WHAT ARE THE EFFECTS OF STANDARDS-BASED GRADING ON STUDENT

LEARNING AND BEHAVIOR IN THE SECONDARY SCIENCE CLASSROOM?

by

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ABSTRACT

Over the last few years of my teaching career I grew frustrated with some recurring problems that I attributed to my points-based grading system. Parents and students seemed to focus more on earning points than on learning. When students and their parents came in for help they asked about making up assignments for partial credit and about earning extra credit, but rarely sought help in understanding content or mastering skills. Homework was often completed quickly with little effort, and feedback given on homework and tests was usually ignored. When I looked into the research I found that points-based grading systems were often inaccurate and conveyed little information to parents, teachers, and students to improve future learning. Many assessment experts recommended switching to a standards-based grading system (SBG).

For this project three high school biology classrooms were assessed with a traditional points-based grading system for the fall semester, and then a SBG system was implemented in the spring semester. During the treatment the curriculum was broken into standards and specific learning objectives. All assignments and quizzes were tied to these standards, and short quizzes were used to assign individual grades to each learning objective. Non-academic achievement factors such as attendance, attitude, behavior, and homework punctuality were recorded separately but not included in students' academic grades. Students were allowed to re-assess over learning objectives throughout the grading period.

Data collection involved an attitude survey, which was given both spring and fall semesters, student interviews, unit assessment scores from both semesters, and semester exams. I also recorded field notes to document summaries of interactions I had with students who asked for help or asked about their grades.

INTRODUCTION AND BACKGROUND

For the first five years of my teaching career I assessed and graded students using a traditional points-based grading system. Although the weighting of different assignment groups changed occasionally, the basic format remained the same. Homework, in-class work, and labs were collected a few times each week and assigned a score, most often out of ten points. The students' homework grades were determined by an average of all homework scores throughout a grading term. Test and quiz grades were separate from homework grades, but were also given simple point and percentage grades that were averaged over the grading term. The students' overall grades were then determined as a weighted average of test and homework points. Students were not generally allowed to retake tests unless I made a specific exemption for a student. None of the students' assignments or tests were tied directly to any specific standards, and student progress towards individual learning goals was not tracked.

As I gained teaching experience I grew increasingly frustrated with some recurring problems that I often heard echoed by other teachers. First, homework assignments from many students were done quickly, incompletely, and inaccurately. When I did take the time to make considerable comments on students' work, it was almost never read. Students were quick to toss their old homework and tests in the trash and failed to learn from their mistakes. Second, grades were often poor indicators of what students knew. Students who actually understood very little course content would pass because of all the points they earned through homework, classwork, and group projects. Because I was not always able to grade homework thoroughly, students would earn points for inaccurate, incomplete, and copied work. On the other hand, strict grading of

homework seemed to punish students for practicing material they did not yet know, and students with a very solid understanding of the material would sometimes have their grades dropped because of a single missed assignment. I would often allow them to make it up, but in truth it was busy work that they didn't need to do and I didn't have time to grade. Finally, my students and their parents were often focused more on earning points than they were on learning the material. When students had low grades they would rarely ask for help understanding the material or for the opportunity to re-assess over important content. Instead they or their parents would ask for extra credit or to make up a missed assignment from weeks prior. These extra credit and make-up assignments, when I allowed them, were usually done very poorly as well. Parent teacher conferences focused on, "What can my student do to get an A?" or, "What can my student do to pass?" not, "How can we help my student learn this?"

To address these issues, I first tried placing more weight on test grades. I thought it would place more emphasis on learning the content and less on simple homework points. This, however, seemed to have little affect other than to lower many students grades severely. It did not seem to motivate them any more than the previous system. I also felt there may be something unfair about heavily weighting tests when students were only assessed a few times each grading period, and a single poor performance on a test could be very detrimental to students' grades. Conversations with parents and students still revolved around improving grades through points, make-up work, and extra credit. Many students were still convinced that they would just never do well on tests.

I came across another possible solution through reading blogs from math and science teachers from different parts of the country. Many of the teachers were strong advocates

of Standards-Based Grading (SBG) and had detailed explanations of their own grading systems posted to their blogs. This led me to review professional literature on assessment, and eventually to experiment with SBG in my own classroom. SBG involves creating a set of standards, or learning goals, for every unit taught. Learning activities are tied directly to these standards, and each standard is assessed individually. Because students earn grades primarily by demonstrating mastery of these specific learning goals, and are not significantly affected by homework, participation, or other sources of points, I felt that it would put more emphasis on learning and less on earning points. Another staple of SBG is that students can reassess over the standards at any time. I hoped this would allow struggling students to experience success and gain confidence. I also thought it might encourage students to pay attention to feedback on their assignments and assessments, and reduce the pressure that would have been felt by students in a high stakes testing system. This led me to my focus question: *What are the effects of using SBG on student learning and behavior?* More specifically, the following sub-questions were researched.

1. How will SBG affect content mastery in science?
2. How will SBG affect student's attitude towards assessment?
3. How will SBG affect student's confidence towards learning?
4. How will SBG affect student and teacher interactions with respect to feedback on improving and maintaining grades?

CONCEPTUAL FRAMEWORK

Designing an effective grading system must begin by determining what grades are meant to do (Brookhart, 2011; Marzano, 2000). Grading systems are used for a variety of purposes, including but not limited to, giving feedback to students, parents, and teachers

about student achievement; guiding future instruction; motivating students to work harder; informing counselors and administrators; and comparing students for class rankings and scholarships. The importance given to each of the uses of grades listed differs from teacher to teacher and between teachers, administrators, and counselors. However, research shows there is a general consensus that one of the most important uses of grades is for reporting student achievement (Marzano, 2000; Guskey, 2009; Brookhart, 2011; Pollock, 2007; Jackson, 2009). A system for reporting student achievement must be consistent from student to student and among different teachers. It should be meaningful and informative to students, parents, and teachers, and should report what students know in order to help guide further instruction and remediation (Marzano, 2000; Guskey, 2009; Pollock, 2007; O'Connor & Wormeli 2011). Traditional points and percentage based grading systems often fail to meet these basic requirements because they are inconsistent, subjective, and limited in the information they convey (Clymer & Wiliam, 2006; Guskey, 2009; Marzano, 2000; Pollock, 2007). Marzano (2000) has made the alarming claim that, "grades are so imprecise as to be almost meaningless" (p. 1).

