THE IMPACT OF TESTING FORMAT AND REFLECTION ON STUDENT PERCEPTIONS OF SCIENCE

by

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ABSTRACT

Part of education is assessment of student content knowledge. For years, this has been conducted using a standard set of question types organized by type which makes data analysis and interpretation cumbersome. The purpose of this study was to investigate whether question organization of summative assessments would impact student performance and perception of performance. Additionally, does teacher led item analysis of assessment results impact student perception of their science content knowledge. Students were assessed at the end of the first two units of the year, ecology and cells, with questions ordered by type and topic respectively. Following each test, students completed feedback and Likert surveys along with teacher-led item analysis. The results indicated that student perceptions improved with item analysis, however performance and perception of performance were independent of the organization of test questions. This action research showed that teacher-led item analysis can provide valuable insights for students and that the organization of test questions does not impact performance, but it does provide insights to both the educator and the student.

INTRODUCTION AND BACKGROUND

Project Background

Throughout my seven years as educator, I have observed that self-reflection and perception are vital to success in school. After students take tests they are given feedback on their performance in the form of a grade, however, this does not show students areas in which they did well or those in which they need to improve. This method of communicating results is not consistent with a growth mindset and instead tends to cause students to shut down. If students are given the opportunity for more detailed feedback as well as areas for improvement their perception of their scientific abilities may improve. Several former students stated they enjoyed science, but were convinced that they were "bad at it" because their test grades were consistently 70% or lower. My perception was that what was really happening was a misunderstanding of a few concepts, but overall a strong understanding of the subject as a whole.

In my experience, most of my students get a test back, look at their score, and immediately judge their performance by saying they did "great" or "bad." They then connect this label to themselves and their abilities in science and/or school. Although a score may be "low," that does not mean a student did not understand all the concepts tested. Instead, typically a student struggled with one or two topics. Occasionally, there are students who recognize this on their own and have the perception of "I will do better next time."

In the 2016 – 2017 school year, I started using Interactive Science Notebooks at Whitefish Middle School and decided to allow students to use them for their tests. A few

students were ecstatic and used them consistently. However, I noticed that most students never even opened them during a test. I was disappointed and asked why. They commented that even when they opened the notebook they were not sure where to look and that the order of the questions caused them to constantly flip pages and move back and forth. One student stated that it was not worth it, because he believes he would still do "bad." I think this happens because students are anxious during tests and they are concerned that using a notebook is form of cheating or that it will slow them down.

During the 2016 – 2017 school year, I was part of a book study reading "Grading Smarter, Not Harder: Assessment Strategies That Motivate Kids and Help Them Learn," by Myron Dueck (2014). As I read and discussed this book with my colleagues, I realized that the heart of the matter is that our current assessment strategy does not give students a chance to reflect on what they know, learn from it, and make goals for the future. I decided at that point to modify a few of Dueck's strategies for my classroom assessments with the intention of improving student perceptions and recognition of scientific knowledge and performance in science.

The following primary question was addressed in this Action Research (AR), How does assessment formatting influence student recognition and perception of their knowledge of scientific concepts? With secondary questions focusing in on the following details: 1) How does test format influence student performance and perception of performance? and 2) How does the completion of item analysis impact student perception of their science knowledge?

School Demographics

Bigfork Elementary and Middle School, is nestled in the Flathead Valley in Northwestern Montana. Flathead Lake, the Swan Mountain Range, and Glacier National Park are part of the incredible community in which we live and learn. For the 2017 – 2018 school year 565 students were enrolled in grades kindergarten through eighth grade. Of this population, 41% receive free or reduced lunch. The seventh grade was comprised of 65 students divided into three classes for the core subjects of English, Mathematics, Social Studies, and Science. Thirty-five of the students were female and 30 were male. Eight of the students have an individualized education program (IEP) and have access to the resource room for support. Within our community there is also a Hispanic population that fluctuates in size throughout the year. I have several students who primarily speak Spanish at home, however they are not English Language Learner students.

CONCEPTUAL FRAMEWORK

Education is essentially a cycle of learning and assessment of that learning. Just as scientists modify their work based on the results of their studies, teachers and students modify their methods of teaching and learning based on assessments. Angelo and Cross agree saying, “the central purpose of Classroom Assessment is to empower both teachers and their students to improve the quality of learning in their classroom” (1993, p. 4). Learning and teaching will not improve without the use of a cycle, just as scientists will not gain new insights without following scientific practices. In both cases reflection, evaluation, and modification are necessary.

Purpose of Education and Assessment

DuFour (2015) posed the question, "Are we here to ensure students are taught, or are we here to ensure our students learn?" (p. 103). Most educators would agree that the purpose of teaching is to help students learn. If that is the case, assessment is an essential part of that process and should be used as a learning experience. In daily life, it is uncommon for individuals to be expected to show what they know on a specific day with no chance of trying again, however in classrooms across the country this is common (Dueck, 2014). An all or nothing approach shuts down student engagement and encourages the practice of looking at a grade, making a judgement about what it means, and recycling the assignment or shoving it into the depths of a locker of backpack (Jackson, 2009).

Assessment Stakeholders

Stiggins (2017) comments that

> It has not been our convention to include students in our list of assessment users. But, as it turns out, they pay attention to the evidence of their own learning success and make crucial decisions based on their interpretation of their own assessment results. These decisions can have long-lasting consequences (p. 29).

So how do educators shift the focus from a grade to a process of learning? To change this mindset, teachers must adjust how feedback and grades are provided.

Assessment and grading are "less about delivering a grade than about delivering timely, accurate, and specific feedback" (Dueck, 2014, p. 4). Stiggins (2017) mirrors this belief saying, "Gross domain sample test scores alone won't help learners much either. To figure out how to do better next time, students need feedback that contains more specific information than they're currently receiving" (p. 23). Wiliam (2011) highlights

that “once a grade is received, learning stops” (p. 123). However, when a student receives feedback they have the opportunity to improve and gain a better understanding of how their grades reflect what they know and are able to do. Jackson (2009) recommends the use of grade tracking sheets, portfolios, peer feedback, and action plans for students to collect and analyze data about their own learning. Dueck’s testing sequences mirror this process of assessment and feedback with students taking the assessment, completing test tracking sheets, analyzing the data, and using the data to inform their next steps. “Master teachers help students collect and analyze their own data and understand what their grades really mean” (Jackson, p. 129). Additionally, students should ask themselves, “What comes next in my learning? and Can I master it?” their answers will determine if learning continues or stops (Stiggins, p. 45). This is precisely what Dueck’s test tracking and feedback forms are designed to do.

Traditional Assessment

Traditional testing formats begin with multiple-choice and end with essay questions. While this formatting works well, Dueck argues that it can be improved for the purpose of providing teachers and students with valuable feedback (2014). When tests are arranged according to topic, patterns of misconceptions are easier to pick out than when the question topics are blended (Dueck, 2014). These patterns can then influence how teachers modify their lessons for future students and their plans for re-teaching or providing feedback for students. For students, the pattern on their test may reveal sections where mastery of the material is demonstrated and sections where further learning is necessary. Although a student may receive an overall grade of less than 70% and be very

discouraged, this process of tracking and analysis sheds light on areas that the student knew well.

Self – Assessment

McMillan (2017) points out, "Self-assessment is needed to provide self-direction, self-reflection, self-determination, and monitoring. Self-efficacy, a belief in being able to be successful, is essential for motivation and engagement in learning" (p. 6) It is not enough for a teacher to simply give a test and put a grade on it; effective feedback is also necessary. Susan Brookhart (2008) argues that specific and meaningful feedback will encourage students to self-assess their learning resulting in increased engagement and confidence. Stiggins (2017) comments, "ongoing self-assessment of their own success generates the evidence they need for self-correction" (p. 59) Therefore, a combination of specific feedback and self-assessment are required for student motivation and the creation of life-long learners.

Science Notebooks

"When learners are given the opportunity to explain and reason using their own creative skills, they are better able to demonstrate evidence of learning" (Dueck, 2014, p. 121). An interactive science notebook (ISN) is a place for notes, lab activities, and readings along with creative expressions of student's interactions with the content (Young, 2003). As students record what they have done in their ISN, it becomes "evidence not only of what they know but also of how they know it" (Marcarelli, 2010, p. 4). This evidence can then be used in student reflections of what they know and how they can improve their learning following an assessment.

Marcarelli (2010) tells the story of a student named Jason who relied on his notebook. She comments that having an ISN instead of traditional loose-leaf assignments meant that "Jason had it in front of him, and he used it, which made him feel smart, and helped him draw conclusions" (p. 16). This highlights the process of metacognition and the benefits of student ownership of their learning.

Open Book Tests

With today's technology, the world is literally at your fingertips. If you have a question, simply ask Siri, Alexa, or Google and you will almost instantly have the answer. Therefore, "closed book tests do not accurately reflect the nature of our information age" (DuFour, 2015, p. 44). Chris Kesler (2017) agrees giving five reasons why teachers should give open notes tests: 1) in the real-world people can look up the answers whenever, 2) empower students, 3) encourages better note taking, 4) forces teachers to write better assessments, and 5) makes students resourceful. When a student is given the opportunity to use their skills of resourcefulness and organization it empowers them to be more successful. That feeling of being successful leads to many beneficial side-effects including a shift in how the student perceives themselves.

