

# Progressive Concept Mapping in Lab: Building Connections All Semester Long

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One challenge in learning biology is conceptualizing how the pieces of a complex story fit together. A typical exam might cover chemistry and cells before the course moves on to genetics and inheritance, but students may never understand how those units relate to each other or to evolution and ecology. To address this issue, we implemented a semester-long concept mapping project in our non-majors biology lab. Early in the semester, small groups of students created concept maps covering the basic concepts of cell chemistry. After review, a corrected map was pushed out to the entire class. When it was time to build the next section, students started with the correct map and added concepts related to DNA, proteins, cell division and inheritance. A few weeks later, we added evolution; ecology came last. This exercise demonstrated the continuity between the textbook, the lab, and the lecture, an aspect previously missing from the class.

**Keywords:** introductory biology, concept mapping, iPad, classroom technology

## Introduction

Our nonmajors biology class at the University of Oklahoma covers everything from atoms to ecosystems, and students struggle to make connections between all of the topics. We implemented a semester-long concept mapping project in the class's lab to help students see the big picture rather than focusing exclusively on individual details.

## iPad App Selection

Our lab classroom is equipped with iPads, and we selected the Inspiration Maps app for our project. This app is not perfect, notably because it does not allow for branched connecting arrows. However, it was the app that best fit our criteria: compatible with iPad, one-time cost, no subscriptions or in-app purchases required, and email capability into and out of the app.

## Overall Implementation Strategy

Students worked on the progressive concept map four times during the semester. During the first session,

they received an iPad with a list of key terms from unit 1 (chemistry and cells) preloaded into the Inspiration app. Working in teams, the students assembled concept maps to the best of their ability. A few weeks later, for session 2, we provided a template with a correct unit 1 concept map and a list of new terms from unit 2 (genetics and inheritance). For session 3, we provided a correct map for units 1 and 2, and we instructed students to add terms from unit 3 (evolution and diversity). Finally, for session 4, students received a correct map covering units 1, 2, and 3, then added terms from unit 4 (ecology). At each stage, students were asked to make a minimum number of connections from the new terms back to terms from previous units.

After each session, we sent out a correct concept map by email. Students were encouraged to use the maps as they studied for each midterm exam.

## Terms Included in Our Maps

Listed below are the terms students were instructed to incorporate into each map. Instructors can easily modify these to fit the unique needs of their own courses.

### *Unit 1 (Chemistry and Cells)*

Atom, ATP, cell, carbohydrate, DNA, enzyme, life, molecule, photosynthesis, protein, respiration

### *Unit 2 (Genetics and Inheritance)*

Binary fission, cell division, gamete, genetic variation, inheritance, meiosis, mitosis, mutations, Punnett square, replication, RNA

### *Unit 3 (Evolution and Diversity)*

Evolution, life's history, fossils, other evidence for evolution [besides fossils], natural selection, other mechanisms of evolution [besides natural selection], phylogenetic tree, reproductive barrier, species

### *Unit 4 (Ecology)*

Ecology, ecosystem, interactions, nonliving environment, organism, population, community, biome

## **Student Feedback**

We have not formally assessed this technique, but comments made informally and on end-of-semester student evaluations suggested that the project was a success. Here are a few written responses to the question, "What is the most important thing you learned this semester?"

- "Everything is related and can tie together."
- "I loved learning about how everything fits together. I like looking through my notes and putting things from exam 1 and exam 3 together."
- "Some of the most useful things I learned were about learning, and how to see the material in a college course as a whole and make connections. I think this is a really great life skill that I want to continue to improve on."
- "The most important thing I learned about biology this semester was how everything is connected and influences one another."

In addition, in the end-of-semester evaluations, 10 students (out of ~70 enrolled) said that a strong point of the lab was that it helped tie into what was taught in lecture. A few students, however, expressed dislike for either the concept maps or the iPads, and two specifically mentioned they would rather have done the concept maps on paper than on the iPads.

## **Conclusion**

We will continue to use the progressive concept maps in our class because they encourage students to

articulate the connections between related concepts within biology.

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## **About the Authors**

Krystal Gayler was a graduate teaching assistant at the University of Oklahoma at the time this project was developed. She is currently a science teacher at Whittier Middle School in Norman, OK.

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