THE EFFECT OF TRANSITIONING TO PAPERLESS ASSESSMENT IN A HIGH SCHOOL BIOLOGY COURSE

by

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DEDICATION

I would like to dedicate this project to my wife, Samantha. Thank you for handling me with grace while working on this project. I could not have done it without you.
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Technology and education are becoming more intertwined each school year. Technology is replacing how we deliver content and perform assessments. Many of these changes are occurring before they have been determined to be effective. This research compares individuals who received the same instruction over a unit and took the same test, but in different formats.

Overall, the students performed significantly better in a paper format over digital. However, the most significant finding hinged on low achieving students (GPA < 2.0). Low achieving students performed significantly worse on digital assessments compared to paper assessment.
INTRODUCTION AND BACKGROUND

Alexandria Area High School (AAHS) is a consolidated school made of the communities of Alexandria, Forada, Garfield, Carlos, and Miltona in Alexandria, Minnesota. The town of Alexandria has a population of 11,070, but that fluctuates between winter and summer. It is estimated that the summer population reaches 20-25,000. This influx is due to the many lakes surrounding the community. The towns of Forada, Garfield, Carlos, and Miltona combined equal a population around 1,200. Aside from tourism, manufacturing is a strong industry with companies such as 3M, Douglas Manufacturing, and Aagard Group all employing a large percentage of the population. The influence of these companies can be felt in the high school where there is a strong push for technology literacy.

The high school is set up into four different academies. Each academy has approximately 300 students, but that fluctuates from year to year. The academy model is a way to create a school within a school, which makes a large school have a small school feeling. Students in the same academy will generally have the same peers in each core class and will have specific teachers for each academy. The academies are freshman exploration (FE), engineering, manufacturing technology and natural resources (EMTNR), business communication and entrepreneurship (BCE), and health science and human services (HSHS). The freshman exploration academy contains all freshman and provides experiences for students to explore different occupations. The engineering, manufacturing technology, and natural resources academy is geared towards students that might enter the workforce, go to a trade school, or enter university following graduation.
The classes are geared towards application and hands on skills. The business, communications, and entrepreneurship academy is made of students who are interested in entering the business world after graduation. In general, the population will move towards a four-year college. Many students participate in Distributive Education Clubs of American or DECA, which is a nationwide business themed competitive event. The health science and human services academy is for students looking to join the public services sector in either healthcare, teaching, law enforcement or another related area. Each academy is working towards creating a capstone course for the top students to work with businesses in the community on real world issues. Currently there are two capstone courses: a teacher education program where students will student teach, and a business program where students are given a real problem from a business and must find a solution and present to that company. This gives the students real world experiences.

According to the Minnesota Report Card, the enrollment of AAHS is 1,211 with 96% White, 2% Black, 1% Hispanic, 1% Asian, and 1% Native American (rc.education.state.mn.us). Free and reduced lunch is 26.5% but noticeably higher in the middle school and elementary schools, roughly 40% as a district. That difference between the high school and other schools is attributed to drop outs and enrollment in the Runestone Alternative Learning Center. The special education population is 16%. To help students who do not qualify for special education, but struggle to do well academically, there is a program called REACH where teachers have students in a class period for support and mentoring.
AAHS is a new school that was built in 2014. It is a state of the art facility in regards to technology and design. All students have a Chromebook in grades 9-12 and we use the Learning Management System (LMS) of Schoology in our classrooms. With the integration of chromebooks, the plan is to sequentially reduce our paper usage, possibly to the point that our classrooms will become paperless. A paperless classroom can be overwhelming for some students and teachers. Students have had Chromebooks for three years by the time this research had occurred. In my class and other teacher’s classes, students have used digital assessments with the same platform I have used, but whether digital and paper are comparable had not been explored. Students take a standardized digital assessment about once a year when they take their state standardized test called the Minnesota Comprehensive Assessment (MCA). At the completion of Biology, students will take the Biology MCA. As my school, and many other schools, move towards a paperless classroom and standardized testing becomes digital, it made me question if there is a difference between the two types of assessment in regards to student achievement and attitudes. The primary goal of this project was to evaluate what the effect of the format in assessment between paper and digital has on student’s ability to show their understanding. The secondary goals include how do students initially perceive digital and paper assessment, how do their viewpoints change throughout the transition, and how much instructor time is devoted to each type of assessment.

**CONCEPTUAL FRAMEWORK**

When comparing the platforms of paper and digital assessment, there are differences; one of those differences is the speed of completion of the test. In one
experiment that involved two tests with the same content in a paper format and a digital format. Participants were measured by comparing the average scores of each group, and the amount of time it took to complete. There was no significant difference in the score obtained for students taking either test. There was a difference in the amount of time required to take the tests. It took on average three minutes less to take the digital test than the paper-and-pencil test (Bodman and Robinson, 2004).

There are advantages and disadvantages to using digital assessment instead of paper assessment. An advantage for teachers in the transition from paper to digital assessment was found in a study interviewing teachers after the integration of digital assessment. Three themes emerged from the interviews. First, the process of grading student assessment was reduced by approximately 50% compared to the paper assessments. Secondly, the teachers perceived the grading of the tests to be fairer, citing the ability to read students written answers and a reduction of fatigue while correcting papers. Finally, the teachers claimed the chances of losing assessments were almost eliminated by storing them online (Berggren, Fili, and Nordgren, 2015).

Flexibility for students and teachers has become important as more education systems have shifted towards a blended or hybrid approach. One study investigated three different methods of assessment, and compared the results with written examinations of the same content. The three different methods of assessment consisted of an evaluation-proctored exam, an evaluation-unproctored exam, and a training-homework task. The results indicated no significant difference between students’ online assessments and paper
assessment, regardless of the delivery method (Ardid, Gomez-Tejedor, Meseguer-Duenas, & Riera, 2014).