Restructuring tests such that questions are grouped by content allows students to focus their thinking and more effectively use their interactive science notebook as they are testing.

Growth Mindset

Failure and mistakes are opportunities for learning; however, many individuals take them to heart and use them to make statements about themselves like "I'm stupid."

or “I will never understand this concept.” Carol Dweck (2016) noticed that some children have a different response and see challenges and failure as fun. “In fact, they didn’t even think they were failing. They thought they were learning” (p. 4) This perception allows students to persevere even when nothing seems to be going right. When a student receives a poor grade, at least from their perspective, there are two ways to handle it. The first is to say or think that they are dumb, they should have expected that grade, and there is nothing they can do about it. This, according to Dweck, represents a fixed mindset in which no amount of practice or effort will change the outcome. The second way, is to say or think “I made some mistakes, but I can learn from them.” This represents a growth mindset, a belief that improvements can be made to our knowledge and abilities.

In a classroom, this plays out each day. Students with a fixed mindset tend not to take risks and instead play it safe, sometimes even refusing to participate in an activity if it stretches their knowledge. On the other hand, students with a growth mindset dive into the challenging activities and even ask for more (Dweck, 2016). As teachers, our goal is to encourage students to learn how to learn even when it is challenging. Perseverance is necessary in our 21st century world of problems to solve. The answers to today’s challenges will not be easy and failure is a very real possibility. Thus, it is important to encourage students to develop a growth mindset through self-reflection and goal setting. In middle school this is a real turning point for many students and Carol Dweck sums it up perfectly saying,

> Adolescence, as we’ve seen, is a time when hordes of kids turn off to school. You can almost hear the stampede as they try to get as far from learning as possible. This is a time when students are facing some of the biggest challenges of their young lives, and a time when they are heavily evaluating themselves, often with a

> fixed mindset. It is precisely the kids with the fixed mindset who panic and run for cover, showing plummeting motivation and grades (Dweck, 2016, p. 228).

Assessment in education has many stakeholders who depend on the results to inform their decisions. For many years students have been left out of the conversation, however they want to be involved in their own education. Students often feign disinterest to protect themselves from being hurt but given the chance to gain understanding and learning from their assessments they may surprise us. In order for students to buy in to assessments, they need to be relevant and realistic to what adulthood will be like, challenging, and the results need to be accessible, not just in an abstract numerical format but also with a way to improve and grow.

METHODOLOGY

The purpose of this study was to assess the effect of test organization and reflection on student attitudes towards science and answer the following questions How does assessment formatting influence student recognition and perception of their knowledge of scientific concepts? With secondary questions focusing in on the following details: 1) How does test format influence student performance and perception of performance? and 2) How does the completion of item analysis impact student perception of their science knowledge?

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 (Appendix A).

Data collection began in November 2017 and ended in January 2017. This spanned two units, Ecology and Cells to Systems. Our year began with Ecology which

included a field trip to Glacier National Park regarding Fire Ecology, notes, labs with and without graphical data analysis, the use of models, hands on activities, the use of foldables in an interactive science notebook (ISN) and writing an "AHA Thesis" in which they summarized what they learned in our unit (Appendix B). In December, we began our Cells to Systems unit with notes, microscope labs, hands on activities, foldables within the ISN, and model designing and building. For the Cells to Systems unit, the "AHA Thesis" was written after their test on cells whereas in the Ecology unit, it was written prior to their test.

All 65 seventh-grade science students at Bigfork Middle School were tested at the end of their Ecology Unit using a traditional open notebook test format, sorted by question type with no regard for sorting by topic (Appendix C). Midway through the Cells to Systems Unit, the same group of students were tested using a nontraditional open notebook testing format in which questions are sorted by topic rather than question type (Appendix D). Both assessments consisted of 40 questions with some matching, true/false, and multiple choice. Many questions were derived from released items from the Montana Criterion Referenced Test for Science. During the assessments, I observed student behaviors and recorded their use of notebooks.

After the assessments, students were administered a "Test Feedback Survey" (Appendix E). Once tests were graded, students completed "Test Tracking Sheets" for item analysis and reflection on their scientific knowledge and understanding (Appendix F). In addition, a Likert Survey was administered (Appendix G) and follow-up interviews were completed with six students to address their feelings and beliefs about the testing

formats, test tracking sheets, and scientific abilities (Appendix H). Students were selected using stratified sampling in which two high, two average, and two low achievers were chosen interview.

Table 1 data matrix organizes the various data collection methods with regard to the different research questions addressed in this AR.

Table 1
Data Triangulation Matrix

Question	Unit Assessments	Test Tracking Sheets	Test Feedback Sheets	Likert Surveys	Interviews	Observations
How does test format influence student performance and perception of performance?	x	x	x	x	x	x
How does the completion of item analysis impact student perception of their science knowledge?		x	x	x	x	

Unit assessments were used to address if the format of tests influences student performance. Both assessments were 40 questions and taken by all students. Results were compared using a paired T-test to determine if the averages were statistically significant.

With the "Test Feedback Survey," I addressed the sub question, "How does test format influence student performance and perception of performance?" Immediately following each test, students completed a survey regarding their study habits and perception of how they performed on the test. All 7th grade students completed the survey during class time. The timing of the survey was important such that it occurred

before students completed the test tracking sheets, so student responses were not influenced by the insights gained by completing item analysis. The survey consisted of a combination of Likert scale style and open-ended questions.

In my data analysis, I tabulated all of the responses using Microsoft Excel for the Likert style questions and grouping for open-ended questions. Graphs comparing students who studied vs. those who did not, student perception of how well they did, and feelings during the tests will be used along with student scores on the tests to examine how student perception compares to actual performance.

The Likert Survey addressed the questions, “What is the impact of student completed item analysis on student perception of their science knowledge?” and “How does test format influence student performance and perception of performance?” I administered the Likert survey to each of the students in the 7th grade class during our meeting times after students completed their tests and “Test Tracking” item analysis. Students recorded their responses to the survey on ZipGrade answer sheets to aid in the analysis of the data. However, participation was heavily impacted by attendance with 54 taking the initial survey and 40 taking the post survey.

In addition to graphs, student responses were converted to numerical scores such that positive responses are a 1, undecided responses are a 3, and negative responses are a 5. This allowed me to examine overall class averages and standard deviations in response to each question. I also looked at the relationship between student grades and attitudes towards science. However, the results may be impacted by the different topics that are covered on the exams as well.

Interviews were conducted within one week of completing the final set of surveys at times that were convenient for both the students and myself. I recorded notes from our interviews. The data was analyzed using emergent thematic analysis in which similar responses were grouped and patterns were recorded.

DATA AND ANALYSIS

Data was collected throughout my AR beginning with our first assessment of the year. After the ecology assessment 55 students completed the Likert survey, 61 completed the test feedback form, and 65 completed the test tracking sheet. Our second assessment saw reduced participation in surveys with 50 completing the test feedback form, 40 completing the Likert survey, and 63 completing the test tracking sheet. This data was used to examine how the formatting of assessments influences student perception of their understanding as well as their actual scientific understanding. I also examined how test tracking impacted student perceptions of their knowledge.

Student performance was significantly less under the treatment than during the traditional assessment ($N=65$). The average test score for the Ecology unit was 77.3% with a standard deviation of 13.1 and the average test score for Cells was 68.3% with a standard deviation of 14.1. A paired t-test gives a t Stat of 8.4 which indicates that the difference in means is not zero. The p-value for this test was 5.7×10^{-12} indicating that the means are statistically significant. A paired box and whisker plot supports this as well showing a 10-point difference in medians with a similar range of scores, 32.5 to 100 for Ecology and 35 to 97.5 for Cells (Figure 1).

