**Agenda**

I. Welcome and Introductions

II. Review Past Meeting Minutes

III. Follow-up on Action Items
   - Updated CA Materials (pre-req and textbook worksheet, syllabi)
   - CA Website - members only page
   - UCF’s Virtual Lab Data
   - Shared Assessments - Identify subcommittee

IV. Review and Update Topics & Subtopics

V. Lunch Break – 12:00pm (will be provided)

VI. Updated Course Sequence Data

VII. Curriculum Alignment Conference - March 1, 2019
   - Valencia College, West Campus, Special Events Center (Building 8)

VIII. Next Steps / Action Items

IX. Set Spring Meeting Date and Identify Host

X. Adjourn
Minutes

Date: Friday, February 15, 2019
Time: 10:00 a.m. – 2:00 p.m.
Location: Eastern Florida State College – Melbourne Campus
          Building 10, Room 206

Meeting began at 10:02 a.m.

ATTENDEES
CCF: Elena Amesbury
DSC: Jim Backer
EFSC: James Bottesch, Bolos Gerges, Penny McDonald
LSSC: Andrew Young
SSC: Kim Maznicki, Laila Nimri
VC: Flora Chisholm, Eunice Laurent, Graeme Lindbeck, Gregg Scible
UCF: Emilie Bottorff, Teresa Dorman, Dena Ford, Eric Hoffman, Harrison Oonge, Kersten Schroeder,
     Angelia Smith
K-12: N/A

WELCOME / INTRODUCTIONS
Harrison Oonge welcomed attendees and then asked everyone to introduce herself or himself.

REVIEW OF PAST MEETING MINUTES
The minutes from the February 16, 2018 meeting were reviewed and approved with minor changes suggested.

FOLLOW-UP ON ACTION ITEMS
UPDATED CA MATERIALS / CA WEBSITE
Harrison Oonge gave a brief overview of the newly redesigned CA website which includes past meeting minutes, latest syllabi, resources and best practices.

Harrison Oonge gave an overview of the opt-in secured portal which is a platform that could house shared assessments and exams. Please email Emilie Bottorff (Emilie.bottorff@ucf.edu) to request access to the shared portal.

Harrison Oonge and Teresa Dorman asked participants to share their latest syllabi so that the CA website and supporting Google drive documentation can be updated accordingly. Also requested syllabi from institutions offering the requisite courses in the course sequence data, these include the following:

- BSC3403 Quant Bio Methods
- MCB3020 General Microbiology
- PCB3023 Molecular Cell Bio
- PCB3044 Prin of Ecology
- PCB3063 Genetics
- PCB3522 Molecular Biology
- ZOO3713 Comp Vert Anatomy
- ZOO3733 Human Anatomy

Elena Amesbury mentioned that at 2018 Curriculum Alignment conference there was a discussion of having a set of shared questions on final exams across institutions. Has there been any action on
Laila Nimri suggested that we follow-up on the notes that were taken during the conference and revisit the topic. Harrison Oonge will investigate and report back to the participants.

**UCF’S VIRTUAL LAB DATA**

Eric Hoffman gave an overview of a whitepaper that compared virtual to F2F lab content (see attached). Eric Hoffman also briefly reviewed UCF’s Biology I (BSC X010) lab learning outcomes (see attached). Discussion ensued and several key points were made.

- F2F labs are preferred by students.
- The SecondLife labs platform is preferred over the LearnSmart Labs platform.
- Labs can be accessed remotely; however, there are scheduled laboratory hours for each course.
- As of now, UCF has no plans to take the Biology II (BSC X011) lab to a virtual platform.

Biology faculty present agreed that face-to-face biology laboratories are preferred to virtual or SecondLife Laboratories.

**SHARED ASSESSMENTS**

Harrison Oonge began a discussion on shared assessments to move forward curriculum alignment. Harrison asked if any participants would be willing to join a subcommittee to discuss the use of a shared assessment. Volunteers are expected to meet several times to determine which learning outcomes should be tested in Biology I. This committee will also draft sample questions that could be used on a shared assessment. Below are those that volunteered.

- Graeme Lindbeck (Valencia College)
- Elena Amesbury (College of Central Florida)
- Michelle Yeargain (suggested for UCF by Eric Hoffman)
- Laila Nimri / Kim Maznicki (Seminole State College)

Harrison Oonge will work to convene the subcommittee and an update on the committee’s work will be presented at the spring 2020 meeting.

Kersten Schroeder asked if there was already a standard test similar to American Chemical Society (ACS). Participants noted there is not a standardize test similar to ACS. Kim Maznicki stated that SSC uses the same final exam across all SSC campuses for biology courses and labs.

Eric Hoffman suggested renaming the Biology Curriculum Alignment meeting to a more relevant title as the curricula is already aligned. Participants agreed.

**SUGGESTED NEW COURSE**

Gregg Scible suggested adopting a new course that is targeted to Life Science majors. Calculus for Life Science majors MAC 2241 / MAC 2242. USF currently offers this course and could be a resource in developing a course outline. Participants supported Gregg’s suggestion. Gregg asked participants to share any thoughts or feedback with him.
It was suggested that this conversation continue at the Curriculum Alignment conference on March 1, 2019.