Another advantage for students taking a digital assessment in comparison to a paper assessment is the ability for instant and varied feedback. A study investigated three different forms of feedback that instructors can utilize along with digital assessment to help student achievement. The three types of feedback include written, audio, and video feedback. Each of which was identified as a complement to digital assessment (McCarthy, 2015)

Another advantage of digital assessment compared to paper assessment is the use of rich images, videos and overall interface available in the assessment process. These upgrades allow instructors to create assessments that are more in depth, and applicable to real world situations than paper based assessment (Noyes and Garland, 2008).

In one study it was determined that students’ answers in digital assessments were of a higher quality and quantity in comparison to paper assessments. This study consisted of analyzing 10 years of other studies that compared the quantity and quality of answers between the two modes of assessment (Goldberg, Russel, & Cook, 2003)

Although digital assessment has many advantages, there are disadvantages to this alternative form of assessment. When using digital assessment, the teacher must be prepared for possible hardware or software crashes on student computers. Computer
malfunctions can lead to wasted time and a change in the perception of digital assessment by the students and the teachers involved (Noyes & Garland, 2008).

In addition to some disadvantages for teachers, there are also disadvantages for students when switching to digital assessments. Earlier it was pointed out that digital assessments took less time to complete compared to paper assessments. Interestingly, in one study it was determined reading from a screen was either slower than paper or a comparable speed (Gould, Alfaro, Finn, Haupt, & Minuto, 1987). The findings are also backed up by a study where paper based reading was found to be 12% faster than reading on a digital screen (Solak, 2013).

In another study it was found that individuals achieve a higher accuracy in reading on paper compared to a screen. This study involved having participants proofread the same papers on either a digital screen or paper. The study came to three conclusions. First, there were more proofreading errors made by participants reading from a digital screen compared to the paper. Second, fewer pages were read and proofread by individuals using digital screens compared to paper. Finally, there was a greater amount of fatigue present in individuals who used the digital screen during the testing. The authors stated this as one of the reasons for the higher number of missed errors by the digital screen readers (Wilkinson & Robinshaw, 1987).

In two different studies it was found that students taking digital assessments reported higher rates of fatigue, irritated eyes, and other issues that may make it difficult

According to another study, digital assessments are generally more difficult for students to move through different test items, either forward or backwards in the test. Depending on the set up of the test, this type of movement is sometimes not possible or too cumbersome for students to review their answers before submitting their assessment (Noytes & Garland, 2008).

Another important aspect of comparing digital and paper assessment is the preference of those involved in the process. The stakeholders involved include students, teachers, and administrators. In one study, digital assessment was implemented for two years and the stakeholders were surveyed throughout the process to determine their preference. From the student perspective, digital assessment was the most popular. Students cited a number of factors as to why they preferred digital assessment, including faster grading, quicker feedback, less stress when editing answers, a reduction in hand cramping or wrist pain, and a perceived fairness in correcting due to anonymity of the student answers. From the teachers perspective, digital assessment was also very popular. Some of the advantages cited by teachers included a fifty percent reduction in the time required to grade exams, a fairer system for grading because fatigue did not have as large of an effect on the teacher, and a smaller risk in losing exams of students because of the lack of physical copies of the exams. From the administrators’ perspective, the digital examinations were not popular. In the study, it appeared that regardless of student and teacher perceptions of digital assessment, the administration was more concerned
with the price of examination software and the time devoted to such practices. At the end of the study, much to student and teacher dismay, the administration decided to return to paper assessment (Berggren, Fili, & Nordberg, 2015). The process of building consensus among stakeholders could be an area of future research.

In another study, there were differences in preference of digital assessment by males and females. The males’ preferences were based on their perception of the effectiveness of digital assessment, while the females were motivated by the ease of use and how well the assessment would prepare them for future assessments (Terzis & Economides, 2011).

As technology becomes a larger part of the education process, it has become part of the assessment process. As outlined in the previous reading, there are advantages and disadvantages to switching from paper assessment to digital assessment. There is also the stakeholder opinion that must be accounted for when making the decision to switch. In the literature, the popularity of digital assessments cannot be overlooked when contemplating a change from paper to digital. All of these factors must be taken into consideration when making the decision of what is best for the students.

METHODOLOGY

The treatment of this study is the alteration of all formative and summative assessments from a paper format to a digital format. At the beginning of the study the students in each class were divided into two groups and given a pretest. Group A consisted of students taking paper assessments and group B consisted of students taking digital assessment. Throughout the unit, students took two formative assessments in their
respective groups. At the end of the unit, students took a summative assessment in the format chosen for them.  

Class A is the first period biology course consisting of 29 sophomore students. Of the 29 there are 26 males and 3 females. There are 12 students who qualify for special education, and two more students who are part of a program called REACH. REACH targets students that have difficulty with school but are not qualified for special education. The demographics of the room include one African American student, one Hispanic student, and 27 Caucasian students.

Class B is the second period biology course consisting of 20 sophomore students. Of the 20, there are six females and fourteen males. There are three students that qualify for special education, and three students who are part of the REACH program. All of the students are Caucasian.

Class C is the third period biology course consisting of 31 sophomore students. Of the 31, there are nine females and 22 males. There are 11 students that qualify for special education, and eight students who are a part of the REACH program. The demographics of the room include one Hispanic student and 30 Caucasian students.

Data Collection

Data collection began at the beginning of the unit on cell energy from early February until the end of February, which consisted of a total of 11 class periods. There were three distinct phases of the action research process. The first part was the pre-treatment section that consisted of the pretest, pre-Likert survey, and student interviews. The second part, the treatment phase, consisted of two formative assessments and the
final summative assessment. Students took each assessment in the format that was assigned to them. The final section, the post-treatment, consisted of the post-Likert survey and student interviews.

The research methodology for this project received an exemption by Montana State University’s Institutional Review Board and compliance for working with human subjects was maintained.