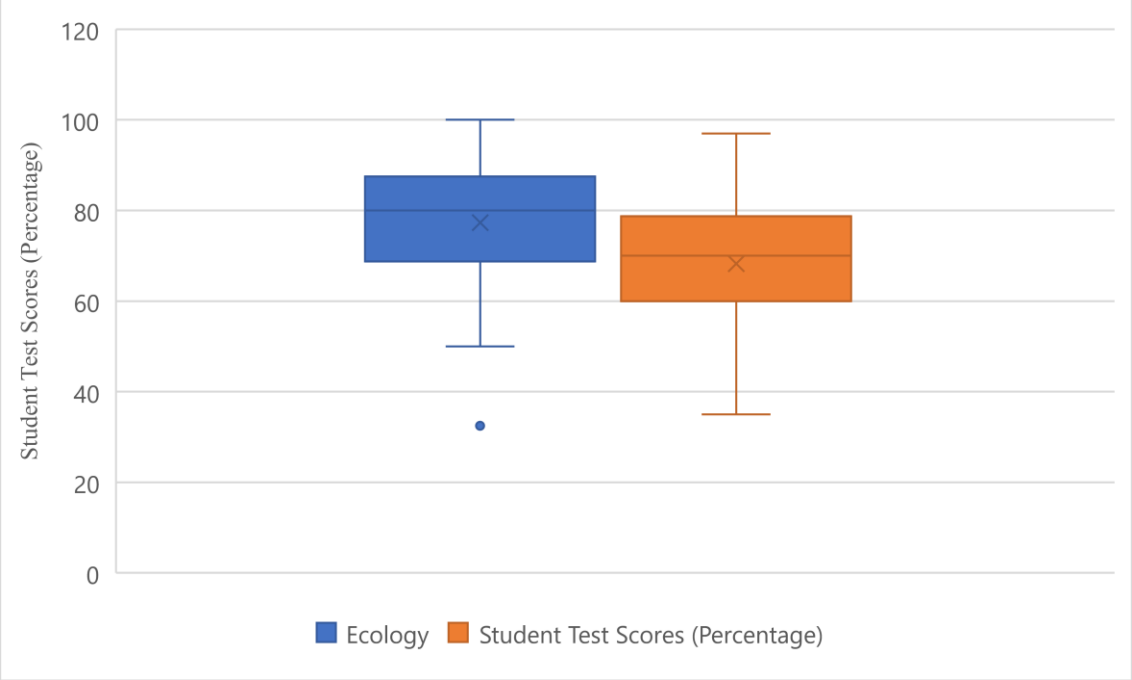

Figure 1. Student test scores for each unit, (*N*=65).

In both units, student perception of knowledge and performance were related. The students I interviewed commented that when they felt prepared and knew the content they did well on their test. Figure 2 shows the responses of students to the statement "I felt prepared for this test." on the Test Feedback Survey. Sixty-three percent of the students agreed or strongly agreed that they felt prepared for the Ecology test, while only 52 percent of students agreed that they felt prepared for the Cells test. This made the average score 2.3 for ecology and 2.62 for cells. Confirming a downward shift in confidence going into the test. However, overall students felt prepared. This corresponds with the differences seen between the average scores on both exams.

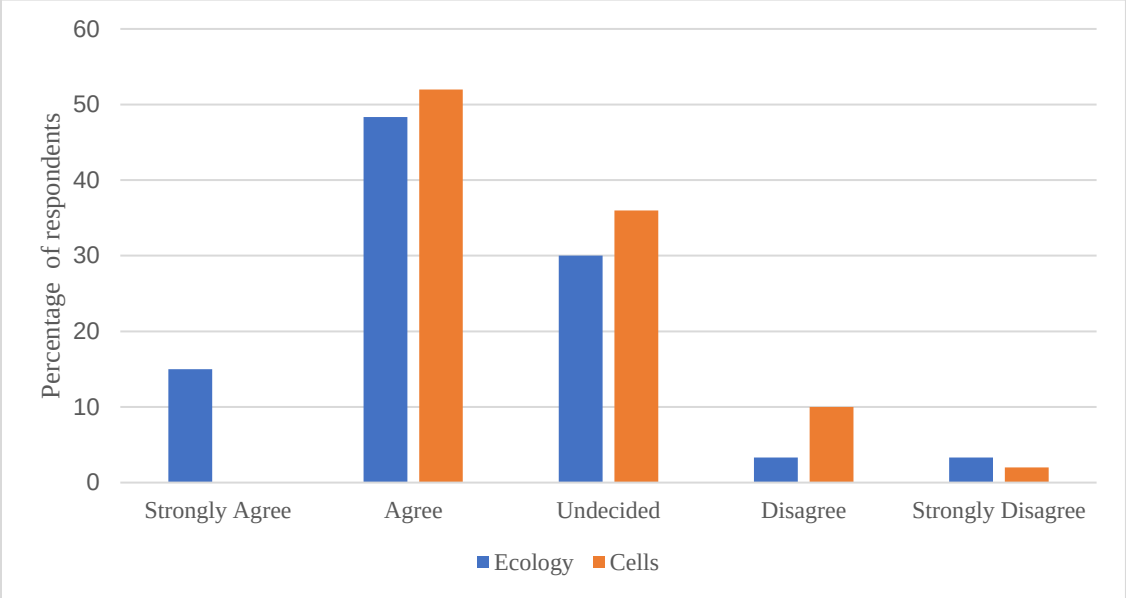

Figure 2. Students who felt prepared for the unit test, (Ecology *N*=60, Cells *N*=50).

In our interviews, one student commented that he felt more prepared for the Ecology test because we had done the AHA thesis prior to taking the test and he already had some background knowledge about ecosystems from earlier grades. Another student commented that they had covered food chains in fourth grade, so she felt more comfortable with Ecology. When asked if the formatting had anything to do with how prepared they felt, all six responded "no." One student commented, "I liked the formatting of the cells test better, but I still felt less prepared for it. I forgot everything over Christmas Break." Another student said, "I don't care how the questions are arranged, I just felt better during the Ecology test."

After the cells test, most students either strongly agreed or agreed (57%) that they know what concepts are challenging for them on the Likert Survey. While only 49% strongly agreed or agreed with the statement after the ecology test (Figure 3). The majority of the remaining responses in both cases were undecided. One student I

interviewed explained that she knew what concepts she understood well on the cells test because those sections were easier to follow, but during the ecology test she wasn't sure how the questions were connected by topic.

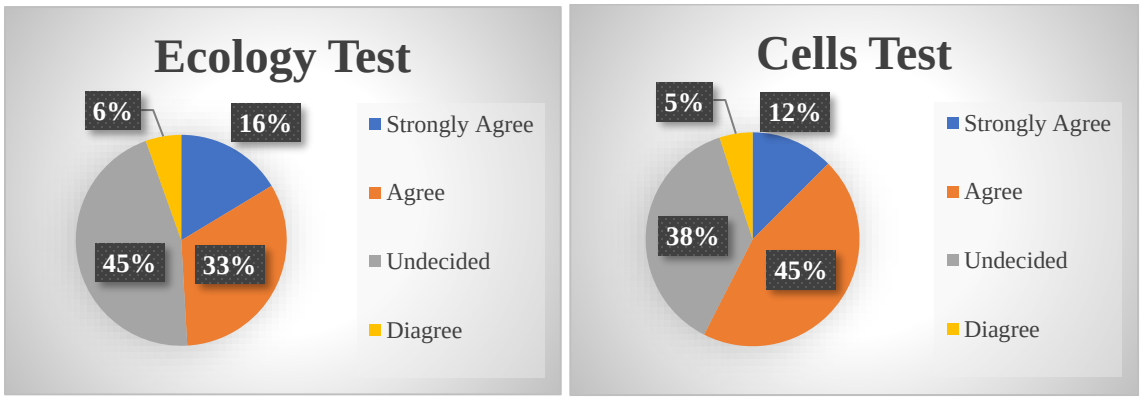

Figure 3. Percentage agreement with the statement, "I know what concepts are challenging for me in science", (Ecology *N*=55, Cells *N*=40).

After completing their first test and test tracking sheet, 49% either strongly agreed or agreed that the anaysis confirmed what they already knew (Figure 4). However, after the cells test, only 32.5% either strongly agreed or agreed. The average scores were 2.5 after ecology and 2.7 after cells indicating little change in students perception of the test tracking sheets in terms of showing students what they already know, but that test tracking sheets are showing them the results they expect.

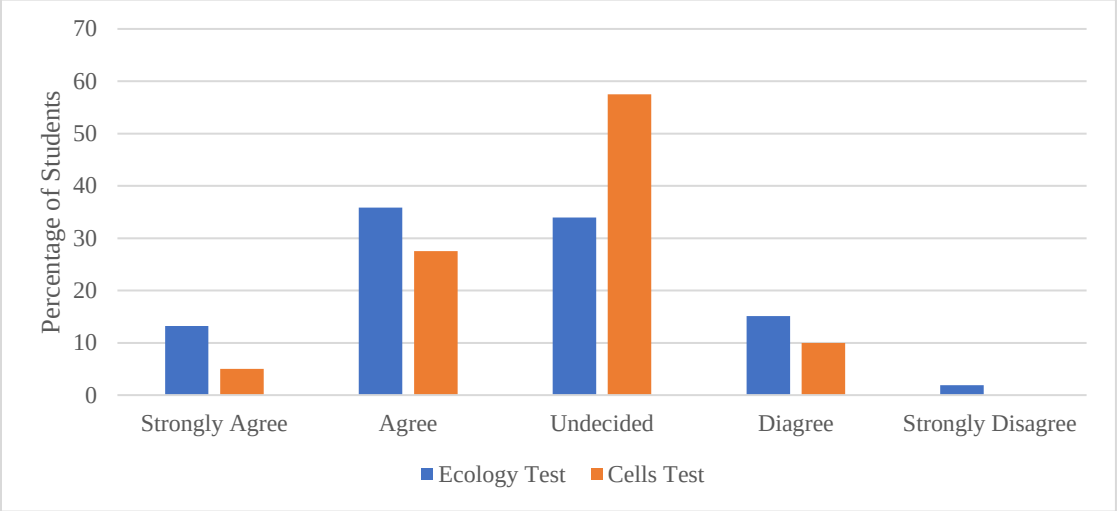

Figure 4. Percentage of students who felt test tracking sheets confirmed which concepts they understand, (Ecology *N*=53, Cells *N*=40).

