Mastering Biology with Adaptive Follow-Up

School Name  Collin College, Plano, TX  
Course Name  General Biology I  
Course Format  Lecture and lab

Key Results  When Adaptive Follow-Up was added, there was a statistically significant increase in end-of-semester student exam scores.

Submitted by  Rebecca Orr, Professor; Shellene Foster, Statistical Analyst  
Course materials  Campbell Biology, Reece, Urry, Cain, Wasserman, Minorsky, and Jackson

About the Course  Collin College is a multicampus, two-year college in North Texas that enrolls approximately 27,000 students, 67 percent of whom attend part-time. General Biology I is taken primarily by students who intend to pursue a degree in the health sciences (e.g., nursing, dental hygiene, respiratory care, and surgical technology) or plan to transfer to a four-year institution. The course covers the fundamental principles of living organisms, including physical and chemical properties of life, organization, function, evolutionary adaptation, and classification. Concepts of cytology, reproduction, genetics, and scientific reasoning are also included. The course has lecture and lab components.

Challenges and Goals  Students who take General Biology I at Collin College come from a variety of backgrounds and have different skill levels and styles of learning; some are not college or course ready. Addressing the needs of this diverse group can be a challenge.1  
Professor Rebecca Orr has been using Mastering Biology for several years, but recently added Adaptive Follow-Up (AFU) to her implementation as a way to help students identify individual gaps in knowledge and remediate at their own pace and on their own time.

Implementation  Orr’s use of Mastering Biology has progressed from an optional resource to a required component. In 2013, she published a study on the effect of online testing as a learning event in the introductory (majors) biology classroom using Mastering Biology to deliver required quizzes. Through detailed statistical analysis, the benefit of quizzes was demonstrated to be significant for students of diverse academic abilities.2

In response to the results of that study, Orr continues to require preexam Mastering Biology quizzes. The course consists of three different types of Mastering Biology assignments:

- Prelecture reading assignments (untimed homework). Ten-question, multiple-choice assignments designed to offer quick feedback regarding students’ initial comprehension of course material. Students may request hints but are limited to two attempts. Diagnostics from these assignments help guide lecture discussion.

- Practice assignments (untimed homework). Chapter-specific tutorials, activities, BioFlix™, and misconception questions. Homework assignments require 30 to 60 minutes to complete. Students may request hints and they have multiple attempts.

- Required quizzes (timed). Designed to provide a snapshot of where students are in preparation for upcoming exams. Quizzes comprise original content that has been uploaded into Mastering Biology. Topics and wording prepare students for the types of questions that will be on the exam.

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1Studies show that students who are not college ready face serious barriers to academic success. In Texas, 38 percent of students who are below the state readiness standard when they enter college graduate or are still enrolled in higher education after three years. This is compared to 57 percent of students who are college ready upon entry. 2013 Texas Public Higher Education Almanac, Texas Higher Education Coordinating Board, p. 13 (www.thecb.state.tx.us).

2“Increasing Student Success Using Online Quizzing in Introductory (Majors) Biology,” Rebecca Orr and Shellene Foster, CBE—Life Sciences Education, Vol. 12, S09–S14, Fall 2013 (http://www.lifescied.org/content/12/3/S09/full?sid=01bb2df5-b239-4c41-8406-bd40c6be1d22).
During summer 2013, Orr tested Mastering Biology’s new Adaptive Follow-Up feature. AFU questions focus students on gaps in their understanding based on individual performance on a Mastering Biology parent assignment and, as such, vary from student to student. Preliminary results from the semester were published in *MyLab & Mastering: Science and Engineering, V. 4*.3

<table>
<thead>
<tr>
<th>Summer 2013</th>
<th>Spring 2014</th>
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<tbody>
<tr>
<td>No Adaptive Follow-Up for exams 1 and 2</td>
<td>No Adaptive Follow-Up for exams 1 and 2</td>
</tr>
<tr>
<td>Optional Adaptive Follow-Up for the second two exam periods</td>
<td>Required Adaptive Follow-Up for the second two exam periods</td>
</tr>
<tr>
<td>Two sets of Adaptive Follow-Up</td>
<td>Three sets of Adaptive Follow-Up</td>
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<tr>
<td>Adaptive Follow-Up due two days after parent assignment</td>
<td>Adaptive Follow-Up due two days after parent assignment</td>
</tr>
<tr>
<td>Test-out set at 95 percent mastery</td>
<td>Test-out set at 95 percent mastery</td>
</tr>
<tr>
<td>Value set as extra credit added to homework portion of lecture grade</td>
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Table 1. Study Implementation of Adaptive Follow-Up, Summer 2013 and Spring 2014

In spring 2014, Mastering Biology homework was a streamlined version of the one assigned in spring 2013. This increased the item availability of questions for the AFU exercises. The same quizzes and exams were used in all semesters. For the third and fourth units in spring 2014, AFU assignments were added to each Mastering Biology practice assignment.