**COLLEGE UPDATES**
Elena Amesbury noted that CCF’s new Health Sciences building has been completed and is now open. This new building will allow the college to consolidate health sciences courses into a central location for students in nursing, emergency medical services, physical therapy, radiography and dental assisting. The new facility will also allow the college to increase program capacity.

No other colleges provided any updates.

**LUNCH BREAK WAS HELD FROM 12:00 – 12:45PM**

**REVIEW BIOLOGY I & II LEARNING OUTCOMES, TOPICS & SUBTOPICS**
Link to Google doc: [https://docs.google.com/spreadsheets/d/1FGinzxs5Uuu0RtvhMa2WTKNkTrlqiA_Y7tQmBd_eB0Y/edit#gid=1078935979](https://docs.google.com/spreadsheets/d/1FGinzxs5Uuu0RtvhMa2WTKNkTrlqiA_Y7tQmBd_eB0Y/edit#gid=1078935979)

Participants reviewed Biology I (BSC X010) learning outcomes, topics and subtopics. All items were confirmed.

Eric Hoffman updated participants on changes to UCF’s coverage of Biology I & II topics. See attached.

**UPDATED COURSE SEQUENCE DATA**
Teresa Dorman gave an update on the latest course sequence data. The course sequences that were reviewed included:

- Biology I → PCB3522
- Biology I → BSC3403
- Biology I → MSC3020

**NEXT STEPS**
- Present/share active learning techniques at spring 2020 meeting. Focus on Biology I.
- Review best practices for teaching Biology I and II; what is most successful in the classroom and labs; review common resource document (shared Google Doc).
- Convene subcommittee to discuss shared assessments.
- Interdisciplinary discussions at future meetings.
- Invite Jason Dodge, Director, Transfer and Transition Services at UCF, to a future meeting to discuss current services and synergies.
- Discuss how we can better prepare the students including addressing external life challenges. Develop modules for remediation?
- Encourage academic advisors to join the curriculum alignment conversations.
  - Confirm contact lists are updated
- Provide all requested syllabi for inclusion on website
CURRICULUM ALIGNMENT CONFERENCE
The spring 2019 Curriculum Alignment Conference is scheduled for Friday, March 1, 2019 at Valencia College, Special Events Center. Harrison Oonge encouraged all participants to attend.

SET SPRING 2020 MEETING DATE AND IDENTIFY HOST
The spring 2020 Biology Curriculum Alignment meeting is scheduled for Friday, February 14, 2020 from 10:00am – 2:00pm with UCF (main campus) offering to host (Eric Hoffman).

The meeting adjourned at 2:02pm.
Virtually the Same: A Comparison of STEM Students’ Content Knowledge, Course Performance, and Motivation to Learn in Virtual and Face-to-Face Introductory Biology Laboratories

By Amber J. Reece and Malcolm B. Butler

Biology I is a required course for many science, technology, engineering, and mathematics (STEM) majors and is often their first college-level laboratory experience. The replacement of the traditional face-to-face laboratory experience with virtual laboratories could influence students’ content knowledge, motivation to learn biology, and overall course performance. Three hundred undergraduate STEM students in face-to-face or virtual laboratories in a Biology I course completed a laboratory content test and the Biology Motivation Questionnaire II at the beginning and end of the semester. Final course grades were also obtained. Analyses revealed no significant differences between STEM students in the face-to-face and virtual laboratories in learning gains on the content test and final course grades. Two thirds of the STEM students experienced a decline in motivation to learn biology over the semester, but no significant differences were found between the laboratory groups. Thus, virtual laboratories may offer an affordable alternative to resource intensive face-to-face laboratories in large-enrollment Biology I courses.
Virtual laboratories

Although hands-on, inquiry-based labs have been recommended for several decades as a means of student engagement and retention (Nagalski, 1980), not all universities have the resources for such activities in the large-enrollment, introductory courses. Research on students in virtual labs has shown that these students can learn science concepts as well as, if not better than, those in the face-to-face laboratory (de Jong, Linn, & Zacharia, 2013; Finkelstein et al., 2005; Scalise et al., 2011). However, little research to date has focused on affective outcomes such as motivation, which can influence a student’s decision to stay in her or his intended major.

Methods

Research problem and design

The large enrollment (~1,500 students in the fall 2014 semester, 32 lab sections with a maximum of 48 students each) in Biology I (BSC 2010) has consumed a large portion of the Biology Department’s resources such as laboratory rooms, graduate teaching assistants (GTAs), and physical materials. This situation has led the Biology Department to consider other avenues for the laboratory portion of the Biology I course that could reduce the resource burden. Virtual laboratories are one option for delivering a laboratory experience to large numbers of students.

Thus, this research project investigated the implementation of virtual laboratories in a Biology I course by assessing academic performance and motivation to learn biology of STEM students in face-to-face and virtual laboratory environments.

The research design was quasi-experimental, with one experimental group (virtual labs) and one comparison group (face-to-face labs). Three sources of data were collected for this study: (a) a laboratory-content-specific comprehensive exam administered at the beginning and end of the semester, (b) a questionnaire on motivation to learn biology administered at the beginning and end of the semester, and (c) final course grades. These data provided information on students’ laboratory content knowledge, motivation to learn biology, and overall performance in the course.