Students were overall undecided if they felt better about their scores after completing test tracking sheets. In the survey following the Ecology test, the average was three with a standard deviation of 0.8 indicating that students (*N=54*) neither agreed nor disagreed that the test tracking improved their perception of performance. Following the Cells test, the score average was a 3.2 with a standard deviation of 0.9 indicating a higher percentage of students (*N=40*) disagreed with the statement that "I feel better about my grade after completing the test tracking sheet." Figure 5 mirrors these results with 21% of the students either strongly agreeing or agreeing after the Ecology Test, while only 20% fall into those categories after the Cells Test with a higher percentage disagreeing.

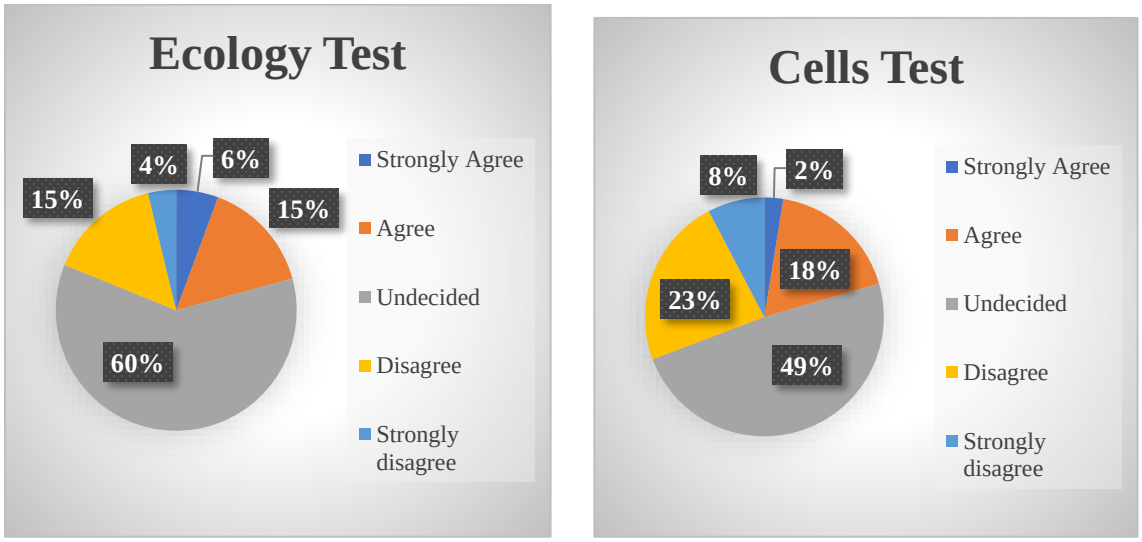

Figure 5. Student responses to "I feel better about my grade after completing the test tracking sheet", (Ecology *N*=54, Cells *N*=40).

After the ecology test, none of the students strongly felt that test tracking sheets were not worth the time to complete them, while after the cells test 2.5% did (Figure 6). However, the average score after the second test is a 2.65 indicating more students (*N=40*) agree that test tracking sheets are worth the time to complete.

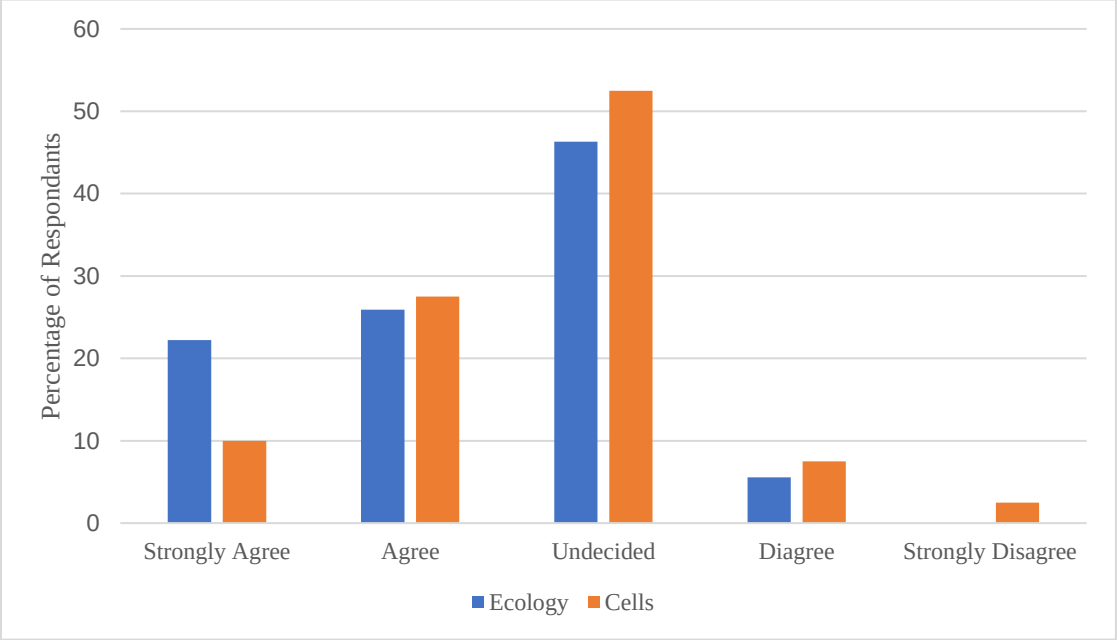

Figure 6. Percentage of students who felt test tracking sheets were worth the time they take to complete, (*N*=54, *N*=40).

Following the second test, students were asked which format they preferred: organized by topic or by question type. When asked how much they agree with, "I prefer questions organized by topic." 77% of students strongly agreed or agreed with only 3% disagreeing (Figure 7). When students were faced with the statement, "I prefer questions organized by type regardless of topic." 30% of students strongly agreed or agreed with 28% either strongly disagreeing or disagreeing (Figure 8). Interviewed students commented that they liked keeping their brains on the same topic during the Cells Test instead of bouncing around from idea to idea like they had on the Ecology Test. One student said, "I liked that I could see which questions went with which topic, so I could skip ahead to concept I felt good about." Another student said, "It was great to be able to stay on one page in my notebook for several questions rather than frantically flipping. Finally, a third student disagreed saying that "I like to leave all the true/false questions

for the end because the other question types help me figure them out. So, I wish the questions were by type, so I would just skip a section instead of a few questions spread out in the test. I forget to go back and do them." Although a few students have strong preference for the traditional organization of questions, a majority prefer questions organized by topic as seen in Figures 7 and 8.

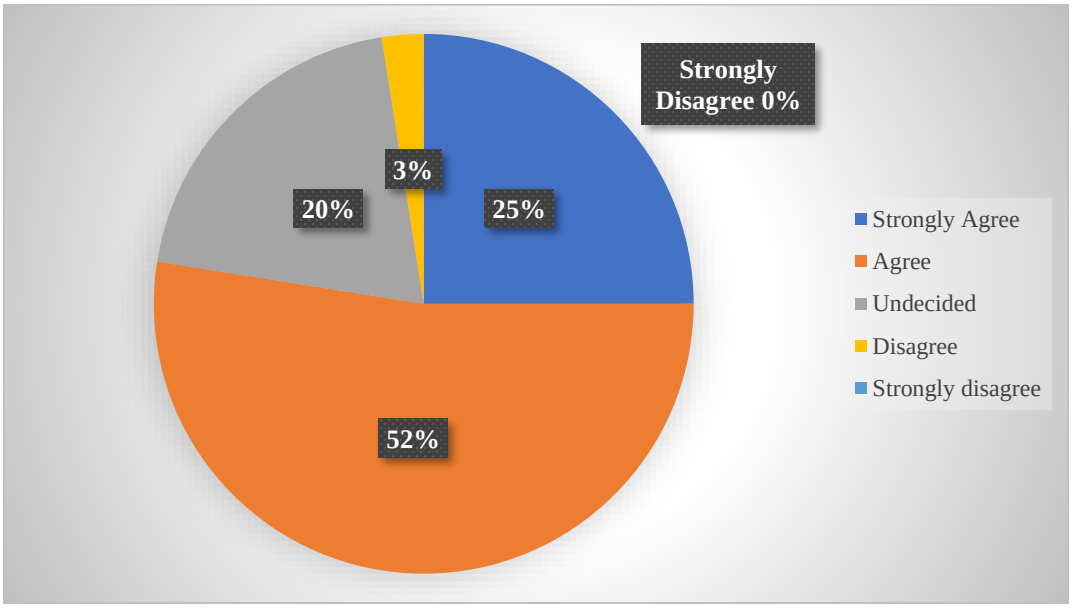

Figure 7. Student responses to "I prefer questions organized by topic", (*N*=40).