Pre-Treatment

Students were assigned into group A or group B. Student grouping by class can be found in Appendix A. The assignment was done by writing student names on slips of paper and drawing their names. This alternated so the first student chosen was in group A, the second in group B, the third in group A, and so on until all students were placed in a group. Only one student was switched groups due to being placed in the digital assessment, but had lost the privilege to use Chromebooks in class.

Students initially participated in a pre-Likert survey, which can be found in Appendix C. The purpose of this survey was to determine the baseline for sub-question two and three. Their answers were recorded and compared to the post-Likert survey. Six students were selected from each class to participate in the interviews. Half from group A and half from group B. A total of 18 students were interviewed. The students selected were the first three from each grouping from Appendix A. The questions for the student interviews can be found in Appendix H.
Treatment

All students took the pretest in the format group they were assigned. The pretest consisted of six sections with a total of 12 questions. Each section is based on a specific strand of a standard from the Minnesota State Science Standards. Data about how each student performed in each section and overall were recorded. The pretest can be found in Appendix B. The digital pretest was given using the LMS Schoology.

Following lessons on the carbon cycle and photosynthesis, the first formative assessment was given. Students were given 15 minutes to take the assessment in the format assigned to them at the beginning of the study. The results for each objective tested were recorded for each student. This formative assessment can be found in Appendix D.

The second formative assessment was given following the lesson on leaf structure and its connection to photosynthesis. Students were given 15 minutes to take the assessment in the format assigned to them at the beginning of the study. The results for each objective tested were recorded for each student. This formative assessment can be found in Appendix E.

The final part of the treatment was the summative assessment. This was conducted in the same manner as the two previous assessments except the time limit was removed. The results of each objective were recorded for each student. This summative assessment can be found in Appendix F.
Post-Treatment

The post treatment consisted of the two parts; the post-Likert survey and student interviews. The post-Likert survey was given following the summative assessment. The post-Likert survey can be found in Appendix G. Student answers on the post-Likert survey were compared to the pre-Likert survey.

The same students who participated in the initial pre-treatment were interviewed after the unit. Their answers were recorded and compared to their initial answers. The post unit interview questions can be found in Appendix H. Below, the essential questions of the project and how they are measured is displayed (Table 1).

<table>
<thead>
<tr>
<th>Focus Question</th>
<th>Pre-Treatment</th>
<th>Treatment</th>
<th>Post-Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Question: 1. What is the effect of a paperless format on student performance on assessments?</td>
<td>Pre Assessment</td>
<td>Two Formative Assessment</td>
<td>Post Assessment</td>
</tr>
<tr>
<td>Sub-Questions: 2. How do students viewpoints and their perceptions of their performance on paper and digital assessments change?</td>
<td>Pre-Likert Survey</td>
<td>Post-Likert Survey</td>
<td>Student Interviews</td>
</tr>
<tr>
<td>3. How does the instructors time devoted to correcting, and using the different forms of assessments in the classroom compare between digital and paper assessments?</td>
<td>Instructor Timing of Assessment Grading</td>
<td>Instructor Timing of Assessment Creation</td>
<td>Instructor Timing of Assessment Management (printing, gathering, etc.)</td>
</tr>
</tbody>
</table>

DATA AND ANALYSIS

The data and analysis section is separated into three sections. Each section is correlated with the questions posed in the triangulation matrix above.
Student Performance

The results of accumulating all assessments by percentage, and analysis by a two-tailed two-sample z test yielded a significant difference between paper and digital assessment ($z = 3.877$, critical value = 1.95996, $p = 0.00011$, $N = 64$). Individuals taking the same test performed better on paper assessment compared to digital assessment as shown below (Figure 1).

![Figure 1](image)

Figure 1. Student cumulative percentage scores, ($N = 64$).

The results of analyzing student posttest scores with a two-sample z test ($N=64$) yielded a significant difference between the results of paper and digital assessment ($z = 2.82788$, critical value = 1.95996, $p = 0.00409$) as shown below (Figure 2).
Figure 2. Student scores on the summative assessment, \((N = 64)\).

The results of analyzing student scores from the first quiz were analyzed using a two-sample z test \((N = 64)\). The results of the analysis yielded a significant difference between paper and digital assessment \((z = 2.51044, \text{critical value} = 1.64485, p = 0.01206)\) as shown below (Figure 3).

Figure 3. Student scores on the first quiz, \((N = 64)\).
The results of the analyzing student scores from the second quiz were analyzed using a two-sample z test \((N = 64)\). The results of the analysis yielded a significant difference between paper and digital assessment \((z = 3.80439, \text{critical value} = 1.95996, p = 0.00014)\) as shown below (Figure 4).

After interviews with students, conversations with teacher assistants, and observations of student test data, an area of interest that developed was the performance of low achieving students. Student scores were compared to their cumulative GPA in Biology from the school year. A scatterplot was composed to compare the student’s cumulative percentage for paper assessment (Figure 5) and digital assessment (Figure 6) to their Biology GPA.
Comparing student achievement by test type for students who had received below a 2.0 on a 4.0 scale, below a C average, revealed a trend that will be of focus in coming action research projects in my classroom. Students with lower GPAs scored lower on the
same assessment in a digital format compared to students taking a paper assessment (Figure 7)(Figure 8).

Figure 7. Paper assessment, students who averaged below a C average science GPA, \((N = 9)\).