The first inconsistent practice common among teachers in the grading process is the inclusion of attitude, effort, and improvement along with achievement in calculating grades (Brookhart, 1993; Cross & Frary, 1996; Guskey, 2007; Marzano, 2000). In a survey given to 465 middle and high school teachers Cross & Frary (1996) found a wide range of importance given to each of the following categories to determine grades: attendance, homework punctuality, class participation, and teacher perception of performance relative to ability. For example, they found that 71% of teachers considered homework grades as important, while 24% counted homework scores little or none. Fifty-

one percent of teachers reported that class participation was important in determining grades, while 44% counted participation little or none (Cross & Frary, 1996). Similarly, Marzano (2000) reported in a survey of 151 teachers in grades 10-12 that 36% of the teachers used *effort*, 14% reported using *behavior*, 9% included *cooperation*, and 24% considered *attendance* in determining grades. He then concluded that students in two separate classes with the same attendance, test scores, homework completion, and class participation could receive significantly different grades.

A second inconsistency involves the weighting of different assignments. In a study at the Mid-continent Regional Educational Laboratory, two teachers were asked to assign end of term grades to a series of students. Both teachers were given the same data and were told to consider only homework, quizzes, and tests. When results were compared there was agreement on only 57.7% of the students' grades, and some scores differed by as much as 2 or 3 letter grades. A third inconsistency stems from the practice of assigning one percentage score to assessments covering a variety of knowledge and skills. Grades can change depending on the number of questions on each topic and the weight given to individual questions (Marzano, 2000).

Besides being inconsistent, traditional points-based grading systems convey little information to students, parents, and teachers about student knowledge and can skew grades (Guskey, 2007; Marzano, 2000; O'Connor & Wormeli, 2011). Part of the problem stems from the practice of averaging a student's knowledge over an entire grading term. Averaging in a points-based system does not differentiate between a student who struggles at the beginning of a unit but then achieves mastery, and a student who scores well initially only to fall short of mastery by the end of instruction. This

practice essentially punishes students for a lack of knowledge before instruction is complete. This can frustrate students, cause them to associate grades with aptitude and not with learning, and cause some students to give up entirely (Marzano, 2000; O'Connor & Wormeli, 2011).

A points-based system also fails to identify which specific concepts a student has mastered and which they have not. An 80% average for a term could mean that students turned in all homework but had a 70% average on all quizzes and tests, or it could refer to a student who averaged over a 90% on quizzes and tests but failed to turn in all assignments on time. A 70% score on a test could mean a student has C level mastery of all standards covered by the quiz, or it could result from a student having a solid mastery of most standards while being very weak in a few others. A simple percentage score gives students little feedback about what they need to improve on and gives teachers little information about what remediation and re-teaching needs to be done (Guskey, 2007; Marzano, 2000; Marzano & Heflebower, 2011; O'Connor & Wormelli, 2011).

Finally, many advocates of reforming current grading systems call for an end to another common practice in standard grading systems, assigning zeros to incomplete work (Guskey, 2009; O'Connor & Wormeli, 2011). O'Connor and Wormelli (2011) note that a zero, when used in a traditional 100 point grading scale, is six increments of ten below a 60%, which is what most schools consider failing. They compare this to giving a student a negative six on a four point scale, which is a common standards based grading scale. This, in their opinion, is a practice that unfairly skews grades and does not closely match the learning that has taken place.

Some feel that grades should be abandoned completely, arguing that grades do not improve learning and can decrease intrinsic motivation in students (Kohn, 2011). However, many experts feel that this is an extreme reaction to the problems of current grading systems, and that a move to a more reliable and useful standards-based grading system would be more effective (Clymer & William, 2007; Marzano, 2000). Although the smaller details of grading differ from one system to the next, there are many commonalities. Many advocates of standards based grading promote the following grading principles:

- Separate grades should be given for each individual standard or learning goal. If an overall percentage must be given, then grades on specific standards should be given to supplement the overall grade (Clymer & Wiliam, 2007; Guskey, 2009; Marzano, 2000; Marzano & Heflebower, 2011; O'Connor & Wormeli, 2011; Pollock, 2007; Tierney, Simon, & Charland, 2011)

- Grades should measure student achievement, and not take into account effort, attendance, homework punctuality, classroom participation, and other non-achievement factors (Clymer & Wiliam, 2007; Guskey, 2009; Marzano, 2000; Marzano & Heflebower, 2011; O'Connor & Wormeli, 2011; Tierney et al, 2011). However, many experts argue these should be reported separately (Clymer & Wiliam, 2007; Guskey, 2009; Marzano, 2000; Pollock, 2007; Tierney et al., 2011).

- Points should be assigned from a much smaller scale. Scales with three to five levels were most commonly recommended (Clymer & Wiliam, 2007; Marzano, 2000; Marzano & Heflebower, 2011; O'Connor & Wormeli, 201l; Pollock, 2007). For example, students could be measured on a scale from zero to four, with one being

novice, two being developing, three being proficient, and four being advanced. O'Connor & Wormeli (2011) suggest that scales using more than ten levels, such as the common 100 point scale, provide too many levels for teachers to accurately assess and report.

- Grades should not be final until the end of the term. Students should have the opportunity to re-learn, re-test, and demonstrate mastery until the end of the term (Clymer & Wiliam, 2007; Marzano, 2000; Marzano & Heflebower, 2011; O'Connor & Wormeli, 2011).

- Students' success on formative homework and practice should not affect their overall grade. Students should not be penalized for practice (Clymer & Wiliam, 2007; Marzano, 2000; O'Connor & Wormeli, 2011; Pollock, 2007).

Clymer & Wiliam (2007) argue that standards-based grading can double as both formative and summative assessments, giving much needed feedback to students, and giving teachers the ability to evaluate and adjust instruction. This feedback, they argue, could greatly increase student learning. Clymer & Wiliam (2007) conducted a study in an 8th grade physical science classroom using a standards-based system. Interviewing the students involved in the study revealed that the majority of students preferred the new standards-based system. Students felt that the standards-based system gave them more direction and helped them gain a better understanding of the major concepts. Interviews with these students also suggested they had started to see the teacher more as facilitator and coach, and shifted their focus from earning a high grade towards understanding the material. Finally, students in the standards-based grading system outperformed other 8th

grade classes in their school on the final examination and on the ACT's Explore test (Clymer & Wiliam, 2007).

In an action research project, Knaack, Kreuz, and Zawlocki (2012) investigated the effect of using standards-based grading to address what they perceived was a lack of awareness about student strengths and weaknesses from both parents and teachers. The study involved 14 teachers, 158 students, and 95 parents. Teachers agreed to remove factors other than student achievement towards state standards from grades and sent home reports about students' progress towards state standards twice a week. Surveys given after the treatment revealed that parents thought that teachers could better explain students' grades. Parents also felt that they had a better understanding of the standards required to pass the course and they knew more about students' strengths and weaknesses. Surveys given to students after the treatment revealed that students felt their grades were fairer and that they had a better understanding of teacher expectations. They were also more likely to report that they knew what their strengths and weaknesses were and that they were more likely to ask for help (Knaack, Kreuz, & Zawlocki, 2012).

