



## Reinforcing student understanding of DNA Replication and PCR through coordinated lecture and lab exercises

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### Abstract

Students in introductory biology courses struggle with understanding the process of DNA replication. We plan to use a combination of coordinated lab and lecture activities to improve student understanding of this process. In lab, students will complete an activity that draws comparisons between PCR and DNA replication. Prior to the in-lab activity students will be introduced to or review both processes using prelab readings and short videos. During the in-lab activity students will illustrate the steps of PCR for the first two cycles and contrast that with the progression of DNA replication from both sides of one replication bubble. Students will then discuss why most of the enzymes required for DNA replication (such as DNA ligase) are not needed for PCR and the fate of primers in the two processes. The in-lab activity will demonstrate the directionality of DNA synthesis in both processes and clarify why lagging strands are not synthesized during PCR. In lecture, students will complete an active learning module that models the process of DNA replication to understand the specific role of each enzyme. The lecture activity will have students use yarn to model the progressive unwinding of double helix, recording the locations of enzymes and drawing the products for each step as they go through at least three rounds of replication bubble expansion. This allows students to observe three features that traditionally are difficult to understand in static diagrams:

1. The same enzymes are used in repeated cycles,
2. There are multiple products being synthesized at the same time,
3. The reason for leading and lagging strands.

For this project, we will add an additional round of modeling for PCR and contrast the two processes. We will compare learning outcomes from completing the in-lab activity first or the in-lecture activity first using a post-activity extra credit worksheet that students will complete in preparation for a midterm exam in the lecture course. We will also assess if there is an improvement on the exam question about DNA replication that has shown mixed success in the past.

**Keywords:** PCR, DNA replication

**Citation:** Mohan S and Keller M. 2024. Reinforcing student understanding of DNA replication and PCR through coordinated lecture and lab exercises. Abstract 55 In: Boone E and Thuecks S, eds. *Advances in biology laboratory education*. Volume 44. Publication of the 44th Conference of the Association for Biology Laboratory Education (ABLE). DOI: <https://doi.org/10.37590/able.v44.abs55>

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