Figure 8. Digital assessment, students who averaged below a C average science GPA, \((N = 15)\).
Student Perception

The pre-Likert survey was conducted to determine student initial preference to the questions of their perceived performance on digital or paper assessment and which test they preferred (Figure 9). On a 1-5 scale with a one meaning they strongly agree with the statement, and five meaning they strongly disagree with the statement. The results of the first question were, as a whole, a mean of 3.08 with a standard deviation of 0.99 ($N = 64$). The post-Likert survey of the same question indicated a mean of 3.08 and a standard deviation of 1.11 ($N = 64$). When student answers were broken into treatment (digital assessment) and non-treatment (paper assessment) there were changes in means. The pre-Likert for digital assessment was 3.37 with a standard deviation of 0.82, while the post-Likert for the same question was 3.13 with a standard deviation of 1.08 ($N = 30$). The pre-Likert for paper assessments was 2.93 with a standard deviation of 0.98, while the post-Likert for paper assessments was 3.07 with a standard deviation of 1.11 ($N = 34$). Although there was not a significant change to student preference between digital and paper assessment in the survey, most of the students during the interview and subsequent class periods voiced a negative opinion of digital assessments. One student stated, “other than seeing how I did right when I finished, I would rather have a paper test.” Another student stated, “my Chromebook always has issues, I don’t have to worry about my battery running out with a piece of paper.” The use of digital assessment does run into issues, but many of them can be compared to students not bringing a writing utensil to a paper assessment. Any instructor looking to incorporate digital assessments must be flexible, because issues will arise.
Figure 9. Student perception of performance on digital and paper assessment, \((N=64)\). A one signifies the individual performs better on digital assessments, and the five signifies the individual performs better on paper assessments.

The second question asked if students preferred digital assessments to paper assessments (Figure 10). A one indicated a strong preference towards digital assessments and a five indicated a strong preference towards paper assessments. The results of the pre-Likert survey as a whole group had a mean of 3.16 and a standard deviation of 1.24 \((N = 64)\). The post-Likert survey scores had a mean of 2.96 and a standard deviation of 1.26 \((N = 64)\). Breaking down student answers to treatment and non-treatment yielded the following results. The pre-Likert mean for digital was 3.37 with a standard deviation of 1.22 \((N = 30)\). The post-Likert score was 2.73 with a standard deviation of 1.18 \((N = \)
The pre-Likert for paper assessment was 3.03 with a standard deviation of 1.14 (N = 34) and the post-Likert for paper assessment was 3.18 with a standard deviation of 1.31 (N = 34). Some of the student’s remarked, “digital tests are difficult to move through, because with a paper I can flip the page but on the computer I have to go through so much more.” The inability to move through questions at a quicker pace, or revisit older questions easily was a common theme. This issue could be fixed with the development of newer test taking software. Another student said “I feel like I do better on paper but I probably do the same on both since they’re the same.” While a different student described “I move through digital tests really fast, I probably don’t read everything I should.” The idea that students read faster and comprehend less was also discussed in the conceptual framework (Wilkinson and Robinshaw, 1987).

![Figure 10](image.png)

*Figure 10.* Student pre- and post-likert answers to preference between digital and paper assessment, (N = 64). A one signifies a preference to digital assessment, and a five signifies a preference towards paper assessment.
Instructor Time

The three separate assessments were written with varying amounts of correcting required. The first quiz required every answer to be corrected manually for both the digital and paper assessment. The second quiz was fully graded by the testing software for the digital assessment. The final summative assessment was half manually graded and half graded by the software. The amount of time spent grading each assessment type was broken down to a mean amount of time spent grading each individual test.

The first quiz had a mean of 42 seconds per paper assessment ($N=34$), and a mean of 38 seconds for digital assessment ($N=30$). The second quiz had a mean amount of 36 seconds per paper assessment and the digital assessment had a mean of 0 seconds per assessment. The final summative assessment had a mean amount of 117 seconds per paper assessment, and a mean of 65 seconds per digital assessment. Each assessment took approximately two to three seconds to correct per point. With a fully automated assessment of 50 points, an instructor could save between 100-150 second per test (Figure 11). With a class load of 100 students, that would mean a savings of between 2.6 and 4.16 hours.
Figure 11. Instructor time devoted to correcting assessments.

INTERPRETATION AND CONCLUSION

A transition to digital assessment is more positive for instructors and students who are high and middle achievers but a negative for students who are low achievers. An instructor who incorporates digital assessment into their classroom will find a time saving approach to correcting assessments, they will be less likely to misplace their assessments, and grading can be seen as more fair. Middle and high achievers will be able to perform at an expected level regardless of the format of the assessment in front of them, they receive instant gratification from their results, and are able to make necessary adjustments to their understanding if needed by asking questions about answers they may have answered incorrectly. Low-level achievers are not able to obtain these same positives from their assessments. Instead, low-level achievers (students with a 2.0 or less science GPA) ended up scoring lower than their similar GPA counterparts on the same
test. The exact reason why low-level achievers did more poorly on digital assessments versus their peers on paper assessments is not answered in this research. However, it does lead to questions of why they do not perform as well as their peers. Some possible areas of further exploration include time it takes to complete an assessment, length of answers provided, how often students look back to previous answers, and reviewing their test before submitting.

As stated earlier, instructors do have many positives to gain by transitioning to digital assessment. However, with all of the positives, low-level students being unable to show their understanding on assessments outweighs any current benefits. Until low-level achieving students are able to consistently perform the same on digital and paper, I will not use digital summative assessments. Digital formative assessments that are short, with limited amount of reading, and do not have an impact on grades may be the only use I have for digital assessments in the near future.

The findings were surprising initially, but the surprise subsided upon further consideration. Low achieving students did not perform well on digital assessments. The research did discuss that students reading on a digital screen do read faster and comprehend less. Many of my low achieving students have low reading scores. Putting these two ideas together can help explain the disparity.

VALUE

Assessing what students know has always been an important part of education, and digital assessment is a growing part of the American education system. Many systems are making the transition to digital, including state assessments and some college
courses. These assessments are being used without enough information to determine whether their results are comparable to paper assessments. In discussions with two special education teachers who co-teach a class with me, came the idea of assessing students to discover what they know. The most important part of the assessment is the student taking the test, from this research, some lower achieving students do not perform as well on digital tests compared to similar peers taking paper tests.

All assessment scores in this research are what the students obtained. Assessments were not modified for students with IEPs before being taken, but instead were altered afterwards in conjunction with their special education teachers. Student scores reported to their gradebook were different from the scores reported in the research.