Setting

This research occurred in the Principles of Biology I course (BSC 2010) at a large metropolitan research university during spring 2014. One lecture section and its affiliated laboratory sections were assigned to the virtual laboratories, and another lecture section and its accompanying laboratory sections were assigned to the face-to-face laboratories to serve as the comparison group. One instructor taught both lecture sections, and GTAs taught the laboratory sections. Campbell Biology (Reece et al., 2010) was the course textbook.

The face-to-face labs met once a week for 1 hour and 50 minutes. Each lab section (maximum 48 students) was led by two GTAs who began each lab class with a brief introduction to the subject matter and instructions, usually via PowerPoint. Students worked in groups of two to four to complete the lab exercise for that week. The instructions for the lab activities were provided in a weekly handout that the students accessed from the class Webcourses page. Webcourses is an online course management system. Students were not graded on their completion of the lab activities or the lab handout; instead, a lab quiz was given every 2 to 3 weeks over the content covered in the lab activities. The GTAs circulated the lab room to provide feedback and assistance to students as needed during the lab class.

The lab sections assigned to the virtual laboratories met in person during the second week of the semester to review the class schedule and syllabus and then met only on weeks when there was a lab quiz. Students were instructed to complete the appropriate virtual lab topic(s) during the week noted on the lab schedule. Students were able to work on the virtual labs independently or with other students at their convenience during the 7-day period each assignment was available. Students could also complete the virtual labs as many times as they chose, unlike the face-to-face lab group. Although the virtual laboratory program provided students with a mastery score for each lab topic, this did not impact their lab grade. Virtual lab students were only assessed through the lab quizzes, just as the face-to-face lab students.

The virtual laboratories used in this research project were the LearnSmart Labs by McGraw Hill Higher Education (New York, NY). The LearnSmart Labs were chosen because their laboratory content and virtual lab simulations were comparable to the content and lab activities covered in the face-to-face labs. A virtual lab began with a series of webpages covering background information on that lab topic. After reviewing the background information, students progressed through a question-and-answer session where they were presented with questions in a multitude of formats such as multiple choice, true/false, fill in
the blank, select all, and so forth. If students chose an incorrect answer, they were directed to remediation material such as a text passage, video, or diagram. Students were also asked to gauge their confidence in their answer by selecting from the following options: “I know it,” “Think so,” “Unsure,” or “No idea” (Figure 1). The adaptive learning software chose subsequent questions based on the student’s mastery of the previous question and confidence in their selected answer. Once a student mastered the pertinent material, he or she could proceed to the lab simulation.

Within the virtual environment, students could manipulate virtual laboratory equipment such as respirometers, pH meters, and microscopes; record data in a lab notebook; and follow written procedures similar to a lab handout (Figure 2). When appropriate, students created a bar or line graph of their data and referred back to their hypothesis at the end of the lab simulation.

A virtual, automated GTA provided instructions on how to complete the lab; pointed out the lab equipment; and at the end of the simulation, informed students whether their data collection was correct. However, it is important to note that students did not have the ability to ask for real-time help or collaborate with other students within this virtual laboratory environment.

**Participants**

The participants in this study were students with a declared STEM major enrolled in one of two different sections of Principles of Biology I (BSC 2010) who completed both the beginning-of-semester and end-of-semester surveys and the comprehensive pre- and posttest \((n = 300)\). The U.S. Department of Homeland Security’s list of recognized STEM degree programs was used to classify the students’ self-identified majors as STEM or non-STEM for this project (U.S. Department of Homeland Security, 2012). Forty-six percent of the participants were in the face-to-face laboratory group \((n = 139)\), and 54% of the participants were in the virtual laboratory group \((n = 162)\).

Self-report data show the characteristics of the participants in the face-to-face and virtual lab groups were similar (Tables 1, 2, and 3). The majority of participants in each group were female, were enrolled...
in their first college-level laboratory course, and (most) were between the ages of 18–22 years (Table 1). Half of the participants were Caucasian (Table 2), and the most common major in both lab groups was biomedical science (Table 3).

**Instrument**

The Biology Motivation Questionnaire II (BMQ-II; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011) was used to measure students’ motivation to learn biology at the beginning and end of the semester. The BMQ-II has 25 items on a 5-point temporal rating scale of 1 = never to 5 = always. Each subscale has five items. The subscale intrinsic motivation measures students’ internal drive to learn biology (Ryan & Deci, 2000). The subscale self-determination measures the level of control students’ believe they have over their learning (Black & Deci, 2000). Self-efficacy refers to students’ belief that they can be successful in biology (Lawson, Banks, & Logvin, 2007). The subscales career motivation and grade motivation are two examples of extrinsic motivation, which involves learning biology for an external reason (Ryan & Deci, 2000). The Cronbach’s alpha for each subscale indicate this instrument had high internal consistency for this study: (a) intrinsic motivation (0.89), (b) self-determination (0.88), (c) self-efficacy (0.83), (d) career motivation (0.92), and (e) grade motivation (0.81). The combined Cronbach’s alpha of all 25 items was 0.92.