Haptonstall (2010) investigated the correlation between classroom grades given to students in five different Colorado school districts and scores those students received on the Colorado Student Assessment Program (CSAP) Tests in reading, writing, math, and science. Four of the school districts in the study used traditional grading systems based on the 100 point scale. One school district, the Roaring Fork School District, used a standards-based grading system. The Roaring Fork School District consistently scored higher on average than the other four districts on the CSAP tests, having the highest average in 76 of 166 possible areas. The next best district had the highest average in 43 of

the 166 areas (Haptonstall, 2010). The Roaring Fork School District classroom grades also correlated more closely with CSAP test scores in nearly every subject. For example, classroom grades for reading in districts with traditional points-based grading systems correlated closely with CSAP scores 71% of the time, while reading classroom grades in the Roaring Fork District correlated well 100% of the time. Classroom grades in math in the traditional school districts correlated well with CSAP scores 88% of the time, while classroom grades in math in the Roaring Fork District correlated well 100% of the time. At the conclusion of the study, Hapstonstall (2010) recommended that all school districts consider moving to standards-based grading systems across all grade levels and provide professional development to teachers towards improving grading systems.

It is important to recognize that inconsistencies still exist within standards-based grading. Researchers have found that even among teachers who consider themselves advocates of standards-based grading there is disagreement on practices such as whether or not to grade homework and include effort and participation in scores (Tierney et al., 2011). However, standards-based grading is seen as more consistent, more accurate, more closely correlated with learning, and more supportive of student learning than traditional points based grading (Clymer and Wiliam, 2007; Guskey, 2009; Marzano, 2000; O'Connor and Wormeli, 2011; Pollock, 2007).

METHODOLOGY

The purpose of this study was to determine the effect of standards-based grading (SBG) on student motivation, attitude, and content mastery. I wanted to know if a different type of grading system would help move the focus in the classroom away from simply earning points and towards learning skills and mastering concepts. I wanted to

see if SBG would increase student motivation and improve content mastery. Research

was conducted in three biology classes during the 2013-2014 school year. Each class was

graded for one semester using a points-based grading system and was then assessed using

a standards-based grading system for the second semester. 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).

During the first semester, instruction was broken down into units of related

content, such as *Cell Structure and Function*, *Cell Transport*, and *Cell Reproduction.* For

each unit classwork, homework, labs, and other assignments were collected and assigned

a certain number of points, usually some number out of ten. At the end of each

instructional unit students were assessed with a summative unit test. Students' final

grades were calculated as a weighted average of homework and test scores. Grades were

given as a percentage on the traditional 100-point scale.

At the start of the second semester I made the change to SBG. All units were

broken down into shorter, more specific learning objectives. I used a model of SBG

called *conjunctive standards-based grading*, which means that the learning objectives

were broken down into two levels. Level I objectives were either more basic, lower level

questions or were the most essential learning objectives for the unit. Level II objectives

were more in-depth, more complex, and required higher level thinking. A sample unit,

"Mendelian Genetics and Meiosis," and the associated learning objectives have been

included in this document (Appendix B).

Students were given a list of the learning objectives at the beginning of each unit.

All assignments, activities, and assessments were linked to specific learning objectives.

Instead of having large unit tests, students were assessed using a series of short quizzes

testing between one and five learning objectives at a time. Separate grades for each

learning objective were recorded on a scale from zero to two (Table 1).

Table 1
Learning Objective Rubric

SCORE	MEANING
0	Little knowledge demonstrated.
1	Partial knowledge demonstrated
2	Learning Objective Mastered

Learning objective scores were recorded in a web-based grading system designed

for SBG called Active Grade. Active Grade allows teachers to record multiple

assessments of the same learning objectives and will replace old scores with more recent

assessment scores. Students were able to log in, identify standards they were struggling

in, and then develop a plan to remediate over those concepts. Students were assessed over

each learning objective at least twice during class. They were also given the opportunity

to remediate and reassess over any learning objective throughout the grading period, as

long as they submitted a reassessment form (Appendix C). More recent scores replaced

older scores, whether they were better or worse. Overall grades were then determined for

each unit using the four-point rubric below (Table 2).

Table 2
Unit Grading Rubric

UNIT RUBRIC	
STANDARD SCORE	DESCRIPTION OF PLACE ON SCALE
4.0	In addition to Score 3.0 performance, in-depth inferences and applications that go beyond what was taught directly.

3.5	In addition to Score 3.0 performance, partial success at inferences and applications that go beyond what was taught
3.0	No major errors or omissions regarding any of the information and/or processes (simple or complex) that were explicitly taught. Students have mastered all Level I and II objectives.
2.5	No major errors or omissions regarding the simpler details and processes (Level I objectives) and partial knowledge of the more complex ideas and processes (Level II objectives).
2.0	No major errors or omissions regarding the simpler details and processes (Level I objectives) but major errors or omissions regarding the more complex ideas and processes (Level II objectives)
1.5	Partial knowledge of the simpler details and processes but major errors or omissions regarding the more complex ideas and procedures.
1.0	With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes.
0.5	With help, a partial understanding of some of the simpler details and processes but not the more complex ideas and processes.
0.0	Even with help, no understanding or skill demonstrated.

Rubric adapted from Marzano (2004c).

Some days of instruction were dedicated to introducing new material, while other days were spent with students working individually or in small groups to remediate over missed concepts. Students' achievement of the learning objectives was the most important factor used to determine their grades. Effort, attendance, participation, and other non-achievement factors were recorded separately but did not factor directly into student grades. Because Capital High School required a percentage based grade to be entered at some point, the following method was used to convert unit scores to one

overall grade. All unit scores were averaged, and then final grades were assigned as

follows:

A: 3.0-4.0
B: 2.5-2.99
C: 2.0-2.49
D: 1.5-1.99
F: Below 1.5

At the end of each semester students' content mastery, attitude towards

assessment, and confidence towards learning were assessed and compared. I also

documented interactions between myself and the students with regards to assessment and

grading. Improvements in content mastery were documented by comparing learning

objective mastery on first semester unit tests to learning objective mastery on second

semester learning objective quizzes. First semester tests were given in a different format

than second semester quizzes, so direct comparison between scores was not possible.

Instead, questions on first semester unit tests were tied to the learning objectives for their

respective units. Students' final unit tests were analyzed to determine the percentage of

the learning objectives for each unit that students had mastered. The average percentage

of learning objectives mastered during two first semester units was determined and

compared to the average percentage of learning objectives mastered through multiple

shorter quizzes during two second semester units.