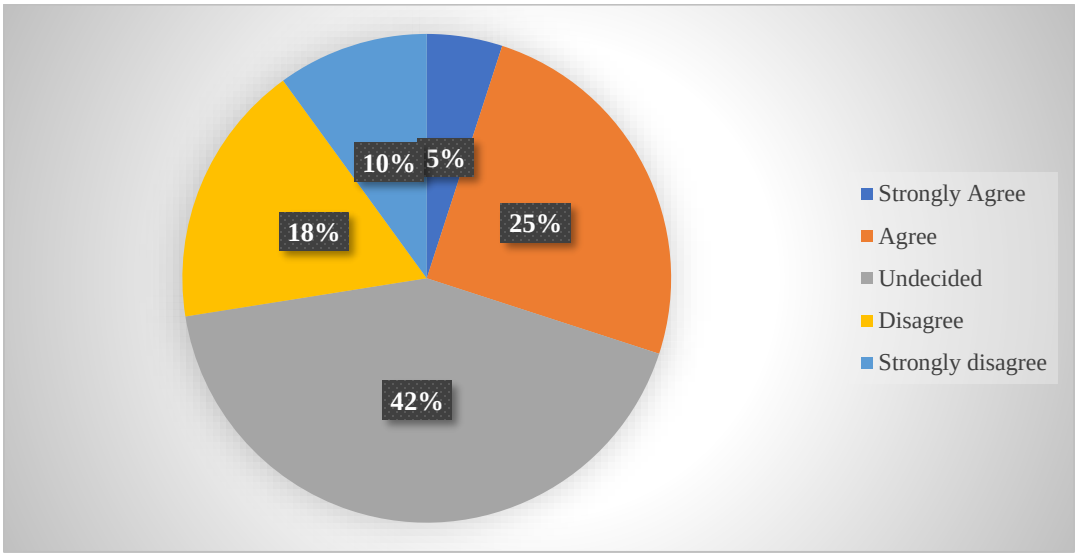

Figure 8. Student responses to "I prefer questions organized by type regardless of topic", (*N*=40).

In conclusion, my students prefer questions that are organized by topic rather than type. However, this organization did not improve their test scores, nor did it make them feel more prepared for their test. Overall, test tracking sheets were perceived as helpful although students did not necessarily enjoy completing them. The sheets usually confirmed what students expected about their knowledge but did not feel that completing them made them feel better.

INTERPRETATION AND CONCLUSION

The results of the assessments indicate that my perception was incorrect, organizing tests by topic does not appear to improve student performance. However, student interpretation of performance does seem to improve. Although average test scores were lower under the treatment, 77.3% for Ecology and 68.3% for Cells, my interviews showed that other factors should be considered. The cells unit and ecology unit were taught in a similar manner; however, the sequencing of assessments may have impacted student performance as well. My interviewees mentioned that having the "AHA Thesis"

before their test “helped them review and strengthen the information in [their] mind.” This was a bonus for the ecology test that was not present with the cells test. Additionally, the timing of these units lends itself to attendance impacts. The ecology unit saw near perfect attendance of most students while the cells unit saw many absences as students and their families extended their winter vacations or students became ill with common colds or the flu after returning to school in January. Fifteen students mentioned the long vacation or absences as a reason they felt unprepared for the cells test on their Test Feedback Survey. Finally, as one of my students mentioned, “Ecology was comfortable, I can see examples every day. Cells were challenging because I couldn’t find a reason why I needed to know the information and I cannot see the processes occur.” As Stiggins (2017) said, if students cannot come up with an answer to “What comes next in my learning?” then the learning will stop. For this student, that is exactly what happened. Dweck (2016) might classify this student as having a fixed mindset in this case as he decided the challenge was not worth it and gave an excuse for not putting in an effort.

Although my data shows that organizing tests by topic does not change student performance, it does seem to have an impact for some students. At the end of this school year, the special education teacher in my building tried something new with our IEP students who test in her room and it was amazingly successful. Since the test was already broken into chunks, she simply gave the students one section of four to ten questions at a time. For one student in particular this was his ticket to change his trend from the entire year. He was consistently my lowest performer, typically scoring less than 50% on every

test, but having his mind on one topic and only that topic allowed him to score an 80%. When I talked with him later, he mentioned that he is overwhelmed by my tests and having just a few questions at a time made him feel more comfortable and less rushed. Other students who experienced this same treatment also showed immense growth and were more relaxed during the Evolution test. In general, students and teachers like tests organized by topic better than tests organized by type of question.

Students like the feedback form because they feel like they have a voice in their learning and the test tracking sheets because it allows them to see the bigger picture. They typically do not feel very confident about their performance on tests and are often surprised by their scores. Even so, some students are disappointed with their scores and have indicated that test tracking sheets made them feel better about specific sections. That being said, many of my students are not interested in putting in the effort on the test tracking sheet because it is not counted as a grade. However, the test tracking sheet is a prerequisite for any test corrections or re-takes a student wishes to complete.

A majority of students stated that they know what sections of the test they knew well, and that test tracking simply confirmed what they already knew, or they were undecided. This shows that many students are already reflecting on their performance prior to learning their scores. This shows that overall, students did not feel that the item analysis changed their perception of what they know about science. However, for a few students, it was invaluable. One student recorded on her Test Tracking sheet, “Yes, I am proud. This section shows that I’m not just a dumb blonde.” Another told me, “I’ve never gotten a 100% on a test before, but I did on one section.” He was proud to be successful

even if it was for just five questions. These two cases show that teacher-led item analysis can impact the perception of performance for students exactly as Dueck (2014) stated.

Since students know what concept they know well in science, I can infer that they also know which concepts are challenging for them. However, from my perspective many students are not seeking enough assistance to help them understand the content. When I surveyed my students, the male students generally said that they ask questions when they need help, but they do not use their notebooks during the tests. Female students on the other hand are not comfortable asking questions in class, but they use their notebooks constantly during the tests. With this knowledge, perhaps a survey prior to each review session could tease out which concepts I should focus on to best support my students as they begin to study.

As far as assessments go, my students were split 50/50 on if they prefer a test or some other form to show what they know. Some students enjoy tests, some think projects are too much work, some think tests should be shorter, some say they are creative, some say they want to draw, and some admit that it doesn't matter either way for them. This reminds me that students perceive success in many ways and tests are not all that assessment is about. My students complete an "AHA Thesis" for each unit and perhaps a little variety should be added to increase student perceptions of their knowledge in science.

If I were to do this study again, I would pick different units to compare and be more consistent with the order in which assignments are presented. I feel that the timing and content of these two units impacted the results and I am unsure if I would gain

different insights if other units were compared. Since Ecology is familiar and Cells are not, it adds an unintended variable to student performance and their perceptions of performance. Additionally, the order in which assignments were presented in each unit may have also had an impact. Students mentioned that the AHA thesis is a great way to review for the test and in the Ecology unit it was before the test, but for the Cells unit it was after the test. Therefore, although I feel the data is reliable and valid, I think selection of units and curriculum order could have impacted the results.

Overall, changing the format of a test can be beneficial. Although my students' test scores in general did not improve, they like the ability to group questions in their minds and skip entire sections to focus on concepts where they feel confident. Test tracking takes time, but it is worth it for those students who may struggle to see the areas where they do succeed.

VALUE

I believe this AR project has educated me and my colleagues about how we approach summative assessments. As educators, reflection and perception are vital to our success just as they are vital to the success of our students. Therefore, I will continue to structure my assessments in a way that benefits both myself and my students and to have students reflect on their performance.

Although my students were not always the biggest fans of taking the time to go through their test and analyze their successes, I still feel it was valuable for many who were feeling downtrodden by their overall score. Even my student who consistently gets a 40% or lower finds sections in each test that he did well on by completing the test

tracking sheet. For the future, I plan on modifying the Test Tracking Sheet and potentially even making a digital version so that it includes some of the information from the Test Feedback Survey. I also plan on having them use emojis to interpret their score, many of my students already add them, but I feel it could make the experience slightly more engaging. This will also benefit students in the future as they become more invested in their success and gain insights into what their test scores actually mean.

For myself, I find myself noticing which topics I taught well and those that I did not. This has become much easier with tests sorted by topic and the use of ZipGrade. The item analysis allows me to see the percentage of students who got each question correct instantly. Since I now sort question by topic, I can easily see which topics where most difficult for my students and reflect on my own teaching and even ask students for feedback on those sections. Specifically, in our cells unit, it was painfully obvious that something was lost in translation between me and my students regarding cellular respiration and photosynthesis, but they totally nailed it with cellular structure. This information is extremely valuable as I begin to plan for next year and continually improve my lesson plans. These same insights would and do benefit other educators as more of my colleagues have begun using ZipGrade and rearranging their tests.

Since my students know what concepts in science are challenging for them, my plan for the future is to try having them complete a survey prior to our review sessions letting me know which topics they feel most comfortable and least comfortable with. My hope is that by tailoring our review sessions in an anonymous way more students will gain the insights they need prior to the test. More than half of my students responded that

they ask for support when they do not understand a concept, however my interviews and our school wide My Voice Survey suggested that is not the case because many students are afraid to admit they do not know something when they think they should because someone might make fun of them. I am hopeful that a pre-survey may encourage students to be honest and if the results are shown anonymously that more will ask specific questions during reviews.

It is also apparent that my 7th grade students spend time outside of class exploring science on their own through clubs, tv shows, and books. I think it would be beneficial to tap into these outside sources and add additional science fun!