**Data collection**

All students in the experimental and comparison groups were given a 33-question, multiple-choice, laboratory-course-specific comprehensive exam at the beginning and end of the semester. Learning gains for the content test were calculated as Posttest score minus Pretest score. Relative learning gains were also calculated (Posttest score minus Pretest score/Pretest score) to look for evidence of ceiling effect in student scores on the comprehensive exam.

The motivation survey was available for students to complete via a link on their Webcourses page at the beginning and end of the semester. Students were awarded one bonus point for completion of the survey at each time point. Students could earn up to 10 bonus points during the semester, with opportunities for more than 10 points being offered to all students in the course. Examples of other ways students could earn bonus points included bonus questions on the lab quizzes, attending a biology seminar, and participating in research projects. Change in motivation was calculated as End-of-semester total motivation score minus Beginning-of-semester total motivation score. Course performance was mea-

### TABLE 1

<table>
<thead>
<tr>
<th>Lab group</th>
<th>Female</th>
<th>First lab course</th>
<th>18–22 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face lab</td>
<td>60%</td>
<td>75%</td>
<td>94%</td>
</tr>
<tr>
<td>(n = 139)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual lab</td>
<td>61%</td>
<td>73%</td>
<td>95%</td>
</tr>
<tr>
<td>(n = 161)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 2

<table>
<thead>
<tr>
<th>Lab group</th>
<th>Asian</th>
<th>Black/African American</th>
<th>Hispanic/Latino</th>
<th>White/Caucasian</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face lab</td>
<td>16%</td>
<td>10%</td>
<td>21%</td>
<td>50%</td>
<td>3%</td>
</tr>
<tr>
<td>(n = 139)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual lab</td>
<td>9%</td>
<td>17%</td>
<td>18%</td>
<td>49%</td>
<td>7%</td>
</tr>
<tr>
<td>(n = 161)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3

<table>
<thead>
<tr>
<th>Lab group</th>
<th>Biology</th>
<th>Biomedical science</th>
<th>Engineering/Computer science</th>
<th>Forensic science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face lab</td>
<td>12%</td>
<td>58%</td>
<td>18%</td>
<td>7%</td>
</tr>
<tr>
<td>(n = 139)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual lab</td>
<td>10%</td>
<td>65%</td>
<td>10%</td>
<td>4%</td>
</tr>
<tr>
<td>(n = 161)</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
measured by students’ final course grades (70% lecture and 30% laboratory) and compared by an independent $t$-test. The lecture grade was composed of five exams (40%), of which the lowest score was dropped; a final exam (25%); and iClicker scores (5%). The laboratory grades were made up of quizzes (80%), a pre/posttest (10%), and one in-lab assignment on plagiarism and graphing (10%).

**Analyses and results**

**Comprehensive exam**

Students in the face-to-face and virtual lab groups scored alike on both the laboratory pretest and posttest (Table 4). An independent $t$-test shows that students in the face-to-face and virtual lab groups had similar learning gains on this test ($t_{(298)} = -0.48, p = .63$). Also, no significant differences were found between the lab groups in relative learning gains ($t_{(298)} = -0.21, p = .83$).

**Course performance**

The STEM students in the face-to-face and virtual laboratory groups performed equally well in the course overall. The average final course grade for both laboratory groups was a mid-range B (Table 5). An independent $t$-test found no difference ($t_{(298)} = -0.44, p = .66$) in the final course grades of the STEM students in the face-to-face lab group and the virtual lab group. A comparison of the final lab grades, a component of the final course grade, shows the students in the face-to-face lab group had significantly higher final lab grades ($t_{(298)} = 2.11, p = .036$) than the virtual lab group (Table 5). However, Cohen’s effect size value ($d = 0.12$) suggests low practical significance between the final lab grades of the face-to-face and virtual lab groups (Cohen, 1992).

A factorial analysis of variance (ANOVA) was conducted to determine if the final course grades differed based on the laboratory groups (face-to-face or virtual) and the gender (female or male) of the STEM students. Again, no significant differences in the final course grades were found ($F_{(1, 1)} = 0.8, p = .37$) between the groups. A factorial ANOVA was calculated for laboratory group and ethnicity (African American/Black, Asian, Hispanic, Caucasian/White, and other) as well, and no differences were found ($F_{(1, 4)} = 0.41, p = .8$).

Motivation to learn biology

The change in motivation from beginning to end of the semester was calculated (end-of-semester motivation to beginning-of-semester motivation) for group comparisons. A declining trend in motivation from the beginning to the end of the semester was found in the STEM students, regardless of their laboratory group. The STEM students in the face-to-face labs experienced a 4.6% decline in their motivation to learn biology, whereas the STEM students in the virtual labs experienced a 5.5% decline. However, this difference in declining motivations was not statistically significant ($t_{(298)} = 0.73, p = .47$). Table 6 shows the mean scores for each of the subscales of the BMQ-II at the beginning and end of the semester and the change in these subscales. Both the face-to-face and virtual lab groups experienced the greatest decrease in the subscale self-efficacy.

A factorial ANOVA was conducted to determine if the change in motivation to learn biology differed based on the laboratory group and the gender of the STEM students. Again, no significant differences in the change in motivation were found ($F_{(1, 1)} = 0.6, p = .44$) between the groups. A factorial ANOVA was calculated for labora-

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**TABLE 4**

Percentage correct on laboratory comprehensive pre- and posttest.