The Semester One Biology Final Exam and the Semester Two Biology Final

Exam were administered at the end of their respective semesters (Appendix D). Exam

scores for each class were averaged to determine an overall score, and scores on the first

semester final were compared to scores on the second semester final. Artifacts of student

quizzes, tests, and other assessments were collected from both classes throughout instruction to give a snapshot of student learning throughout the semester.

Student motivation, confidence and attitude towards assessment were measured through the use of student surveys and interviews. The Student Motivation and Attitude Survey (SMA Survey), an anonymous survey administered over the internet, focused on students' classroom motivation and attitudes towards grading, assessment, and learning (Appendix E). It was administered near the end of first semester and again near the end of second semester. Student answers were then analyzed to look for trends. After the administration of the online survey during the second semester, four random students from each class were selected and interviewed to supplement survey data. The Student Interview questions were similar to the anonymous survey questions but asked students for more detailed explanation (Appendix F).

Teacher Field Notes were recorded to document student-teacher interactions with respect to grading and assessment, and were used to provide further data about student motivation and attitude (Appendix G). Data recorded included observations of the nature of student questions and how often students came in for help outside of class. Special focus was given to conversations between the teacher and individual students that related to their grades. Field notes from first semester were compared to notes from second semester to look for trends. Observations of the quality and completeness of student classwork and homework were also recorded and compared between first and second semester. This, in conjunction with data from the grade book such as missing assignments, was used to answer the research question related to student motivation (Table 3).

Table 3
Triangulation Matrix

Research Questions	Data Source 1	Data Source 2	Data Source 3	Data Source 4
Student attitudes toward assessment	Teacher Field Notes	Student Motivation and Attitude Survey (Pre and Post)	Student Interviews (Pre and Post)	
Student Motivation and Confidence Towards Learning	Teacher Field Notes	Student Motivation and Attitude Survey (Pre and Post)	Student Interviews (Pre and Post)	Record of classwork and homework completion
Content mastery	Mastery of learning objectives	Semester Exams	Artifacts from quizzes and unit tests	Teacher Field Notes
Student-Teacher Interactions Involving Assessment	Teacher Field Notes	Student Motivation and Attitude Survey (Pre and Post)	Student Interviews (Pre and Post)	

DATA ANALYSIS

Analysis of data from the Cell Transport Test and the DNA to Protein Test, both

given pre-treatment during the second quarter, showed that an average of 34% of students

mastered each learning objective (Figure 1)(N=62). Analysis of the post-treatment

Mendelian Genetics Unit and Human Genetics Unit, assessed third quarter through

standards-based grading (SBG), found that an average of 46% of students mastered each
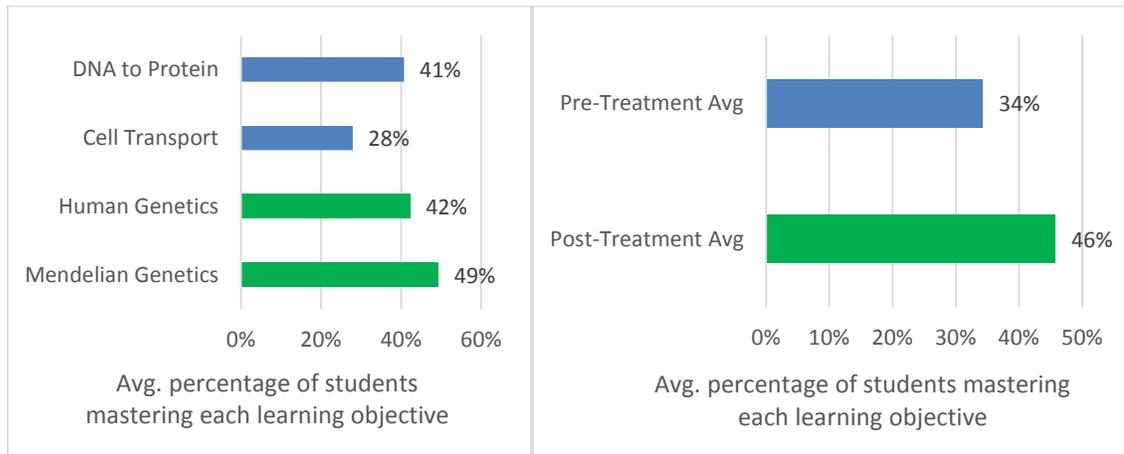
learning objective (N=63).

Figure 1. Pre-treatment and post-treatment mastery of learning objectives on two unit exams during the second quarter compared to mastery obtained after all quizzes over two standards third quarter, ($N = 60$).

Following the implementation of the SBG system, students were asked on the SMA Survey if they thought the SBG system had helped them learn more ($N = 58$). Thirty-nine percent either *strongly agreed* or *somewhat agreed*, 36% were *neutral*, and 26% either *somewhat disagreed* or *strongly disagreed* (Figure 2). However, the average semester test scores from semesters one and two were nearly identical. The average score on the Semester One Biology Final Exam was a 67.6%, and the average score on the Semester Two Biology Final Exam was a 68%.

When asked if they thought the SBG system should be continued one student said, "I think that you, along with all the other teachers in this school, should. It has helped me tremendously and rewards me for knowing the material, not doing redundant tasks that help no one." Another said, "Yes. It makes me learn more to get a good grade, so if I want a good grade I really have to learn the material." However students who did not think the system helped them learn often felt strongly. Of the 26% of students who disagreed with the statement, 62% of them *strongly disagreed*. When asked whether or not to continue SBG one student said, "No because most kids do not have the learning