Overall, through this process, I learned that data analysis can be challenging, but the results are worth the effort. If you try something new: How do you know if it is successful? and How do you know it is worth continuing? I will continue to take what I learned this year and apply it, so I can keep answering those questions as I implement new ideas.

REFERENCES CITED

Angelo, T. A., & Cross, K. P. (1993). *Classroom assessment techniques: A handbook for college teachers.* (2nd ed.) San Francisco, CA: Jossey-Bass, Inc.

Brookhart, S. M. (2008). *How to give effective feedback to your students.* Alexandria, VA: ASCD.

Dueck, M. (2014). *Grading Smarter Not Harder: Assessment strategies that motivate kids and help them learn.* Alexandria, VA: ASCD.

DuFour, R. (2015). *In praise of American educators and how they can become even better.* Bloomington, IN: Solution Tree Press.

Dweck, C. S. (2016). *Mindset: the new psychology of success.* New York, NY: Ballantine Books.

Jackson, R. R. (2009). *Never work harder than your students & other principles of great teaching.* Alexandria, VA: ASCD.

Kesler, C. (2017, January 17). Open notes assessment in the science classroom [Web Log Post]. Retrieved from http://www.keslerscience.com/open-notes-assessments-in-the-science-classroom/

Marcarelli, K. & Bybee, R. W. (2010). *Teaching science with interactive notebooks.* Thousand Oaks, CA: Corwin.

McMillan, J.H. (2017). *Classroom assessment: Principles and practice for effective standards-based instruction.* (7th ed.). New York, NY: Pearson.

Stiggins, R. (2017). *The perfect assessment system.* Alexandria, VA: ASCD.

Wiliam, D. (2011). *Embedded formative assessment.* Bloomington, IN: Solution Tree.

Young, J. (2003). Science interactive notebooks in the classroom. *Science Scope,* 26(4), 44-47.

APPENDICES

APPENDIX A

INTITUTIONAL REVIEW BOARD EXEMPTION

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects
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MEMORANDUM

TO: Elise Van Valkenburg and Marcie Reuer

FROM: Mark Quinn Mark Quinn CJ
Chair, Institutional Review Board for the Protection of Human Subjects

DATE: November 27, 2017

RE: *"The Impact of Testing Format and Reflection on Student Perceptions of Science"* [EVV112717-EX]

The above research, described in your submission of November 27, 2017, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

_X_ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

___ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

AHA THESIS GRADING RUBRIC

AHA Thesis Grading Rubric

3	¶1	**Introductory Paragraph**: Keep it short & sweet. Save the details and page #s for body paragraphs. • Topic sentence that introduces the main idea & importance of your essay • Let your reader know what they are about to read about • Sentences flow together
15 x 3 = 45	¶2 ¶3 ¶4	**Body Paragraph that answers one aha question** * Choose TWO ideas that support your topic sentence & that you understand well and can expand on. Use your own words & examples from class to describe each idea in detail. Body paragraphs should be longer than your intro & conclusion (~ 7-12 sentences). Cite page #s at the end of each detail (ISN, p.6). • Topic sentence that addresses the question • ❑ Introduce TWO aha ideas that help answer this question • ❑ ❑ ❑ Support: Explain each idea in your own words. Give specific examples OR use an analogy. • ❑ 4 correctly-used <u>underlined</u> scientific words appear within your sentences • ❑ information is accurate and clear • Wrap-up sentence • ❑ ❑ Paragraph is well-written with logical flow, organization, transitions & a formal tone of voice
3	¶5	**Conclusion Paragraph:** Emphasize the importance of your main ideas and leave a final impression. • Re-cap the main ideas that you covered in your essay • Kudos if you can use a theme to tie all your ideas together • Maintain a formal voice

14	**Proofreading Checklist:** Make it look nice!	Ask an adult or trustworthy classmate to help edit.	Read it out loud to catch mistakes!
	Yes Please: • 1.5 spacing • 12-point font • Times New Roman • Name, Period, Date left-aligned in top right corner (use "tab" key) • Header on each body P • Title and Section Headers are consistently formatted	• Use a formal, objective voice • Paragraphs indented • Proper punctuation • Capitalization • Grammar • Spelling • Black ink • 1" margins • min 1 page - max 2 pages	**Avoid these:** • Contractions • Misinformation • Plagiarism • Awkward spacing • Sounding like you are talking • 1st person (I, you, we, my)

5	**Citations:** Tell your reader where they could look to verify info. Ex. Mutualism is a symbiotic relationship that benefits both the host and symbiont (ISN, p.33).

	❑ ❑ ❑ Appropriate page #s referenced in each body paragraph, (but not in introduction or conclusion) • Citations should come at the end of the sentence that includes the detail • Punctuation appears AFTER the parenthesis
30	**Got it done!** _____ **/ 100 points total**

APPENDIX C

ECOLOGY TEST

Name_____ Period_____

ECOLOGY TEST 2017

1. If beans are placed in a refrigerator and in a cupboard, then the ones in the cupboard will have more sprouts, because the cupboard has a better temperature for growing. What is this statement?
   a. a reasonable hypothesis
   b. the procedure
   c. data analysis
   d. the conclusion

2. When looking at a complicated graph or diagram, you should first _____ what you _____; then begin to _____ what it _____.
   a. identify, know, identify, means
   b. identify, mean, interpret, sees
   c. interpret, mean, identify, sees
   d. identify, see, interpret, means

3. The key below is used to identify some trees and shrubs on Grant-Kohrs Ranch in Montana. A student finds a shrub on Grant-Kohrs Ranch that keeps its leaves all winter. What is it?

Classification Key

1. a. plant has a central trunk (tree) ..... go to step 2
   b. plant has one or more upright stems (shrub)..... go to step 3
2. a. smooth, white bark; tooth-edged leaves with mid-vein ..... quaking aspen
   b. whitish or gray grooved bark; oval leaves that are dark above, light below..... black cottonwood
3. a. evergreen leaves..... common juniper
   b. deciduous leaves (leaves that fall off in the winter)..... go to step 4
4. a. flowers form small cone-like seed structures..... water birch
   b. flowers form dense, white clusters ..... chokecherry

   a. quaking aspen
   b. black cottonwood
   c. common juniper
   d. chokecherry

4. Which of the following is not one of the characteristics that define life?
   a. made of cells
   b. ability to reproduce
   c. need to see the sun
   d. can grow and develop
   e. can respond to their environment

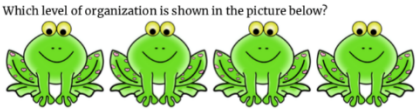
5. Which word best describes zebra mussels and their relationship to northwest Montana?
   a. native
   b. symbiotic
   c. non-native invasive
   d. non-native

6. Ants protect a tree from plant-eating animals, and the tree provides food to the ants. How would this relationship be classified?
   a. mutualism
   b. commensalism
   c. parasitism
   d. predation

7. Which of the following symbiotic relationships is considered parasitic?
   a. ticks feeding on a dog
   b. bees transporting pollen from flowers
   c. pilot fish swimming under sharks
   d. birds eating the insects from the back of a hippopotamus

8. Which species is non-native in Northwest Montana
   a. grizzly bear
   b. cutthroat trout
   c. rainbow trout
   d. lodgepole pine
   e. huckleberries

9. Which level of organization is shown in the picture below?



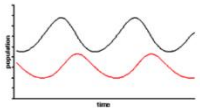
   a. organism
   b. population
   c. community
   d. ecosystem

10. The environment around an oak tree can affect the number of acorns the oak tree grows each year. The table below shows the average number of acorns grown on each branch of four different oak trees. Which tree most likely lives in the shade of another tree?

Oak Tree	Average Number of Acorns per Branch
W	24–28
X	12–14
Y	6–8
Z	16–20

   a. W
   b. X
   c. Y
   d. Z

11. What does A most likely represent in the graph below?
   a. host
   b. symbiont
   c. predator
   d. prey



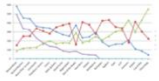
12. Non-living things are also called _____.
   a. heterotrophs
   b. autotrophs
   c. abiotic factors
   d. biotic factors

13. Which list includes only abiotic factors?
   a. wind speed, trees, air temperature
   b. rainfall, predators, disease
   c. prey, disease, grasses
   d. wind speed, rainfall, air temperature

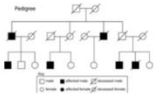
14. Which biotic factor most directly affects the size of a deer population in an ecosystem?
   a. air temperature
   b. annual precipitation
   c. number of birds
   d. number of plants

15. Which graph most likely represents the composition of species in a 90 year old forest?

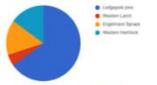
a.



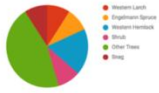
b.



c.



d.