<table>
<thead>
<tr>
<th>Lab group</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Face-to-face lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($n = 139$)</td>
<td>45.59</td>
<td>9.92</td>
</tr>
<tr>
<td>Virtual lab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>($n = 161$)</td>
<td>45.15</td>
<td>10.75</td>
</tr>
</tbody>
</table>

**TABLE 5**

Final course grades of STEM students by lab group.

<table>
<thead>
<tr>
<th>Lab group</th>
<th>Final course grades</th>
<th>Final lab grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Face-to-face lab</td>
<td>84.34</td>
<td>8.32</td>
</tr>
<tr>
<td>($n = 139$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtual lab</td>
<td>84.69</td>
<td>9.34</td>
</tr>
<tr>
<td>($n = 161$)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
tory group and ethnicity as well, and no significant differences were found between the groups ($F_{(1, 4)} = 0.19, p = 0.94$).

**Discussion**

In this study, we did not find differences in STEM students’ laboratory course knowledge, course performance, or motivation to learn biology based on their completion of the face-to-face or virtual laboratories. We also examined the motivation and course performance data for differences between the genders and ethnicities, but found no differences there either. Although there is no question that the students in the virtual lab group had a different laboratory experience compared with the students in the face-to-face lab group, they had similar laboratory course knowledge, they performed equally well in the course overall, and their change in motivation over the course of the semester was comparable.

Large enrollment introductory courses can promote isolation and student disengagement from their community of learners (Tinto, 1993). The laboratory portion of large-enrollment introductory science courses is often a more conducive environment than the lecture portion of the course for students to interact with their peers and instructors (Hofstein & Lunetta, 2003). Frequent student–teacher interactions have been shown to support college students’ motivation to learn (Kowalski, 2007) and increase academic achievement and retention (Pascarella & Terenzini, 1979, 2005). Thus, the replacement of face-to-face labs with virtual labs could be a serious threat to student motivation and persistence. Yet, the results presented here provide evidence that STEM students in face-to-face and virtual laboratories experienced similar negative changes in their motivation to learn biology over the course of the semester.

Performance in gateway science courses, specifically Biology I, can influence students’ persistence in STEM majors (Dai & Cromley, 2014). Consequently, because the implementation of virtual laboratories in this Biology I course had no differential impact on STEM students’ motivation to learn, laboratory course knowledge, or overall course performance, this instructional method may be a suitable alternative for laboratory experiences where the traditional face-to-face laboratory course is straining the resources of the Biology Department.

This research study provides a foundation for comparing face-to-face and virtual laboratories in an introductory science course and offers other scholars opportunities to further research the topic. Additional research comparing student experiences in face-to-face and virtual laboratories is needed to understand how students collaborate and interact with their instructors and peers in these environments.

**Acknowledgments**
The Principles of Biology I faculty and staff graciously allowed the researchers

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### TABLE 6

Mean scores for the subscales of the Biology Motivation Questionnaire II for STEM students in the face-to-face (F2F) and virtual laboratory (VL) groups.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>F2F</td>
<td>19.08 (3.75)</td>
<td>22.60 (2.22)</td>
<td>19.44 (3.28)</td>
<td>20.14 (5.22)</td>
<td>21.17 (2.77)</td>
</tr>
<tr>
<td></td>
<td>VL</td>
<td>19.88 (3.46)</td>
<td>22.96 (2.53)</td>
<td>20.63 (3.26)</td>
<td>21.17 (5.15)</td>
<td>21.73 (2.91)</td>
</tr>
<tr>
<td>End</td>
<td>F2F</td>
<td>17.81 (4.24)</td>
<td>21.63 (3.19)</td>
<td>18.62 (3.87)</td>
<td>18.83 (6.01)</td>
<td>19.69 (3.6)</td>
</tr>
<tr>
<td></td>
<td>VL</td>
<td>18.75 (3.98)</td>
<td>21.72 (3.34)</td>
<td>19.32 (3.77)</td>
<td>20.02 (5.27)</td>
<td>19.68 (4.12)</td>
</tr>
<tr>
<td>Change</td>
<td>F2F</td>
<td>−1.27 (2.94)</td>
<td>−0.96 (2.62)</td>
<td>−0.82 (3.31)</td>
<td>−1.31 (3.42)</td>
<td>−1.47 (3.58)</td>
</tr>
<tr>
<td></td>
<td>VL</td>
<td>−1.13 (3.11)</td>
<td>−1.24 (2.78)</td>
<td>−1.31 (3.42)</td>
<td>−1.14 (3.32)</td>
<td>−2.06 (3.94)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are in parentheses.
access to their classes and laboratories. McGraw Hill Higher Education provided access to the virtual labs for the students assigned to that group.

References


Contemporary Educational Psychology, 25(1), 54–67.