Based on her experience with Adaptive Follow-Up, Orr recommends the following best practices:

- Enable the test-out feature to motivate students to complete the Mastering Biology parent assignment.
- Carefully select what is added to the Mastering Biology parent assignment. Keep in mind that AFU sets for the current chapter are drawn from the same item library.
- Schedule due dates of future assignments so the adaptive engine can integrate consideration of future content prerequisites into current recommendations.
- Streamline homework assignments to account for total time to do the Mastering Biology parent assignment and the AFU sets (~15 minutes per set).
- Select items for the Mastering Biology parent assignment that specifically address ultimate learning goals.
- Sequester items you don’t want in AFU assignments in an unscheduled assignment.
- When enabling AFU for an assignment that includes content from multiple chapters, be aware that the sets will be drawn from all material covered in the assignment. Inclusion of even one item from a given chapter results in the potential for all information prerequisites to that chapter being included in the set. If you skip a chapter or include only one section from a given chapter, temporarily sequester items from chapters (or portions of chapters) that you don’t want included in AFUs.

**Assessments**

**Course Grade**

- 75 percent Lecture
- 25 percent Lab

**Lecture Grade**

- 80 percent Exam average
- 10 percent Mastering Biology quizzes (100 total points)
- 10 percent Mastering Biology homework (1,500 total points)

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Mastering Biology with Adaptive Follow-Up: Collin College

• “I really like how [Adaptive Follow-Up] takes me back to the basics so I know where I need to study to build my strengths.”

• “Have [Adaptive Follow-Up] for all of the practices from the beginning of class.”

• “I originally thought that the [Adaptive Follow-Up] assignments were going to be a waste of time, but they are actually more of a benefit.”

Students report putting more effort into Mastering Biology parent homework because of the test-out option. According to one student, “Adaptive Follow-Up questions motivated me to learn the material better. I really think it’s just the idea of testing out of something that makes me feel smarter and

Results and Data
The summer 2013 study indicated that by exam 4 the gap in exam averages of those students who were offered Adaptive Follow-Up became pronounced. After making the changes in Table 1 in spring 2014, Orr reevaluated the results.

Figure 1 shows that offering Adaptive Follow-Up has a significant effect: student performance on exam 4 increased with the effect of exams 1 and 2 factored out (p = 0.032). Table 2 shows participation in Adaptive Follow-Up for summer 2013 and spring 2014.

The Student Experience
Student feedback has been positive.

• “I really like how [Adaptive Follow-Up] takes me back to the basics so I know where I need to study to build my strengths.”

• “Have [Adaptive Follow-Up] for all of the practices from the beginning of class.”

• “I originally thought that the [Adaptive Follow-Up] assignments were going to be a waste of time, but they are actually more of a benefit.”

Students report putting more effort into Mastering Biology parent homework because of the test-out option. According to one student, “Adaptive Follow-Up questions motivated me to learn the material better. I really think it’s just the idea of testing out of something that makes me feel smarter and encourages me to get a better grade on the [Mastering Biology parent] homework.”

Table 2. Participation in Adaptive Follow-Up, Summer 2013 and Spring 2014 (summer 2013, n = 37; spring 2014, n = 36)

<table>
<thead>
<tr>
<th></th>
<th>Summer 2013 (AFU Optional)</th>
<th>Spring 2014 (AFU Required)</th>
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<tbody>
<tr>
<td>Earned Adaptive Follow-Up credit</td>
<td>74.8%</td>
<td>78.7%</td>
</tr>
<tr>
<td>Tested out of Adaptive Follow-Up by earning 95 percent or more on the Mastering Biology parent assignment</td>
<td>16.7%</td>
<td>36.6%</td>
</tr>
<tr>
<td>Chose to actively work on Adaptive Follow-Up sets after completing the parent assignment</td>
<td>58.1%</td>
<td>42.1%</td>
</tr>
<tr>
<td>Did not participate in Adaptive Follow-Up</td>
<td>25.2%</td>
<td>22.3%</td>
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Conclusion
Adaptive Follow-Up provides individualized recommendations to increase student proficiency in course content and delivers content based on demonstrated understanding of topics as well as the content graphed as a prerequisite for the success of future assignments.

Evaluation of AFU during summer 2013 and spring 2014 shows that AFU had a significant, positive effect on student exam performance. Students often complain about their perceived disconnect between the time and effort spent studying and their subsequent performance on exams. A resource that can identify individual gaps in knowledge facilitates the kind of focused effort and targeted remediation students need to succeed.

In fall 2014, Orr enabled the Adaptive Follow-Up sets beginning with Chapter 2. This was both in response to student requests that AFU be available earlier and a reflection of the results obtained to date. Orr will continue to evaluate the impact on student learning in future semesters.

In 2000, the Texas Higher Education Coordinating Board adopted Closing the Gaps by 2015: The Texas Higher Education Plan. The report focuses on key goals and outcome measures which include student participation (as measured by enrollment) and success (as measured by certificate and degree completion). Completion of a program starts with a student achieving success in core courses, such as General Biology I. By redesigning the course to enhance individual student learning, Orr is providing a learning opportunity to help more students accomplish their educational and career goals.