capability and do not like the idea of having so many quizzes when we could spend more time learning about the topic than just testing over it." Another replied, "No because the system is confusing and difficult."
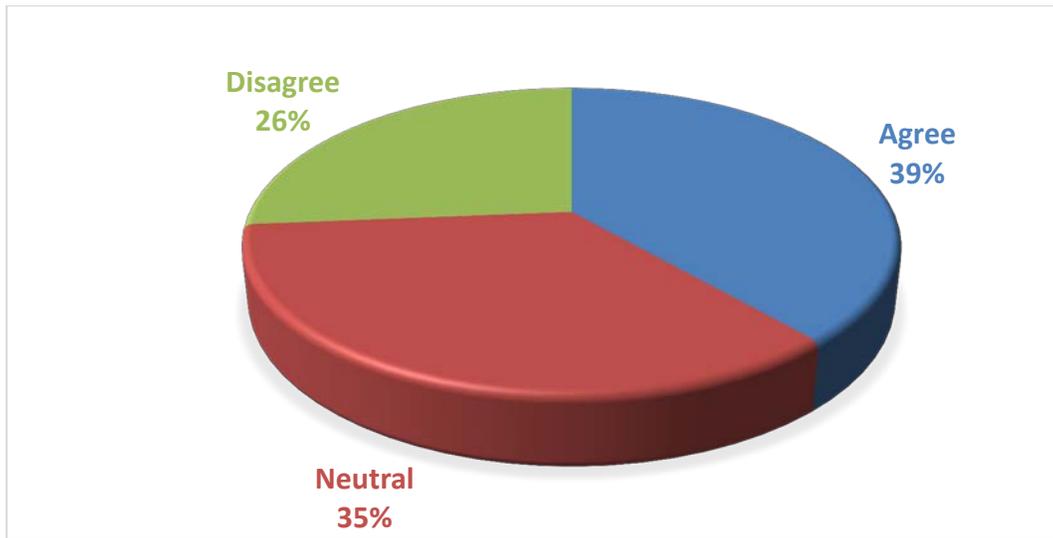

Figure 2. Survey Question: "The standards-based grading system used second semester helped me to learn more," (*N*= 58).

Data from the Student Motivation and Attitude Survey (SMA Survey) also suggested that students' attitude towards assessment improved overall as a result of the treatment. After implementing the SBG system, the percentage of students who felt their grade was fair increased slightly from 45% to 47% (Figure 3). When asked if they thought their grade was fair and why, students gave vary different responses. One student said, "I think it's fair because you're graded on what you learned." Another said, "No, because I do try but it isn't always good enough and doesn't always reach the teachers expectations" Finally another student said, "Somewhat. I think it is important that you learn the material but I also think a little more should be put into doing homework on time and accurately." The percentage of students who thought their grade reflected what they actually knew

increased from 42% to 47% (Figure 3). One student said, "I like it because it is a test of how much you actually know, not how much free time you have at home to do your assignments." The percentage of students who felt they understood how to improve their grade increased from 55% to 60%, and the percentage of students who believed they were capable of improving their grade increased from 64% to 67%. When asked what they liked about the system one student said they liked that, "It gives us more of a chance and lets us have more control over our grades." Some students did find the grading system confusing. Following treatment, the percentage of students who felt they understood how their grade was determined decreased from 51% to 47% (Figure 3). This was supported by data from the Student Interviews, as only 17% of students interviewed where able to describe accurately how their overall grades were calculated ($n = 12$). One student gave an answer that was typical of others interviewed saying, "I guess I don't really get it. I mean I know it is based off of how many things you master, and that there are like two levels, but I guess I don't really understand the overall grade."
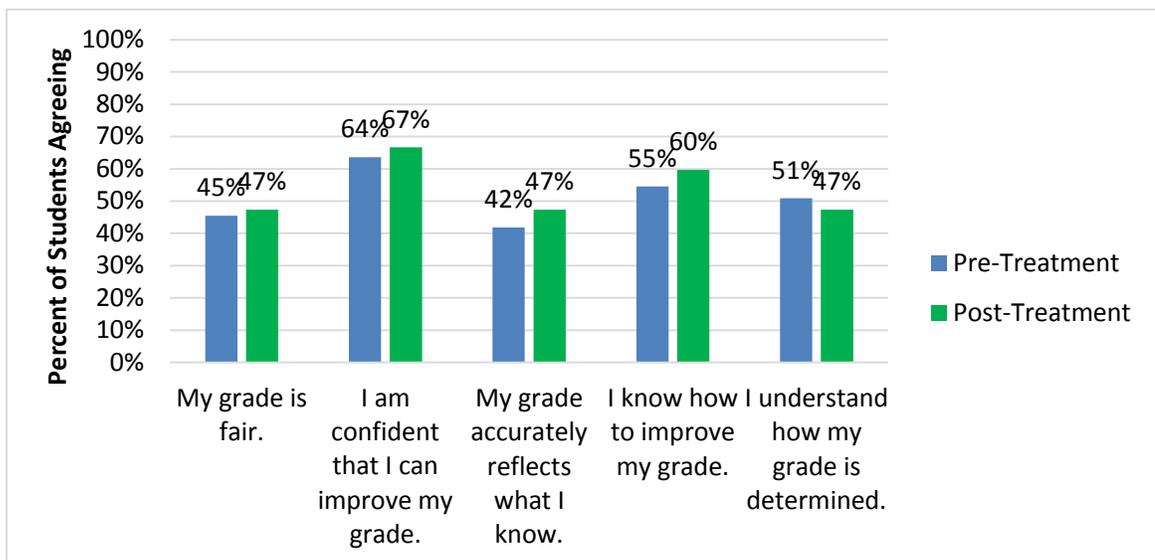

Figure 3. Survey questions related to students' attitudes towards assessment, (*N=58*).

A majority of students, 54%, agreed that the SBG system was more challenging than the regular grading system, while only 18% of students disagreed. When asked what they didn't like about SBG, one student said, "I don't like that if you want to get a good grade you have to come in outside class a lot, and the tests are more difficult." Another student said, "I think we should be able to do homework or labs or something for points to get our grades up. Not everyone is a genius at science!"
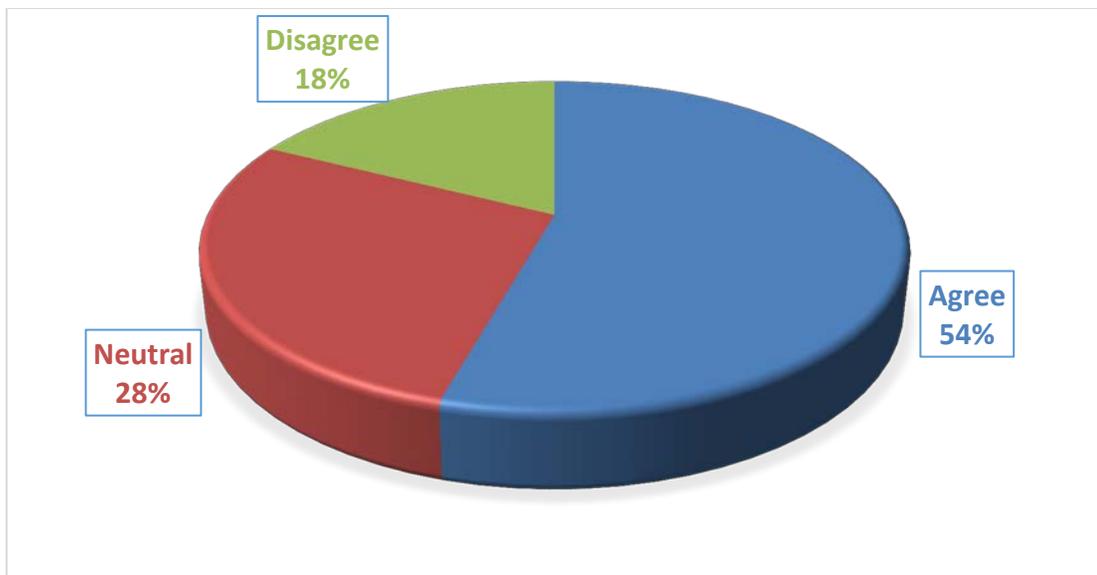
Figure 4. Survey question: "The standards-based grading system used second semester was more challenging than the regular points-based system," (*N*=58).