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Amber J. Reece (areece@csufresno.edu) is an instructor in the Biology Department at California State University, Fresno. Malcolm B. Butler is a professor in the School of Teaching, Learning, and Leadership at the University of Central Florida in Orlando.
UCF – BSC 2010 Laboratory Learning Outcomes

Measurements Laboratory Learning Outcomes:

- Make measurements using the metric system
- Understand and use scientific notation
- Explain the pH scale, how pH relates to [H+] and substances based on pH

Microscope Laboratory Learning Outcomes:

- Learn the parts of a dissecting microscope
- Learn the parts of a compound microscope
- Describe the difference between dissecting and compound microscope
- Learn how to use both types of microscopes
- Determine which microscope should be used to view various objects

Cellular Organelles Laboratory Learning Outcomes:

- Correctly identify cellular organelles/structures.
- Explain each organelle’s function within the cell

Osmosis and Diffusion Laboratory Learning Outcomes:

- Understand then predict diffusion across membranes
- Understand then predict direction of osmosis in potato cells based on tonicity of various solutions
- Calculate percent change to assess osmosis
- Describe tonicity as it relates to red blood cells in various solutions

Enzymes Laboratory Learning Outcomes:

- Understand enzyme structure and function
- Describe conditions that affect enzymatic function
- Predict rate of enzymatic activity under varying environmental conditions (temperature and pH)

Cellular Respiration Laboratory Learning Outcomes:

- Describe glycolysis, pyruvate oxidation, citric acid cycle, and oxidative phosphorylation
- Complete each of the above cycles in the cell by gathering required components necessary
- Complete each of the above cycles in the proper location within the cell
- Starting with one molecule of glucose, create 30-32 ATP

Mitosis Laboratory Learning Outcomes:

- Describe mitosis as single cell division resulting in two diploid daughter cells
- Create each phase of Mitosis within the cell
- Predict chromosome number, chromatid number in various diploid cells

Meiosis Laboratory Learning Outcomes:

- Describe meiosis as two cellular divisions resulting in four haploid daughter cells
• Create each phase of Meiosis within the cell
• Predict chromosome number, chromatic number in various diploid cells

Mendelian Genetics I Laboratory Learning Outcomes:
• Explain the difference between phenotype and genotype
• Use phenotype to predict genotype
• Understand Punnett squares
• Complete monohybrid cross
• Complete dihybrid cross

Mendelian Genetics II Laboratory Learning Outcomes:
• Predict individual’s genotype using phenotype and pedigree analysis
• Understand sex-linked traits and how to predict them using pedigree analysis
• Solve genetic analysis problem

DNA Synthesis, Transcription and Translation Laboratory Learning Outcomes:
• Explain DNA synthesis
• Learn function of enzymes associated with DNA synthesis
• Complete one cycle of DNA synthesis within the cell
• Explain difference between Transcription and Translation
• Explain where these processes occur within the cell
• Understand relationship between DNA, mRNA, and polypeptides
• Understand amino acids, codons, anti-codons
• Complete one cycle of transcription and translation within the cell
The laboratories in BSC 2010 are designed to supplement student acquisition and retention of the biological concepts taught in the lecture component of this course. Laboratory pre- and post-quiz quizzes, and experiment modules are held on our virtual campus using the Second Life platform. You are required to log in during your laboratory section as shown on your class schedule. Only during your scheduled lab time are you guaranteed access to the virtual environment.

“Failure to Launch/Complete” Penalty
Any student who has not purchased laboratory access and registered with CNDG by 5 pm on Friday, February 22nd, will automatically receive a zero (0) grade for the laboratory portion of this course. In addition, failure to complete more than five (5) laboratory modules (pre-quiz, post-quiz, experiment module) will automatically result in a zero (0) grade for the laboratory portion of this course. There will be no exceptions to this policy. Please note that the laboratory grade accounts for 25% of your overall semester grade in this course, receiving a zero (0) grade for the laboratory will likely result in an F grade for the entire course.

Background Material
Each lab has an accompanying background material file which will provide you with three things: 1) biology concepts associated with the upcoming lab, 2) pertinent information about the virtual laboratory module, and 3) virtual campus navigational information. You must read this background material prior to entering our virtual campus each week. You will be quizzed on this information in the pre-laboratory quiz, and your performance in the laboratory module will be affected by how well you read/comprehend this information. The background material file for each lab can be found in the Background Material for Second Life Labs module in Webcourses, and it will be attached to the weekly CNDG email. It is recommended that you have each background file handy when you take the pre-quiz and while completing the laboratory module.

Pre-Laboratory Quizzes
- 10 laboratory pre-quizzes
  - Each pre-laboratory quiz is worth 5 points
  - 10 pre-quizzes X 5 points each = 50 points
- Each pre-laboratory quiz will test:
  - Your understanding of the concepts required to complete the virtual lab
  - Information contained in the supplied background material.
- You must score at least 60% on the pre-laboratory quiz to gain access to the associated virtual experiment.
- Only one attempt per pre-quiz.

Laboratory Modules
- You are required to complete each laboratory module according to the schedule provided below.
- There are 10 laboratory modules plus Orientation
  - Orientation is worth 5 points
  - Each module is worth 1 point
    - total of 15 points
- To gain access to the laboratory module, you must score at least 60% on the pre-laboratory quiz.
- You must complete the entire laboratory module to gain access to the post-quiz.
- Each laboratory module must be completed during the week that it is open, according to your scheduled laboratory time
- There are no make-up laboratories.