In my class, I have decided to shelve the idea of using digital assessments to assess student overall understanding. In instances where a test will be used to achieve this, I will use a paper assessment. But, as software and learning management systems improve, there could be a day when digital assessment comes back into my classroom.

Since there was a significant difference between the results of students taking paper and digital assessments, I will be repeating this experiment in the coming school year. Possible areas of future exploration include at risk students and their performance on digital assessment, speed at which students complete their tests, length of time spent on each question, different software programs to conduct the assessments, student reading scores compared to their scores on digital assessments, and comparing student performance on standardized tests (such as ACT and the MN Science MCA) that are in digital and paper format.


APPENDIX A

STUDENT GROUPINGS INTO PAPER AND DIGITAL GROUPS
Table 2
*Group A – Paper Assessment (N=40)*

<table>
<thead>
<tr>
<th>Class A Students (N=15)</th>
<th>Class B Students (N=10)</th>
<th>Class C Students (N=15)</th>
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<tr>
<td>AA1 (student interview)</td>
<td>AB1 (student interview)</td>
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Table 3
*Group B – Digital Assessment (N=40)*

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<th>Class C Students (N=16)</th>
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<tr>
<td>BA1 (student interview)</td>
<td>BB1 (student interview)</td>
<td>BC1 (student interview)</td>
</tr>
<tr>
<td>BA2 (student interview)</td>
<td>BB2 (student interview)</td>
<td>BC2 (student interview)</td>
</tr>
<tr>
<td>BA3 (student interview)</td>
<td>BB3 (student interview)</td>
<td>BC3 (student interview)</td>
</tr>
<tr>
<td>BA4</td>
<td>BB4</td>
<td>BC4</td>
</tr>
<tr>
<td>BA5</td>
<td>BB5</td>
<td>BC5</td>
</tr>
<tr>
<td>BA6</td>
<td>BB6</td>
<td>BC6</td>
</tr>
<tr>
<td>BA7</td>
<td>BB7</td>
<td>BC7</td>
</tr>
<tr>
<td>BA8</td>
<td>BB8</td>
<td>BC8</td>
</tr>
<tr>
<td>BA9</td>
<td>BB9</td>
<td>BC9</td>
</tr>
<tr>
<td>BA10</td>
<td>BB10</td>
<td>BC10</td>
</tr>
<tr>
<td>BA11</td>
<td></td>
<td>BC11</td>
</tr>
<tr>
<td>BA12</td>
<td></td>
<td>BC12</td>
</tr>
<tr>
<td>BA13</td>
<td></td>
<td>BC13</td>
</tr>
<tr>
<td>BA14</td>
<td></td>
<td>BC14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BC15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BC16</td>
</tr>
</tbody>
</table>
APPENDIX B

PRE ASSESSMENT
Pre Assessment – Cell Energy

Part A: Comparing Photosynthesis and Cellular Respiration
1. Write out the balanced equation for the following

Photosynthesis

\[ \text{ } + \text{ } \rightarrow \text{ } + \text{ } \]

2. Where in the cell does cellular respiration occur?

3. “Who” performs photosynthesis?

Part B: Structures of Leaves and Photosynthesis

4. Identify the following structure and their function

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>

Part C: Understanding Factors that Affect Photosynthesis
5. Which of the following can be used to measure the rate of photosynthesis?
   a. Light intensity
   b. Temperature
c. Oxygen production  
d. CO₂ level

6. Look at the graph to the right and select the proper claim.
   a. A decrease in light intensity will increase oxygen flow
   b. A decrease in oxygen flow will increase light intensity
   c. An increase in light intensity will increase oxygen flow
   d. An increase in oxygen flow will increase light intensity

Part D: Comparing Fermentation to Cellular Respiration
Circle the correct answer for the statements in question 1 and 2 below. Your choices are in brackets.

7. Organisms that lack oxygen are getting their energy under [ aerobic / anaerobic ] conditions.

8. Organisms that have oxygen are getting their energy under [ aerobic / anaerobic ] conditions.

Part E: Understanding Cellular Respiration
9. Jim is exercising on a treadmill, what substances do his cells need to continue cellular respiration?

Part F: Connections to the Carbon Cycle
10. Carbon will _________.
    a. Flow through an ecosystem
    b. Cycle through an ecosystem
    c. Both A and B
    d. None of the above

11. Carbon moves from the atmosphere to plants through what process?

12. Carbon moves from organisms to the atmosphere through what process?
APPENDIX C

PRE-LIKERT SURVEY
Pre-Likert Survey for Biology – Cell Energy Unit

Mark the area that best answers your feelings about the statement.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I perform better on digital assessments than on paper assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I prefer digital assessments more than paper assessments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I prefer to read material on a digital screen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

PAPER FORMATIVE ASSESSMENT – CELL ENERGY
Part A: The “Big Picture” of the Cell Energy Cycle
The picture below shows the Cell Energy Cycle. Write the following terms in the correct place on the diagram below. (10 points)

- mitochondria
- (C₆H₁₂O₆)
- chloroplast
- light energy
- CO₂
- O₂
- H₂O
- cellular respiration
- photosynthesis
- Glucose
- ATP

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Part B: Comparing Photosynthesis and Cellular Respiration

1. Using the completed diagram from the first page to help you, write out the balanced equations for the following! (10 points)

   A. Photosynthesis

      _______ + _______ + _______   ------------->   _______ + _______

   B. Cellular Respiration

      _______ + _______   ------------->   _______ + _______ + _______

2. Fill in the blanks in the following table. (6 points)

<table>
<thead>
<tr>
<th>Photosynthesis</th>
<th>Cellular Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Where (in the cell) does this take place?</td>
<td></td>
</tr>
<tr>
<td>B. “Who” (what organisms) performs this process?</td>
<td></td>
</tr>
<tr>
<td>C. Function: Why is the process important?</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX E

DIGITAL FORMATIVE ASSESSMENT – CELL ENERGY
Question 1 (10 points)