Data from the post-treatment SMA Survey showed that following the treatment students were less likely to think that some science concepts were too difficult to learn. The number of students who either *somewhat agreed* or *strongly agreed* dropped from 60% to 42%, and the number of students who *strongly disagreed* with this statement more than doubled from 5% to 11% (Figure 5). One student said, "I feel like I have more freedom to learn at my own pace. If I get the material, I can focus on other classes. When

I have troubles in this class, I have more time to figure it out. Especially more chances to learn the material. I feel like the material actually sticks, instead of forgetting it the next day."
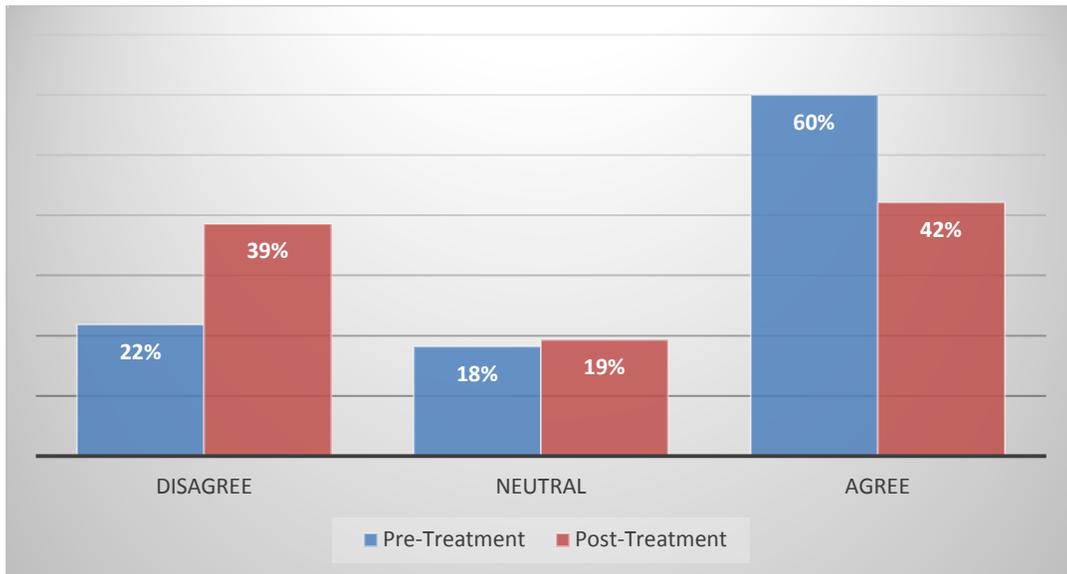
Figure 5. Survey question: "Some science concepts are just too hard for me to learn," (*N*=58).

When asked in SMA survey what they liked about the SBG grading system, 40% of the students specifically mentioned they liked that the SBG system allowed them to re-assess over learning objectives. In addition 75% of students in the Student Interviews described the ability to retake assessments as their favorite part of the grading system. For example one student said, "It has a lot of leeway, and or, wiggle room and that makes me more comfortable because I know I have more of an impact on my grade." Another student said, "The only thing I like is that you can retake tests." Another mentioned that, "I like being able to redo worksheets and tests to improve my grade and understanding, especially because I have test anxiety."

Data from the Teacher Field Notes suggest that the SBG grading system encouraged more students to come in for extra help and helped shift the conversations between the teacher and students from missed assignments and extra credit to learning and understanding. Although there were students who came in at lunch to make up missed tests, no students during the second quarter prior to treatment came in at lunch or outside of class to review or get help on a topic. There were 14 separate instances recorded second quarter where students approached the teacher at the beginning or end of class to ask about their grade. Seven of these conversations happened in the last two weeks before the end of the semester. In 100% of those conversations students asked if they were missing any assignments and if they could still turn them in, but did not ask for help learning the material. Six of these students asked if they could do extra credit to bring their grades up.

The number of students coming in outside of class to review or get help increased from 0% to 18% from second quarter to third quarter. During the third quarter post-treatment, 11 different students came in outside of class, either at lunch or after school (Figure 6). These students came in a total of 23 times to get help and review learning objectives that they needed to master. Although field notes on conversations with students about their grades were not completely comprehensive, it is notable that of the conversations recorded after treatment, only 26% of students asked about whether or not they could turn in missing work, and only 14% of them asked about doing extra credit. This was also supported by data from the SMA Survey. When asked what they could do to improve their grade, one student said, "I come in a lot to get help from Mr. Mannix and that has helped my grade immensely so I could keep coming in or study more often."

Another student said, "You could come in at lunch or at any time that you are free and talk to your teacher about improving your grade."
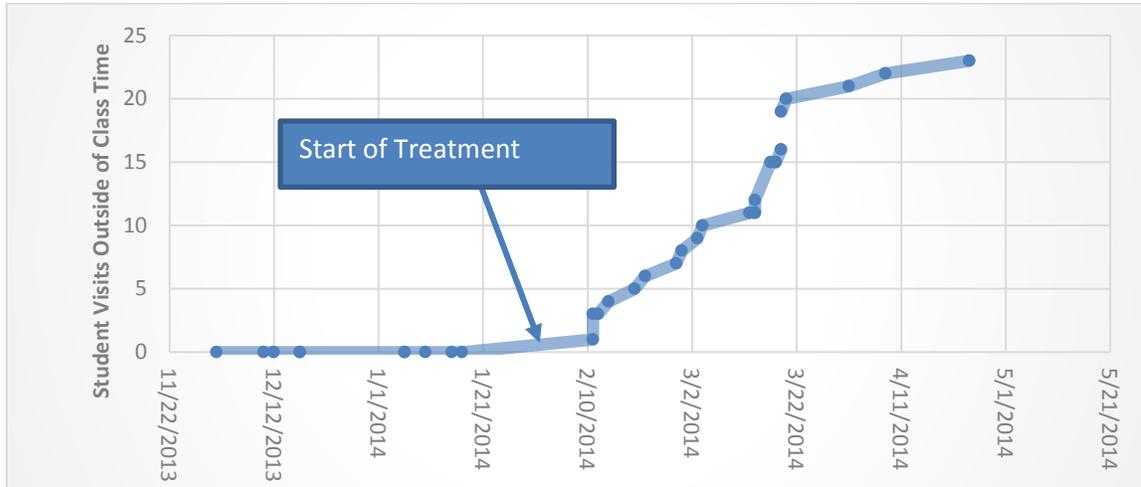
Figure 6. Students coming in for help outside of class time, (*N*=63).