Post-Laboratory Quizzes
- There is a post-quiz for each laboratory module except Measurements and Microscope.
  - 9 post-quizzes
    - Each post-quiz is worth 10 points
  - Measurements and Microscope activities are also worth 10 points each.
- The lowest scoring post-quiz will be dropped. Measurements and Microscope activities will be included in this since their completion requirements equal 10 points
- Post-laboratory quizzes (or requirements) will total 100 points (10 highest scoring post-quizzes/activities x 10 pts each).
Some post-quizzes will contain a “Critical Thinking” question; if answered correctly it is worth 1 extra credit point.

Post-quizzes will test your understanding and retention of the procedures and concepts in the associated laboratory module.

- The quiz questions are application based; not merely factual recall.

**Grading Information**

- **Semester Point Total: 165 points**
  - See schedule/assignments below.
  - The laboratory grade accounts for 25% of your overall semester grade.

- **How to view your grades:**
  - Pre- and Post-quiz grades can be viewed at [https://my.cndg.info](https://my.cndg.info) Click on “your results” on the top left of the page.
  - Grades will be uploaded weekly to Webcourses

- **Avatar Display Name:**
  - Your avatar display name must be your registered first and last name. Your grades are linked to your display name. Failure to change display name to registered first and last name will result in zero points for all labs.

- Any grading discrepancies must be brought to the attention of the Michele Yarger within two weeks of the grades being posted on Webcourses. **Semester-end grade review will not be permitted.**

**Laboratory Hours of Operation**

- **Scheduled laboratory times:**
  - Monday: 10:30 am – 5:30 pm
  - Tuesday: 12:30 pm – 5:30 pm
  - Wednesday-Thursday: 8:30 am – 5:30 pm
  - Friday 8:30 am – 2:30 pm
  - Can log in **ONLY** during YOUR scheduled laboratory time
  - Full TA and CNDG support

- **“Open Lab” time:**
  - Monday - Thursday: 5:30 pm – 7:30 pm
  - **No Open Lab on Fridays**
  - First come, first served
  - Minimal TA and CNDG support

- **After Hours:**
  - Monday: 7:30 pm – Tuesday 5:30 am
  - Tuesday - Thursday 7:30 pm – 8:30 am
  - **No After Hours on Fridays**
  - No TAs or CNDG staff present
  - If you choose to complete your lab during this time, **you are accepting full responsibility for any and all problems you may encounter during this time.**

- **Virtual Campus Closed:**
  - Tuesday 5:30 pm – 12:30 pm for maintenance of environment
  - Friday 2:30 pm – Monday 10:30 am
Absence Policy
Laboratory modules, quizzes and assignments are available online and can be accessed from any location with sufficient internet connectivity. Since all students have access to the laboratory modules Monday-Friday, there will be no excused absences. All laboratory modules, quizzes and assignments must be completed by the due date. The only exceptions to the “no absence” policy are: hospitalization, jury duty, etc. extending longer than the opening period of the missed laboratory. In such a case, you must provide valid, official documentation to Michele Yeargain within 48 hours of the due date of the missed laboratory module. In the rare case of an excused absence, your grade for the semester will be calculated based on the labs you completed. We DO NOT accept excuse notes from family members (even if those family members are doctors, lawyers, etc.).

How to retrieve your username/password
- Second Life:
  - Go to [www.secondlife.com](http://www.secondlife.com) and click “Log in” and then “Forgot your login information?” This will allow you to reset your Second Life Viewer password.
- CNDG:
  - Go to [http://my.cndg.info](http://my.cndg.info) and click on “forgot password”. This will reset your CNDG access.

Student Responsibilities
You are responsible for sufficient internet connection (>1MB/second, computer function, time management, etc. Failure to complete laboratory assignments, modules or quizzes due to lack of/insufficient internet access, computer malfunction, proper planning, etc. will result in a zero for the missed work. Time will not be extended for any assignment. Campus wifi is not strong enough to stream Second Life.

Tech Commons Computer Labs
The Second Life viewer is installed on the computers in the three Tech Commons computer labs. Locations & hours of operation are:
- **Tech Commons 1 room 106**: Monday - Friday 8 am – 5 pm.
- **Tech Commons 2 room 117**: Monday – Thursday 8 am – 10 pm, Friday 8 am – 5 pm
- **Classroom Building 1 room 101**: Monday – Friday 8 am – 6 pm, Friday 8 am – 5 pm

Virtual Laboratory Code of Conduct
- The UCF Golden Rule applies to the UCF Virtual Campus
  - Cheating of any kind will result in a ZF grade and referral to the UCF Disciplinary Action Committee
  - Derogatory/Offensive/Abusive behavior will result in expulsion from the UCF Virtual Campus as well as the Second Life world. Students displaying such behavior will be referred to the UCF Disciplinary Action Committee
- Avatar display name must be your legal first and last name and match UCF registration
- Avatars must be human. Non-human avatars are not permitted on the UCF Virtual Campus

**Technical Support:**
- If you are logged into Second Life and are experiencing technical difficulties, you should send a help request through your HUD.
- If you are logged into Second Life and need assistance with the laboratory module, you should IM one of the TAs or speak to them using SL Voice.
- If you are having difficulties logging into the Second Life environment, check that your internet connection is active, that you have downloaded all required software, and are using the Second Life Viewer. If you still have problems, email help@cndg.info. If you do not receive a response, you can email Michele Yeargain at michele.yeargain@ucf.edu

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**Spring 2019: Laboratory Schedule (and point distribution)**

**Jan 7-11: CNDG/SecondLife Registration**

**Jan 14-18: Laboratory Orientation**
- Virtual Orientation: 5 points
- Orientation post-quiz: 10 points

**Jan 22-25: Measurements Laboratory** (UCF is closed on Monday, January 21. Monday lab students complete this Jan 22-24)
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Collection of at least 15 tickets: 10 points

**Jan 28 – Feb 1: Microscope Laboratory**
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Correct ID of evidence/suspect: 10 points.