Part A: The "Big Picture" of the Cell Energy Cycle

The picture below shows the Cell Energy cycle. Write the following terms in the correct place on the diagram below. (10 points)

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ______</td>
<td>a. Light Energy</td>
</tr>
<tr>
<td>2. ______</td>
<td>b. Water or H₂O</td>
</tr>
<tr>
<td>3. ______</td>
<td>c. Chloroplast</td>
</tr>
<tr>
<td>4. ______</td>
<td>d. ATP</td>
</tr>
<tr>
<td>5. ______</td>
<td>e. Carbon Dioxide or CO₂</td>
</tr>
<tr>
<td>6. ______</td>
<td>f. Cellular Respiration</td>
</tr>
<tr>
<td>7. ______</td>
<td>g. Glucose or C₆H₁₂O₆</td>
</tr>
<tr>
<td>8. ______</td>
<td>h. Mitochondria</td>
</tr>
<tr>
<td>9. ______</td>
<td>i. Photosynthesis</td>
</tr>
<tr>
<td>10. _____</td>
<td>j. Oxygen or O₂</td>
</tr>
</tbody>
</table>
Question 2 (12 points)

Part B: Comparing Photosynthesis and Cellular Respiration

1. Using the completed diagram from the first page to help you, write out the balanced equations for the following.

   (12 points)

   **Photosynthesis**
   
   \[ \underline{________} + \underline{________} + \underline{________} \rightarrow \underline{________} + \underline{________} \]

   **Cellular Respiration**
   
   \[ \underline{________} + \underline{________} \rightarrow \underline{________} + \underline{________} + \underline{________} \]

   **Balanced Equation (do not fill in \( \rightarrow \) \underline{________} \underline{________})**

   Blank 1:
   Blank 2:
   Blank 3:
   Blank 4:
   Blank 5:
   Blank 6:
   Blank 7:
   Blank 8:
   Blank 9:
   Blank 10:
   Blank 11:
   Blank 12:

Question 3 (6 points)

Fill in the blanks in the following table. (6 points)

| A. Where (in the cell) does this take place? | Photosynthesis | Cellular Respiration |
| B. “Who” (what organisms) perform this process? | | |
| C. Function: Why is the process important? | | |

Blank 1:
Blank 2:
Blank 3:
Blank 4:
Blank 5:
Blank 6:
APPENDIX F

PAPER FORMATIVE ASSESSMENT – LEAF ANATOMY
FA/Quiz: Leaf Anatomy & Structure/Function

Word Bank:

- Chloroplasts
- Waxy layer/cuticle
- Guard Cells
- Xylem
- Phloem
- Epidermis
- Palisade Layer
- Spongy Layer
- Stoma/stomata

Part A: Identifying structures of the leaf
Using the word bank above, write the name of the structure on the lines provided below. (7 points)
Part B:
Using the word bank on the first page, write the correct structure in the blanks provided. (9 points)

<table>
<thead>
<tr>
<th>Leaf Structure/Anatomy</th>
<th>Structure Function – What it does…</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transports WATER and minerals TO the leaf</td>
</tr>
<tr>
<td></td>
<td>The cell part/organelle that contains the green pigment chlorophyll</td>
</tr>
<tr>
<td></td>
<td>The transparent protective layers that allows light to pass through</td>
</tr>
<tr>
<td></td>
<td>Transports FOOD/SUGARS FROM the leaf to the rest of the plant</td>
</tr>
<tr>
<td></td>
<td>Tightly packed cells filled with chloroplasts and thus is the primary site of photosynthesis</td>
</tr>
<tr>
<td></td>
<td>Changes in the amount of water in these cells can change their shape causing an opening for gas exchange</td>
</tr>
<tr>
<td></td>
<td>Covers the leaf’s surface and prevents excessive water Loss</td>
</tr>
<tr>
<td></td>
<td>Pores that open and close for gas exchange. (CO₂ in &amp; O₂ out); plants also lose water through these structures during transpiration</td>
</tr>
<tr>
<td></td>
<td>Large air spaces with loosely packed chlorophyll containing cells. Functions include gas exchange &amp; some photosynthesis.</td>
</tr>
</tbody>
</table>

**Part C:**
Beneath each part of the photosynthesis equation below, write ONE leaf part involved in getting the plant that molecule, storing that molecule, or releasing the molecule. (4 points)

\[
6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{Light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2
\]
APPENDIX G

DIGITAL FORMATIVE ASSESSMENT – LEAF ANATOMY
Question 1 (7 points)

Part A: Identifying Structures of the Leaf

Using the word bank provided, write the name of the structure on the lines provided below. (7 points)

1. ________
2. ________
3. ________
4. ________
5. ________
6. ________
7. ________

Word Bank:
Waxy Layer/Cuticle  Xylem  Phloem  Stomata  Guard cells  Epidermis  Chloroplasts  Spongy layer  Palisade layer

Blank 1: 
Blank 2: 
Blank 3: 
Blank 4: 
Blank 5: 
Blank 6: 
Blank 7: 
Question 2 (5 points)

Part B:
Beneath each part of the photosynthesis equation below, write ONE leaf part involved in getting the plant that molecule, storing that molecule, or releasing that molecule. Pick your choice from the word bank below.

\[
\begin{align*}
6 \text{ CO}_2 & + 6 \text{ H}_2\text{O} & + \text{ Light Energy} & \rightarrow \text{ C}_6\text{H}_{12}\text{O}_6 & + 6 \text{ O}_2 \\
1 & & & 2 & 3 & 4 & 5
\end{align*}
\]

Word Bank:
- Palisade Layer
- Waxy Layer
- Guard Cell
- Stomata
- Palisade Layer
- Spongy Layer
- Chloroplast
- Chloroplast
- Chloroplast
- Phloem
- Palisade Layer
- Palisade Layer
- Guard Cell
- Chloroplast
- Epidermis
- Spongy Layer
- Stoma
- Xylem

Blank 1:

Blank 2:

Blank 3:

Blank 4:

Blank 5:
**Question 3 (9 points)**

**Part C:**
Using the word bank provided, write the name of the structure on the lines provided below. (9 points)

<table>
<thead>
<tr>
<th>Leaf Structure/Anatomy</th>
<th>Structure Function - What it does...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. __________</td>
<td>Transports WATER and minerals TO the leaf</td>
</tr>
<tr>
<td>2. __________</td>
<td>The cell part/organelle that contains the green pigment chlorophyll</td>
</tr>
<tr>
<td>3. __________</td>
<td>The transparent protective LAYERS that allow light to pass through</td>
</tr>
<tr>
<td>4. __________</td>
<td>Transports FOOD/SUGARS from the leaf to the rest of the plant</td>
</tr>
<tr>
<td>5. __________</td>
<td>Tightly packed cells filled with chloroplasts and thus is the primary site of photosynthesis</td>
</tr>
<tr>
<td>6. __________</td>
<td>Changes in the amount of water in these cells can change their shape causing an opening for gas exchange</td>
</tr>
<tr>
<td>7. __________</td>
<td>Covers the leaf’s surface and prevents excessive water loss</td>
</tr>
<tr>
<td>8. __________</td>
<td>Pores that open and close for gas exchange. (CO₂ in, and O₂ out) Plants also lose water through these structures during transpiration</td>
</tr>
<tr>
<td>9. __________</td>
<td>Large air spaces with loosely packed chlorophyll containing cells. Functions include gas exchange and some photosynthesis</td>
</tr>
</tbody>
</table>

**Word Bank:**
Stomata/Stoma  Palisade Layer  Chloroplast  Epidermis  Waxy layer/cuticle  Phloem  Guard Cells  Xylem  Spongy layer
APPENDIX H

PAPER SUMMATIVE ASSESSMENT
Test: The Carbon Cycle, Cellular Energy, Photosynthesis and Cellular Respiration
Part A: Comparing Photosynthesis and Cellular Respiration
1. Write out the balanced equations for the following. (10 points)

A. Photosynthesis
   _______ + _______ + _______ ------------------> _______ + _______

B. Cellular Respiration
   _______ + _______ ------------------> _______ + _______ + _______

2. Fill in the blanks in the following table. (6 points)

<table>
<thead>
<tr>
<th></th>
<th>Photosynthesis</th>
<th>Cellular Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Where (in the cell) does this take place?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. “Who” performs this?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Function/importance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Part B: How are the structures of a leaf related to the process of photosynthesis?
Identify the labeled structures in the leaf below and state how they help a plant maintain homeostasis during photosynthesis. (10 points)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>
Part C: Understanding factors that affect photosynthesis

1. Which of the following can be used to measure the rate of photosynthesis?
   A. light intensity  B. oxygen production  C. temperature  D. CO₂ level

2. If chlorophyll were red instead of green, making plants red in appearance, which color of light would you expect to produce the LOWEST rate of photosynthesis?
   A. White light  B. Blue light  C. Red light  D. Green light

3. The graph at the right was produced by a student trying to answer the question “How does light intensity affect the rate of photosynthesis?” After examining the graph, write a claim to answer the question, discuss the evidence that supports your claim and provide a reason that explains the evidence. (3 points)

Part D: Comparing Fermentation to Cellular Respiration
Circle the correct answer for the statements in questions 1 and 2 below. Your choices are in brackets. (2 points)

1. Organisms that lack oxygen are getting their energy under [ aerobic / anaerobic ] conditions.
2. Organisms that have oxygen are getting their energy under [ aerobic / anaerobic ] conditions.

3. Yeast is a microorganism that is used to help bread rise and to make beer carbonated. Yeast cells can carry out both fermentation and cellular respiration, depending on whether oxygen is present or absent. In which case would you expect yeast cells to grow more rapidly and therefore do a better job of baking bread and making beer? Explain. (2 points)
Part E: Understanding Cellular Respiration
Use the information and diagram below to answer questions 1-3 below. (6 points)

A scientist set up a respiration chamber as shown. She placed a mouse into flask B. Into flasks A, C, and D, she poured distilled water mixed with an indicator - phenolphthalein. In the presence of CO$_2$, phenolphthalein turns from pink to clear. She allowed the mouse to stay in the chamber for about an hour.

1. Based on your knowledge of cellular respiration, what substance(s) would you expect the mouse in flask B to give off? What experimental evidence would support your answer?

Substance: __________________________________________________________________________

Evidence: __________________________________________________________________________

____________________________________________________________________________________

2. What will the mouse require to carry out cellular respiration? __________ + __________

3. Assume that the scientist set up an identical respiration chamber, except that in this setup she placed a mouse that had been exercising on a hamster wheel. Then the scientist measured the amount of CO$_2$ given off by both mice at the end of 15 minutes. Predict which setup produced the most CO$_2$. Explain your answer.

____________________________________________________________________________________

____________________________________________________________________________________
Part F: Making connections...the carbon cycle

1. Carbon dioxide cycles throughout the Earth system in many forms. Based on your understanding of the carbon cycle, explain how carbon moves in the following. (2 points)

<table>
<thead>
<tr>
<th>Carbon moves…</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. From the atmosphere to plants:</td>
<td></td>
</tr>
<tr>
<td>B. From living things to the atmosphere:</td>
<td></td>
</tr>
</tbody>
</table>

2. What role or influence do humans have within the carbon cycle? **List two** specific ways or actions in which humans influence the carbon cycle. **Describe how** those actions affect the carbon cycle. (4 points)

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
APPENDIX I

DIGITAL SUMMATIVE ASSESSMENT
Part A: Comparing Photosynthesis and Cellular Respiration

Question 1 (5 points)

Using the word bank, write out the equations for the following.

