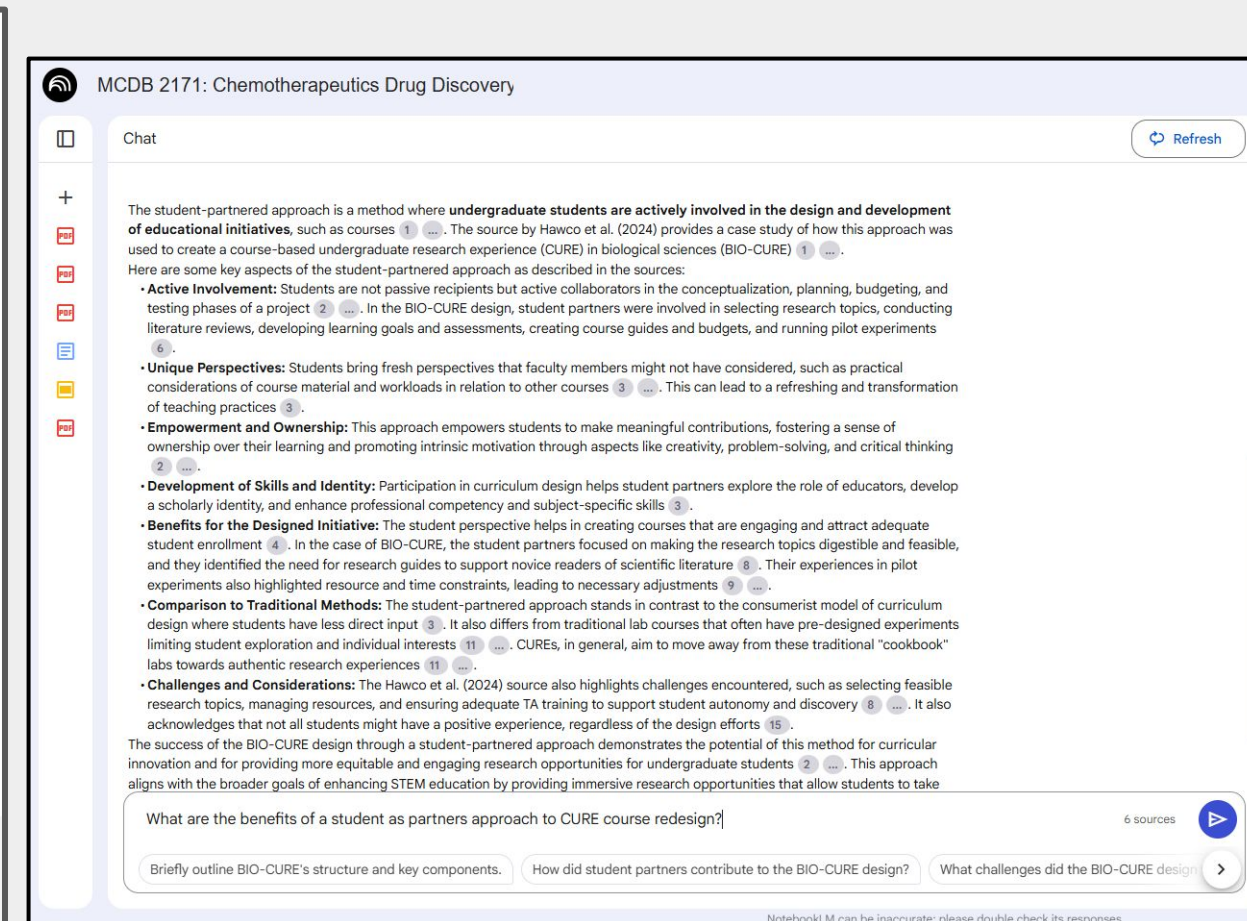
Helps faculty create and refine learning outcomes, then assess them. Now includes learning outcome generation from assessments.

How can I align my assessment with learning outcomes?

Would you like to generate learning outcomes from an exam?

What are the key learning goals for my course?

Google NotebookLM



Courtesy of CU Boulder OIT Pilot

Courtesy of Dr. Rebecca Machen, DBER meetings organizer

Provided suggestions to revise Learning Outcomes, comprehensively align Assessments to Outcomes, and create a Study Guide & Mind Map of course.

3-Dimensional Learning

Good science is more than just a set of facts; it is a set of skills and crosscutting concepts that intersect. The 3-Dimensional Learning (3DL) framework combines **core ideas**, **scientific practices**, and **crosscutting concepts** in all standards to train scientists who can engage in science and reason with it.³

In our courses, we focus on depth over breadth to allow students to master scientific practices and core ideas. We use crosscutting concepts that overlap with other courses such as system/system models and structure & function.

We seek to use the 3DL framework more in the new chemotherapeutics course, so we give special attention to how the structure of chemotherapies lead to function within the model system. Students also engage in new pre-lab assignments that allow them to make predictions and have more scaffolding for data analysis, which are key scientific practices.

Systems & Models

Structure & Function

Multiple Means of Engagement

Students have diverse learning preferences and ways they are motivated to learn. We seek to capture as many as possible and so we have multiple modalities of engagement to earn points:

- Low-stakes, weekly assignments are based on material that can be either read or watched
- Lectures have active-learning activities in them
- Assessments include traditional exams, manuscript, poster, presentations (live and recorded), lab notebook, and a project
 - Drafts can be submitted for feedback
- Hands-on lab skills complement theoretical knowledge of cancer, statistics, and fruit fly biology
 - Lab worksheets help build lab knowledge

udlguidelines.cast.org

CURE: Course-based Undergraduate Research Experiences

Course-based Undergraduate Research Experiences (CUREs) are immersive pedagogical learning experiences in which students work to formulate and address a novel research question, thereby fuelling scientific discovery and permitting early exposure to research.²



colorado.edu/research/cure/

Promote research & technical skill development

Enhance student self-regulated learning

Universal access to research opportunities

Reflection / / Metacognition

Increasing bodies of research are coming out in support of student metacognition, where they are given opportunities to **reflect on their learning in a transformative way**. Drug Discovery seeks to incorporate metacognition through its weekly assignments that are administered after the weekly lecture so they can reflect on what they know and figure out what they need to study. Questions will be included to probe their study methods. Furthermore, exam review includes a **learning objective mapping** assignment so students can learn how to use those to study.

Appreciation and Recognition

Thank you to Jacie Moriyama and Rebecca Lee, Arts & Sciences Support of Education Through Technology (ASSETT) and the Center for Teaching & Learning for support working on this project. We are grateful to the Molecular, Cellular and Developmental Biology Department and Arts & Sciences for continued support to work on and improve these introductory CURE courses to rely on evidence-based pedagogy.

Drug discovery labs were designed by Dr. Pamela Harvey, many elements remain.

¹Wiggins, G., and McTighe, J. (2014). Improve curriculum, assessment, and instruction using the Understanding by Design® framework. ASCD.

²Hawco, O. et al. (2024). A student-partnered approach to design a course-based undergraduate research experience (CURE) in biological sciences. *International Journal for Students as Partners*, 8(2), 129–143

³Laverty, J. T., et al. (2016). Characterizing College Science Assessments: The Three-Dimensional Learning Assessment Protocol. *PLoS ONE*, 11(9), e0162333.