**Feb 4-8: Cellular Organelles/Structures Laboratory**
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Post-quiz: 10 points

**Feb 11-15: Osmosis/Diffusion Laboratory**
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Post-quiz: 10 points

**Feb 18-22, Feb 25 – Mar 1: Cellular Respiration Laboratory** (open two weeks to accommodate exam schedule)
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Post-quiz: 10 points.

**Mar 4-8: Mitosis Laboratory**
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Post-quiz: 10 points.

**Mar 11-15: Spring Break! No Laboratory this week.**

**Mar 18-22: Meiosis Laboratory**
- Pre-quiz: 5 points
- Laboratory Module: 1 point
- Post-quiz: 10 points.

**Mar 25-29: Extra Credit Quiz in SecondLife**
- Extra Credit Quiz: 2 points
Apr 1-5: Mendelian Genetics I Laboratory
Pre-quiz: 5 points
Laboratory Module: 1 point
Post-quiz: 10 points.

Apr 8-12: Mendelian Genetics II Laboratory
Pre-quiz: 5 points
Laboratory Module: 1 point
Post-quiz: 10 points.

Apr 15-19: DNA Synthesis, Transcription, and Translation Laboratory
Pre-quiz: 5 points
Laboratory Module: 1 point
Post-quiz: 10 points.
UCF – shared by Eric Hoffman

BSC 2010 (Bio 1):
Chapters (Campbell’s Biology, 11th ed) and content covered:
1 (Introduction to Biology): Very briefly
2 (Atoms & Molecules)
3 (Water)
4 (Carbon & Functional Groups)
5 (Macromolecules)
6 (Cell structure)
7 (Membranes)
8 (Metabolism)
9 (Cell Respiration)
10 (Photosynthesis)
12 (Mitosis and Cell Cycle)
13 (Meiosis)
14 (Mendelian Genetics)
15 (Chromosomal Inheritance)
16 (DNA Synthesis)
17 (Protein Synthesis)
18.2 (Eukaryotic Gene Expression Control): Some instructors

Laboratory:
- Virtual 2nd Life lab for regular sections, Face to Face lab for Honors Sections

Current Textbook: Campbell’s “Biology”, 11th ed. Bio 1 students get e-text included with virtual lab purchase

Pearson Mastering Biology: Most instructors use some parts as a required course component

Classroom response systems: Some instructors iClicker, SquareCap

Future plans:
- Not as much detail in early chapters, particularly Chapter 2 and 3. Adding some Chapter 11 content about Cell Communication due to needed introductory material for upper level Biology courses.
- Active learning exercises added in lecture which will require some introductory content delivered online to prepare for exercises and give background.
- Development of Learning Assistant program which will allow active group work in large lecture sections for problem solving, case studies and other active learning work about the course material.
BSC 2011 (Bio 2):
- Stress how important it is to take Bio 2 before transferring if at all possible
- Without Bio 2, limitations on what electives they can take when they come to UCF so many end up taking Genetics (if they have Bio 1 and Chem 2 finished) which is NOT a good class to begin UCF with

Chapters (Campbell’s Biology, 11th ed) and content covered: Order sometimes changes
22 Darwin
23 Evolution of Populations
24 Origin of Species
25 Introduction to Evolution
26 Phylogeny
19 Viruses
27 Bacteria and Archaea
28 Protists
29 Plants Diversity I
30 Plants Diversity II
31 Fungi
32 Animals Diversity
33 Invertebrates
34 Evolution of Vertebrates
40 Animal Form and Function
41 Digestive System
42 Circulatory/Respiratory System
43 Immune/’Lymphatic System
44 Excretory System
45 Endocrine System
46 Reproductive System
48 Neurons
49 Nervous System
50 Sensory, Skeletal, Muscular System
35 Plant Growth and Development
38 Angiosperm Reproduction and Development
51 Animal Behavior
52 Intro to Ecology
53 Population Ecology
54 Community Ecology
55 Ecosystems
56 Conservation Biology

Laboratory:
- Face to Face lab for all Bio 2 sections
**Current Textbook:** Campbell’s “Biology”, 11th ed. Bio 2 students who took Bio 1 at UCF get continued access to their e-text

**Pearson Mastering Biology:** Instructors moving to use some parts as a required course component

**Classroom response systems:** Some use either iClicker or other smart device options

**Future plans:**
- Culling of details to allow better understanding of major concepts.
- **Active learning exercises** added in lecture which will require some introductory content delivered online to prepare for exercises and give background. Expectation will be that students will do more reading of content outside of class, learning the basic facts before coming to class.
- Continued use of **Learning Assistant** program which will allow active group work in large lecture sections for problem solving, case studies and other active learning work about the course material.