Despite a large increase in the number of students coming in outside of class to get help, on the SMA Survey the number of students claiming to come in outside of class for help decreased significantly. The number of students claiming to come in outside of class for help *sometimes* decreased from 15% to 9%, and the number of students claiming to come in *often* decreased from 11 to 5%. While it is not true that the number of students coming in outside of class decreased, the 9% and 5% estimates are much closer to the actual estimates than students' original claims.

The SBG grading system did have a negative impact on students' homework and classwork completion. Data from the SMA Survey showed a decrease in the number of students claiming to complete homework assignments on time, pay attention in science class, participate in class discussion, and contribute to group work (Figure 7). There was a small increase in the number of students claiming to work hard on homework assignments.
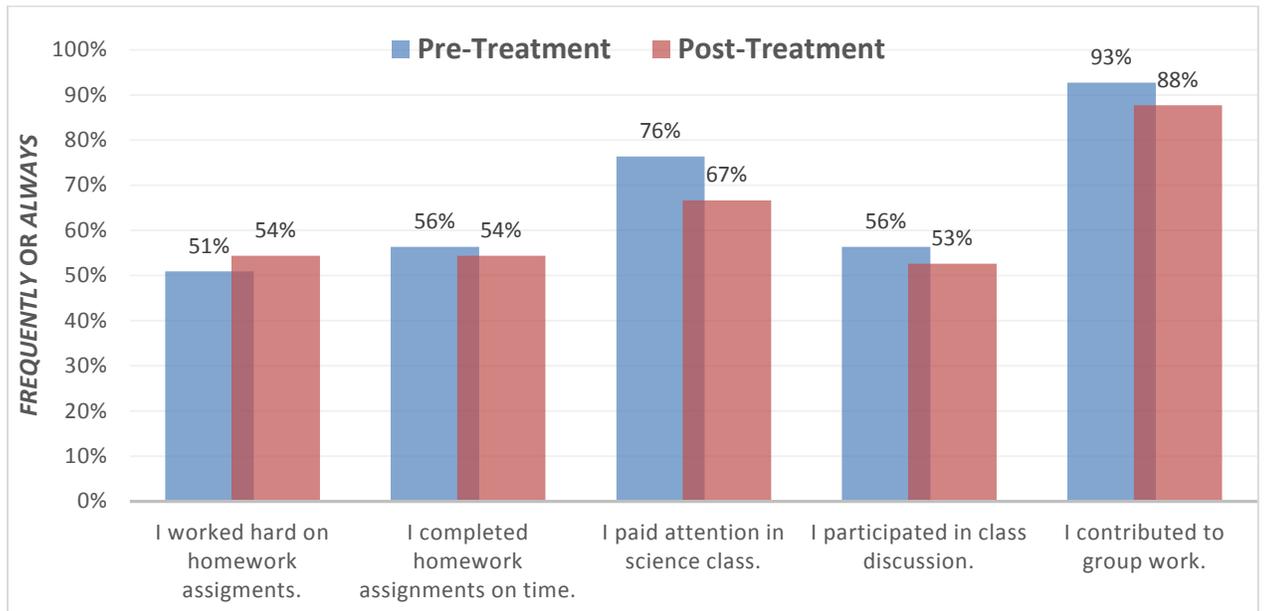
Figure 7. Survey questions related to student homework completion and class participation, (*N*=58).

This was supported by Power School Data, which showed an increase in the number of missing assignments from 2nd quarter to 3rd quarter in all three of my biology classes. On average the number of missing assignments increased from 20% to 29% after implementing the SBG system (Figure 8).
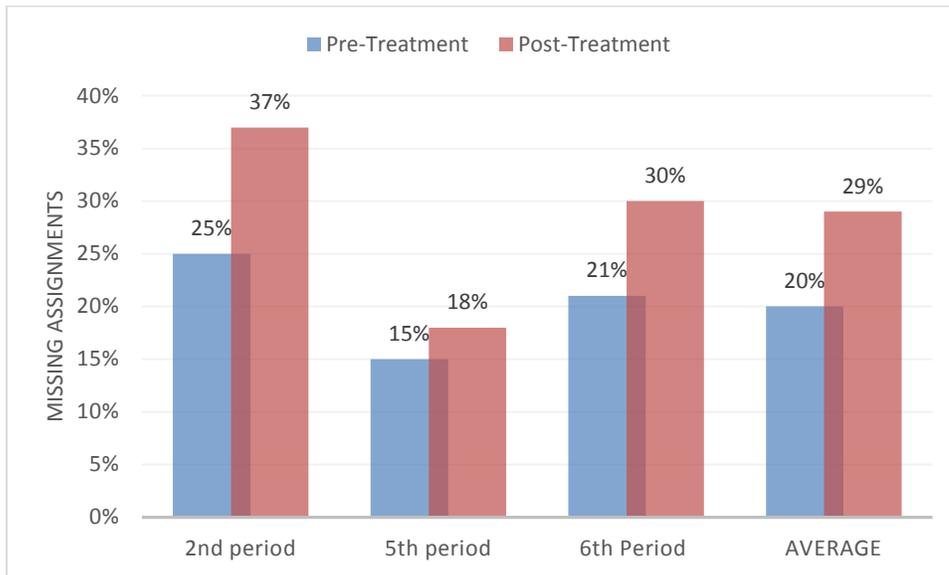
Figure 8. Power School missing assignment data, (*N*=63).

When students were asked what they didn't like about the SBG system, three

different answers were common. First, students and their parents found the system

confusing. When asked on the SMA Survey what they didn't like about the SBG system

27% of the students mentioned that the system was confusing (Figure 9). When

interviewed, only 25% of students were able to describe how their overall grade was

determined with this system accurately, although most were able to describe parts of it.

Eighty-three percent of the students interviewed mentioned that the system was confusing

at first, and most still felt it was confusing at the end of the quarter. One student said, "It

was hard to explain to my parents why my grade was low at the beginning of a unit

sometimes, they would get upset and didn't understand that I could improve it as the unit

went on." Another student said, "Well it is quite confusing at first and still really is to me.