16. Western larch and Ponderosa pine trees have fire resistant adaptations that often allow them to survive forest fires. Which is an example?
   a. thick bark
   b. shallow roots
   c. dry, narrow leaves
   d. pollen producing cones

17. The slow process of recovery following a disturbance is called _____
   a. succession
   b. symbiosis
   c. predation
   d. community

18. Students in a science class conducted the experiment described below:
   1. The students bought 20 bean seeds and 2 identical containers.
   2. They placed 10 seeds and a moist paper towel into each container.
   3. They placed 1 container in a refrigerator and the other in a cupboard.
   4. They looked at the seeds after one week and counted how many had sprouted

   What are the steps above called?
   a. a reasonable hypothesis
   b. the procedure
   c. data analysis
   d. the conclusion

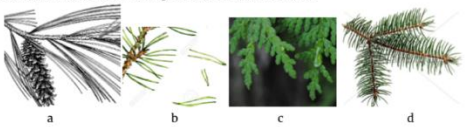
Use the following image for questions 19 and 20.

19. Through which organism does energy enter the food web pictured above?
   a. worm
   b. tree
   c. fox
   d. rabbit

20. Name the primary consumer(s) in the picture of a food web.
   a. worm
   b. butterfly
   c. squirrel
   d. rabbit
   e. all of the above

21. What percent of energy is passed up each trophic level?
   a. 0%
   b. 10%
   c. 50%
   d. 100%

22. Which plant fits the description below?
   Leaves are in the form of long needles in bunches of five.



a b c d

23. Anything that restricts the number of individuals in a population is a _____.
    a. limiting factor
    b. carrying capacity
    c. niche
    d. habitat

24. Which food chain shows the correct order in which food and energy flow through the chain?
    a. grass --> ant --> robin --> hawk
    b. owl --> snake --> mouse --> corn
    c. snake --> grass --> corn --> hawk
    d. corn --> hawk --> snake --> robin

25. The first step in the scientific method is:
    a. organize data
    b. form a hypothesis
    c. ask a question
    d. gather information

26. Scientists use models
    a. when it is unsafe to conduct the experiment in the field
    b. when time is limited
    c. to represent a real world situation
    d. all of the above

27. The number 1 priority in the science classroom is:
    a. getting the correct answer
    b. have fun
    c. safety
    d. finishing quickly

28. A niche does not include
    a. what the organism smells like
    b. what type of food an organism eats
    c. how an organism obtains its food
    d. physical conditions it requires to survive

29. In Yellowstone National Park, the reintroduction of wolves changed the ecosystem at many levels.
    a. True
    b. False

30. When an organism dies and decomposes, essential elements will be returned to the soil.
    a. True
    b. False

Match each question with the type of graph used to answer it.

31. What is the population of foxes over 20 generations?	a. Scatter Plot
32. What is the %composition of tree species in a forest?	b. Bar Chart
33. Does the force of a baseball bat affect the distance a ball travels?	c. Dot Plot
	d. Line Graph
	e. Pie Chart

Select the vocabulary word that best matches each statement

34. a mountain lion has this type of relationship with a deer	a. predatory
35. male bighorn sheep (rams) smash their horns together in hopes of securing the best mate (ewe)	b. autotrophs
36. consumers and decomposers are both considered _____ because they cannot create their own food	c. competition
37. producers are also known as	d. heterotrophs
	e. symbiotic relationship

Select the vocabulary word that best matches each statement

38. this layer of a tree contains cells that are actively growing and dividing	a. heartwood
39. this structure protects the tree	b. bark
40. these two structures allow nutrients and molecules to flow up and down in a tree	c. cambium
	d. leaves and branches
	e. xylem and phloem

APPENDIX D

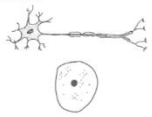
CELLS TEST

Name_____ Period_____

cells - January 2018

Section One: Themes in Biology

1. The pictures below show two healthy human cells. Why do the cells differ in structure?



   a. The cells have lived for different amounts of time
   b. The cell on the bottom was exposed to water
   c. The cell on the top has been stretched
   d. The cells have different functions

2. A scientist is looking at tissue under a microscope. She looks at these two samples. Based on the structure of the samples, what would you infer?

   a. They look like they perform the same function; they are both bone.
   b. They look like they perform the same function; they are both muscle.
   c. They look like they perform different functions; one is muscle and one is bone.
   d. It is impossible to infer anything.

3. Which of the following is not a major theme in biology?
   a. Cells form the basis of all life
   b. New properties arise as complexity increases
   c. Structure matches function
   d. The brainstem controls involuntary actions

4. New properties emerge as complexity increases. Which of the following are examples of emergent properties?
   a. A group of similar cells working together to perform a task
   b. A bike that is properly built
   c. 1 gram of cytoplasm
   d. A and B only
   e. A, B, and C

12. A theory is....
   a. An educated guess
   b. Often a collaborative effort with many scientists working together to explain a phenomenon
   c. A wild guess
   d. A graph caption that interprets multiple data points

Section Three: Cell Basics

13. This photo was taken looking through a microscope. What type of cell is shown in the photo?

   a. Animal cells
   b. Plant cells
   c. Bacteria cells

14. Choose the answer that is not part of cell theory.
   a. Cells must come from pre-existing cells
   b. Cells are difficult to see, even with a microscope
   c. Organisms are made of at least one cell
   d. Cells are the basic unit of structure and function

15. Scientists have discovered a new single-celled organism living at the bottom of a lake in Antarctica. Which procedure would best allow the scientists to classify this organism as either a prokaryote or a eukaryote?
   a. studying the growth of the cells in the absence of oxygen
   b. determining if the genetic material of the cell is made of DNA or RNA
   c. isolating the cell membrane to determine if lipids are present
   d. viewing samples of whole cells to study internal cell structures

16. Choose the answer that best describes key differences between plant and animal cells.
   a. Presence or absence of cell wall
   b. Different size vacuole
   c. Presence or absence of chloroplasts
   d. A and B only
   e. A, B, and C

17. Which organelle plays the biggest role in maintaining homeostasis?
   a. Mitochondria
   b. Nucleus
   c. Cell membrane
   d. lysosomes

Section Two: Science Basics

5. In 1839, the scientist Theodor Schwann stated that all animals are made of cells. Which technology most likely helped Schwann gather the evidence used to draw this conclusion?
   a. Computer
   b. Microscope
   c. Prism
   d. Telescope

6. How should a gardener set up an experiment to test which type of plant food grows the largest plants?
   a. Give the plants equal amounts of the same plant food.
   b. Give the plants different amounts of the same type of plant food.
   c. Give the plants equal amounts of the same plant food but put the plants in different places.
   d. Give the plants equal amounts of different types of plant foods.

7. What can cause a theory to change?
   a. The majority of scientists support a new theory.
   b. Public opinion of the theory is negative.
   c. A scientist collects evidence that contradicts the theory.
   d. A new hypothesis is introduced based on the original theory.

8. Which organelle found in both animal and plant cells can a student see with a light microscope?
   a. Cell wall
   b. Chloroplast
   c. Flagellum
   d. Nucleus

Students in a science class conducted the experiment described below:

I. They bought 20 bean seeds and 2 identical containers.
II. They placed 10 seeds and a moist paper towel into each container.
III. They placed 1 container in a refrigerator and the other in a cupboard.
IV. They looked at the seeds after one week and counted how many had sprouted

9. What variable is being tested in this experiment?
   a. Container size
   b. Moisture
   c. Temperature
   d. Time

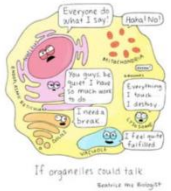
10. In this experiment, the number of seeds that sprouted is the _____.
   a. Independent variable
   b. Dependent variable
   c. Control
   d. Consumer

11. The ocular lens of a microscope has a magnification of 10x. If you looked through the 4x low power objective, what is the total magnification of your slide?
   a. 4x
   b. 14x
   c. 40x
   d. 400x

18. Which function is not carried out within cells?
   a. eliminating waste
   b. producing energy
   c. pumping blood
   d. storing genetic information

19. Which structure is common to bacteria and plant cells, may be viewed with a light microscope in plant cells, and is composed mostly of carbohydrates?
   a. Cell wall
   b. Golgi apparatus
   c. Mitochondrion
   d. Nucleus

20. Which type of cell is shown in the cartoon?



   a. Animal cell
   b. Bacteria cell
   c. Plant cell

Word Bank: Questions 21-23	
a. Organs	c. Eukaryotic
b. Organelles	d. Prokaryotic

21. A cell with many membrane-bound organelles is called a _____ cell.
22. _____ are sub-units inside a cell that each do a different job.
23. _____ cells are the smallest and simplest form of life

Word Bank: Questions 24-27	
a. Cell membrane	d. Cell wall
b. Mitochondria	e. Ribosome
c. Golgi Body	

24. Like a powerhouse
25. Like a post office
26. Like a factory
27. Like a gatekeeper

Word Bank: Questions 28-30		
a. Nucleus	c. Chloroplast	e. Cell membrane
b. Mitochondria	d. Cell wall	

28. I'm found only in plant cells. I'm green as can be. I make food for the plant. Using the sun's energy

29. I'm the brain of the cell. Or so they say. I regulate activities. From day to day.

30. I'm strong and stiff. Getting through me is tough. I'm found only in plants and prokaryotes. I'm what makes sticks tough.