Photosynthesis

\[ \underline{\text{ } } + \underline{\text{ } } + \underline{\text{ } } \rightarrow \underline{\text{ } } + \underline{\text{ } } \]

Word Bank:
- Water
- Light
- Oxygen
- Sugar
- Carbon dioxide
- ATP (energy)

Blank 1: 

Blank 2: 

Blank 3: 

Blank 4: 

Blank 5: 

Question 2 (5 points)

Cellular Respiration

\[ \underline{\text{ } } + \underline{\text{ } } \rightarrow \underline{\text{ } } + \underline{\text{ } } + \underline{\text{ } } \]

Word Bank:
- Water
- Water
- Sugar
- Light
- ATP (energy)
- Carbon dioxide

Blank 1: 

Blank 2: 

Blank 3: 

Blank 4: 

Blank 5: 

**Question 3 (3 points)**

Fill in the blanks in the following table.

<table>
<thead>
<tr>
<th>Photosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Where (in the cell) does it take place</td>
</tr>
<tr>
<td>B. &quot;Who&quot; performs this?</td>
</tr>
<tr>
<td>C. Function/Importance</td>
</tr>
</tbody>
</table>

Blank 1:

Blank 2:

Blank 3:

---

**Question 4 (3 points)**

Fill in the blanks in the following table.

<table>
<thead>
<tr>
<th>Cellular Respiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Where (in the cell) does it take place</td>
</tr>
<tr>
<td>B. &quot;Who&quot; performs this?</td>
</tr>
<tr>
<td>C. Function/Importance</td>
</tr>
</tbody>
</table>

Blank 1:

Blank 2:

Blank 3:
Part B: How are the structures of a leaf related to the process of photosynthesis?

Question 5 (5 points)
Identify the labeled structures in the leaf below and state how they help a plant maintain homeostasis during photosynthesis.

<table>
<thead>
<tr>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E (opening)</td>
</tr>
</tbody>
</table>

Word Bank:
- lower epidermis
- vascular bundle
- phloem
- xylem
- guard cells
- upper epidermis
- stoma
- palisade mesophyll
- spongy mesophyll
- waxy cuticle

Blank 1:
Blank 2:
Blank 3:
Blank 4:
Blank 5:
Question 6 (5 points)

State how they help a plant maintain homeostasis during photosynthesis.

<table>
<thead>
<tr>
<th></th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
</tr>
<tr>
<td>E (opening)</td>
<td></td>
</tr>
</tbody>
</table>

Blank 1: 
Blank 2: 
Blank 3: 
Blank 4: 
Blank 5: 
Part C: Understanding factors that affect photosynthesis

Question 7 (1 point)
Which of the following can be used to measure the rate of photosynthesis?

- a. light intensity
- b. temperature
- c. oxygen production
- d. CO₂ level

Question 8 (1 point)
If chlorophyll were red instead of green, making plants red in appearance, which color of light would you expect to produce the LOWEST rate of photosynthesis?

- a. blue light
- b. white light
- c. red light
- d. green light

Question 9 (3 points)
The graph at the right was produced by a student trying to answer the question “How does light intensity affect the rate of photosynthesis?” After examining the graph, write a claim to answer the question, discuss the evidence that supports your claim, and provide a reason that explains the evidence.

Claim: ______
Evidence: ______
Reasoning: ______

Blank 1: ______
Blank 2: ______
Blank 3: ______
Part D: Comparing Fermentation to Cellular Respiration

Question 10 (2 points)
1. Organisms that lack oxygen are getting their energy under ________ conditions.
2. Organisms that have oxygen are getting their energy under ________ conditions.

Word Bank:
- anaerobic
- aerobic

Blank 1: ____________________________  
Blank 2: ____________________________

Part E: Understanding Cellular Respiration

Use the information and diagram below to answer questions below.

A scientist set up a respiration chamber as shown. She placed a mouse into flask B. Into flasks A, C, and D, she poured distilled water mixed with an indicator - phenolphthalein. In the presence of CO₂, phenolphthalein turns from pink to clear. She allowed the mouse to stay in the chamber for about an hour.

Question 11 (2 points)
1. Based on your knowledge of cellular respiration, what substance(s) would you expect the mouse in flask B to give off? What experimental evidence would support your answer?

Substance: ____________________________  
Evidence: ____________________________

Blank 1: ____________________________  
Blank 2: ____________________________
Question 12 (2 points)
What will the mouse require to carry out cellular respiration? __________ + __________
Blank 1: 
Blank 2: 

Question 13 (2 points)
Assume that the scientist set up an identical respiration chamber, except that in this setup she placed a mouse that had been exercising on a hamster wheel. Then the scientist measured the amount of CO₂ given off by both mice at the end of 15 minutes. Predict which setup produced the most CO₂. Explain your answer.
Prediction: __________
Explanation: __________
Blank 1: 
Blank 2: 

Part F: Making connections... the carbon cycle

Question 14 (2 points)
Carbon dioxide cycles throughout the Earth system in many forms. Based on your understanding of the carbon cycle, explain how carbon moves in the following. (2 points)
<table>
<thead>
<tr>
<th>Carbon moves...</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. From the atmosphere to plants:</td>
<td></td>
</tr>
<tr>
<td>B. From living things to the atmosphere:</td>
<td></td>
</tr>
</tbody>
</table>
Blank 1: 
Blank 2: 

Question 15 (4 points)
What role or influence do humans have within the carbon cycle? List two specific ways or actions in which humans influence the carbon cycle. Describe how those actions affect the carbon cycle. (4 points)
APPENDIX J

POST-LIKERT SURVEY
Post Unit Likert Survey - Biology

Mark the area that best answers your feelings about the statement.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I perform better on digital assessments than on paper assessments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I prefer digital assessments more than paper assessments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I prefer to read material on a digital screen.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX K

STUDENT INTERVIEWS
Students Interview Questions – Biology

1. How was your experience with your assessment format?
2. What did you like about your assessment?
3. What did you dislike about your assessment?
4. How did you think you performed? Compared to the other assessment?
5. Which assessment would you prefer to have in our class?