**Development of an Introductory Biology Preparation Assessment Tool**

Cynthia Giffen\(^1\) and Laura Olsen\(^2\)

cgiffen@umich.edu, ljo@umich.edu

\(^1\)Comprehensive Studies Program & Dept. of Ecology & Evolutionary Biology
\(^2\)Department of Molecular, Cellular, and Developmental Biology & Program in Biology

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### Results

\[ \text{Exam Average} = (1.225 \times \text{ACT score}) + (0.345 \times \text{pre-assessment %}) + 21.5 \]

\(R^2 = 0.322\) (32% of variation is explained by ACT and pre-assessment score)

\[ \text{Biology class exam average (73% in Fall & 69% in Winter)} \]

\[ \text{Biology course grade (Fall 2015 only) (-79.5%)} \]

\[ \text{Current GPA (-3.1 in Fall & Winter)} \]

Pre-assessment % alone is not sufficient to predict success (Figs. 4, 5, 6)

Better align pre-assessment with 172

Use multiple linear regression (MLR) to incorporate additional variables we believe may have predictive value: 171 vs. 172, semester in college, first-generation status, number of previous college science courses, ACT score, AP biology course & exam score.

Only variables that have statistically significant predictive value are pre-assessment score & ACT score

Works well for many students, but some

Further analysis on outliers may help us understand what factors are allowing underprepared students to succeed

What other data can we collect to greatly outpace model predictions underprepared students to succeed

Bio 172 CSP students appear to be better prepared, but the 172 CSP students' outcomes are the same as 171 students (exam average, course grade).

### Introduction

Introductory Biology is a two-semester course:
- 171 (ecology, evolution, genetics, and diversity of life)
- 172/174 (cell and molecular biology, animal and plant physiology)

Enrollment in each of these courses is 500+ students per semester.

Students in Introductory Biology have diverse biology backgrounds and prior coursework experience. Differing levels of preparation stem from the diversity with which high school biology is taught and the curricular experiences (summer science camps, entrance exam prep courses) students have available to them.

Starting in Fall 2013, CSP (Comprehensive Studies Program) students interested in taking Introductory Biology were enrolled in smaller standalone sections taught by dedicated Lecturers (Giffen and Laury Wood). CSP sections meet an additional 2.5 hours per week to allow for greater instructor-student contact and more time to focus on mastering the course material. This change was made to help these at-risk students succeed in Introductory Biology so that we might retain more students in the STEM disciplines.

While this additional in-class time has helped many CSP students succeed, there remains a group of students whose high school science preparation is grossly insufficient. Approximately 50% of students in CSP sections earn final course grades of C or lower (Figure 1). We need to find ways to correct this preparation deficit and increase success of these students in Introductory Biology if we hope to retain more students in STEM fields.

![Pre-assessment construction](image)

### Research Questions

1. What prior knowledge is necessary for successful performance in Introductory Biology?
2. Can we properly identify under-prepared students with a Preparation Assessment designed specifically for Introductory Biology at UM?
3. Once identified, what can we do to help students bolster their biology preparation to increase success in Introductory Biology?

### Approach

- **Summer 2015**: drafted pre-assessment using Next-Generation Science Standards, published concept inventories, other biology placement tests
- **Fall 2015**: administered pre-assessment in CSP sections of 171 & 172 (n = 92); revised questions as needed and removed questions and non-distractor choices
- **Winter 2016**: administered pre-assessment in CSP sections of 171 & 172 (n = 88); coded and analyzed data using multiple linear regression

### Pre-assessment construction

- MC questions in 7 blocks: chemistry, cell bio/physiology, evolution, genetics, ecology, graph reading, quantitative skills
- 56 questions in Fall; 50 questions in Winter
- “I don’t know” option for every question
- Administered in first Discussion section of each semester
- At end of assessment, basic demographic questions, including semester in college, HS and college science courses, first-generation status, why the student is taking Intro Bio, etc.

### Results

**Comparison between 171 & 172 CSP students**

No significant differences (p > 0.05) between 171 & 172 CSP students in:
- Biology class exam average (73% in Fall & 69% in Winter)
- Biology course grade (Fall 2015 only) (-79.5%)
- Current GPA (-3.1 in Fall & Winter)

Bio 172 CSP students are on average 0.5 semester farther along in their college careers.

**What other data can we collect to greatly outpace model predictions underprepared students to succeed**

- Better align pre-assessment with 172
- Works well for many students, but some greatly outpace model predictions
- Further analysis on outliers may help us understand what factors are allowing underprepared students to succeed
- What other data can we collect to explain variation in achievement?

### Next Steps:

- Analyze exam results.
- Work with a larger group of students.
- Use MANOVA to explore differences in course performance.
- Use a multiple linear regression model to predict course outcomes.

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