Section Four: Cellular Respiration and Photosynthesis

31. Where would you expect cells to contain the most chloroplasts?
    a. Petals
    b. Leaves
    c. Lungs
    d. Roots

32. An organism uses carbon dioxide and water to begin a cellular process that makes a simple sugar. What else is essential to start the process?
    a. Heat
    b. Oxygen
    c. Soil
    d. Sunlight

33. Choose the products made in cellular respiration.
    a. Sunlight and rainbows
    b. Water, carbon dioxide, and ATP
    c. Sugar and oxygen
    d. Glucose and oxygen

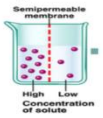
34. The _____ tree would grow most in the spring and summer when there is the most sunlight available. When the seasons change and snow begins to fall, the _____ leaf would be more stable.
    a. Maple, maple
    b. Pine, pine
    c. Maple, pine
    d. Pine, maple

35. Which statement best compares photosynthesis and respiration in plants and animals?
    a. Plants use photosynthesis to capture energy; animals use respiration to release energy.
    b. Plants use photosynthesis to capture energy; both plants and animals use respiration to release energy.
    c. Plants use photosynthesis to release energy; animals use respiration to capture energy.
    d. Plants use photosynthesis to release energy; both plants and animals use respiration to capture energy.

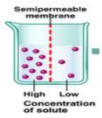
Section Five: Active and Passive Transport

36. Choose the beaker with an arrow that correctly shows the direction water will move without energy.

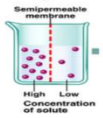
a.



b.



c.



37. Which process requires no energy?
    a. Carrier proteins
    b. Photosynthesis
    c. Active transport
    d. Passive transport

38. Students observe that a potato slice feels squishy after sitting in salty water for two days. Only three of the statements below accurately explain this observation. Choose the one that is false.
    a. Osmosis occured
    b. The vacuoles inside the potato cells deflated
    c. This is an example of active transport
    d. The potato will continue to change until equilibrium is reached

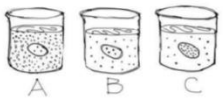


Figure 1. Imagine a grape is placed into 3 solutions of different concentration.

39. Which beaker is at equilibrium in Figure 1 (above)?
    a. Beaker A
    b. Beaker B
    c. Beaker C
    d. All of the above

40. Which beaker in Figure 1 (above) contains a hypertonic solution as compared to the grape?
    a. A
    b. B
    c. C

APPENDIX E

TEST FEEDBACK SURVEY

Name_____ Class Period_____ Test _____

Test Feedback

1. I felt prepared for this test.

   Strongly Agree Undecided Strongly Disagree
   Agree Disagree

2. Why?_____
   _____

3. I think I did well on this test.

   Strongly Agree Disagree
   Agree Strongly Disagree
   Undecided

4. Why?_____
   _____

5. I studied outside of class time for this test. □ Yes □ No

6. Approximately how long did you study? _____ □ min □ hours

7. Why?_____
   _____

8. Describe how you felt during the test. (select all that apply)

   Confident Okay Stressed
   Knowledgeable Knew some stuff My mind was blank
   Calm A little nervous Rushed
   In total control Sketchy Scattered

9. Why?_____
   _____

10. Are there parts, sections, or topics where you felt more confident than others?
    □ Yes □ No

11. Which parts, sections, or topics did you feel confident about?
    _____
    _____

12. Which parts, sections, or topics did you **not** feel confident about?
    _____
    _____

13. If you were given a chance to show your knowledge and understanding in a different way would you prefer that? □ Yes □ No

14. Why?_____
    _____

APPENDIX F

TEST TRACKING SHEETS

Ecology Test Tracking Sheet

How did you prepare *before* the test?

VOCABULARY must be mastered before you can think critically and make connections. Learn it as we go!

- I DID complete all of the words for the unit. And I PRACTICED them!
- I DID complete all of the words for the unit. But I NEVER looked at them again.
- I completed about HALF of the vocab words.
- I did NOT complete the vocab list for this unit.
- OTHER. Explain _____

AHA CONNECTIONS encourage us to chunk the material and to connect it to the big picture. How often do you update your AHA Connections and Table of Contents?

- I update my Aha Page and my TOC on my OWN INITIATIVE (without reminders)!
- ONLY when my teacher tells me to.
- What AHA Page? TOC?!?
- OTHER. Explain _____

STUDY GUIDES are like road maps that tell you what to expect on a test. Did you use the Study Guide?

- YES! I spent at least ½ hour outside of class (on my own/ with a friend/ parent) reading the study guide and my ISN.
- DUH. We looked at it together in class.
- Actually, I left it in your room, thank you for RECYCLING it for me.
- OTHER. Explain _____

How did you perform *during* the test?

Topic	Q #s	Your Score	Possible Points	%	Are you proud? Explain.
Scientific Method & Skills	1-3, 18, 25-27, 31-33		10		
Ecosystem Basics	5-9, 22, 28, 34-40		14		
Abiotic & Biotic Factors	4, 10, 12-14		5		
Response to Change	11, 15-17, 23, 29		6		
Energy Flow in Ecosystems	19-21, 24, 30		5		
Total			**40**		

How will this information influence your *future* tests?

Make a SMART (Specific, Measurable, Attainable, Realistic, Time-bound) Goal for our next test? _____

Cell Test Tracking Sheet

How did you prepare *before* the test?

VOCABULARY must be mastered before you can think critically and make connections. Learn it as we go!

- I DID complete all of the assigned words. And I PRACTICED them!
- I DID complete all of the assigned words. But I NEVER looked at them again.
- I completed about HALF of the vocab words.
- I did NOT complete the vocab list for this unit.
- OTHER. Explain _____

AHA CONNECTIONS encourage us to chunk the material and to connect it to the big picture. How often do you update your AHA Connections and Table of Contents?

- I update my Aha Page and my TOC on my OWN INITIATIVE (without reminders)!
- ONLY when my teacher tells me to.
- What AHA Page? TOC?!?
- OTHER. Explain _____

STUDY GUIDES are like road maps that tell you what to expect on a test. Did you use the Study Guide?

- YES! I spent at least ½ hr outside class (on my own/with a friend/parent) looking over the study guide and my ISN.
- DUH. We looked at it together in class.
- Actually, I left it in your room, thank you for RECYCLING it for me.
- OTHER. Explain _____

How did you perform *during* the test?

Topic	Q #s	Your Score	Possible Points	%	Are you proud? Explain.
Themes in biology	1-4		4		
Science basics	5-12		8		
Cell Basics	13-30		18		
CR / Photosynthesis	31-35		5		
Active & Passive Transport	36-40		5		
Total			**40**		

How will this information influence your *future* tests?

Make a SMART (Specific, Measurable, Attainable, Realistic, Time-bound) Goal for our next test?

_____

_____

APPENDIX G

STUDENT LIKERT SURVEY

Student Survey

Directions: Please select the letter that best represents how you feel for each statement and record it on the ZipGrade answer sheet.

Please Note: Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

A = Strongly Agree B = Agree C = Undecided D = Disagree E = Strongly Disagree

1. I get good grades in school
1. I like science class.
2. I am good at science.
3. I know what concepts are challenging for me in science.
4. I ask for help when I do not understand a concept.
5. I used my ISN (interactive science notebook) during the test.
6. I my ISN was helpful during the test.
7. I will do better on the next test.
8. Test tracking sheets help me learn.
9. Test tracking sheets are worth the time it takes to finish them.
10. I feel better about my grade on a test after completing a test tracking sheet.
11. I am bad at science.
12. The test tracking sheet confirmed which concepts I understand.
13. I prefer questions grouped by topic.
14. I prefer tests to be organized by question type regardless of the topic.

Answer the following questions on the <u>back</u> of your Zipgrade with as much detail as possible.

16. What personal qualities do you feel you have, or do not have that influence how confident you are in your science ability?"

17. "What factors (school, educational programs, televisions shows, science clubs etc.) have the greatest influence on your personal science knowledge?"

APPENDIX H

STUDENT INTERVIEW QUESTIONS

Interview Questions

1. Do you like school?
    a. What about school do you like or not like?
2. Do you find science in general interesting?
    a. What do you find interesting about science?
    b. Why do you not find science interesting?
3. Do you like science class?
    a. Why do you say that?
4. If you could choose 2 words to describe science class what would they be?
5. Are you good at science?
    a. Why do you say that?
    b. Are you willing to ask questions when you do not understand something in science?
6. How confident did you feel on our most recent test?
    a. Why do you say that?
7. Do you feel your test scores accurately reflect your science knowledge?
    a. Why?
    b. Would something else do a better job showing what you know?
        i. Can you give an example?
8. Do you prefer how the Ecology test was formatted or how the Cells Test was formatted?
    a. Why?
    b. Did format impact how you felt you did on the test?
9. What do you think about the Test Tracking Sheets?
    a. Do they help you find your misconceptions?
    b. Are they worth the time?
    c. Do they help you plan for the next test?
10. Do you feel you are able to successfully complete the activities we do in science class?
    a. Why do you say you that?
    b. How do you know if you are successful or not?
11. Do you feel challenged in science class?
    a. How so?
12. Is there anything else you would like me to know?