I think it needs to be explained better because the 0, 1, 2 grading system is just

confusing." The second most common complaint, made by 19% of the students taking

the SMA Survey, was that that homework points should make up more of the grade. Many students felt that they had to take too many tests, thought they should have more homework points to pad their grade, and wanted chances to do extra credit. One student commented that, "I do feel like I understand then I get to the quizzes and I feel like I know everything. Then I do bad somehow. We should have more homework worth points because homework is practice so if we have some it will help us learn and motivate us to turn it in for a better grade. Also I think extra credit is a good source." Finally, many students did not like that their grade was based off of mastery. Students made comments such as, "I don't like how you can't get a good grade unless you master all of the level one objectives," and, "You have to master everything in level 1 to get a C!"
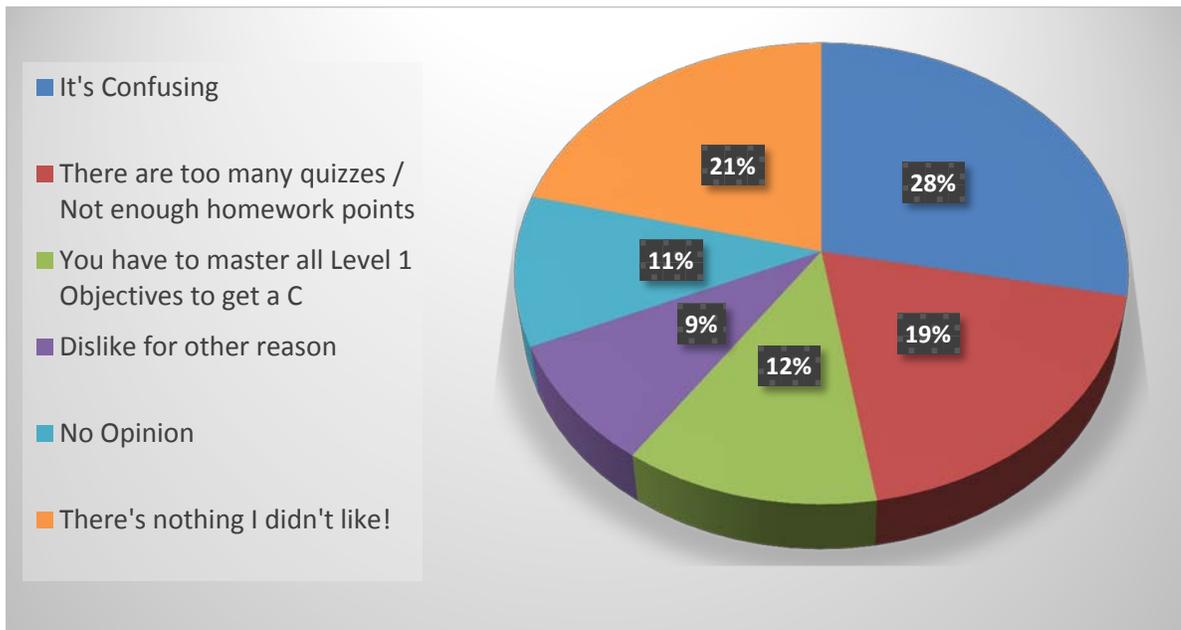

Figure 9. Survey Question: "What didn't you like about the SBG system?" (*N*=58).

INTERPRETATION AND CONCLUSION

The implementation of standards-based grading may have improved the level of content mastery in my biology classroom, although I think more research is needed to

answer that question definitively. The SBG system clearly helped the few students who took advantage of out of class review and reassessments. Students were tested over every learning objective at least twice in class, and although some students did not improve or even did worse on the second or third attempt, most students improved each time they were tested. As shown in Figure 1 above, students were more likely to master unit learning objectives under the SBG system, and a majority of students claimed that the SBG system helped them to learn more. However, this improvement in content mastery was not demonstrated by the semester test scores. I was also left with other questions, such as whether or not I covered less material under the SBG system than I would have otherwise, and if that trade-off was worth it. Some students grew weary of all of the quizzing involved in the system. One student said, "I don't like all of the tests we have. With all the tests we don't have time to actually learn the material." Due to the fact that I tried to test over each learning objective at least twice in class, and sometimes hit some objectives three or four times, I do think we spent more time testing under the SBG system. I occasionally wondered if class time would be better spent on other things. Survey data showed that the percentage of students who said they enjoyed learning actually decreased from 60% to 42%, and this is a worrying statistic for me. The SBG system led me to focus really hard on a few concrete learning objectives, and the opportunities for interesting labs, activities, and enrichment may have decreased. Did the focus on the learning objectives in this system prevent me from doing activities that would have encouraged curiosity and a life-long love of learning in my students? I'm not sure. On the other hand, the percentage of students saying they enjoyed science class increased by 5%, so I'm not sure how to interpret those survey results.

The SBG system improved students' attitude towards assessment. Students nearly unanimously liked having the ability to re-assess over learning objectives, and this is a practice I plan to continue. Allowing reassessments helped relieve stress for students and encouraged students to continue working even after taking a quiz over a concept. Students seemed more likely to pay attention to feedback given on assignments, especially early quizzes. Fostering a growth mindset, or a belief that intelligence can be improved and grades are earned through hard work, is an important educational goal and I believe that the SBG system supports that. The data showed that students' confidence in their own ability to learn difficult concepts improved, and more students felt they had the ability to improve their grades. Not only did students like being able to reassess, but I believe the practice aligns more closely with how research suggests learning really happens. It has the potential to turn nearly every assessment, except for the final semester test, into a formative assessment that students can use to inform themselves and improve. I think the biggest question left in my mind is when to offer these reassessments, and how to set them up. I could reduce the amount of class time spent testing if re-takes were only an option for students coming in outside of class, but then I might miss the students who would benefit from the practice the most. Right now I am thinking about offering re-assessments on a specific day during the week, and allowing students who didn't need to improve their scores to work on some sort of enrichment activity.

One of the most obvious positive effects of the SBG system was how it changed the conversations I had with my students and their parents. Before introducing the SBG system conversations with students and their parents focused almost entirely on late work and extra credit. During the last month of the second quarter before introducing SBG I

had 13 different students come in and ask if they could turn in late work and if they could do extra credit to bring their grade up. Not a single one asked for help reviewing, studying, or understanding a confusing topic. Each time I would tell them that I would accept more recent work for partial credit, explained that I did not give any extra credit, and offered them a chance to retake one of their lower tests. Only one student took advantage of the retake. I even had one student who didn't come in until the last day of the first semester and asked, "What can I do to get my grade up? Can I turn in missing assignments? Is there any extra credit or anything I can do?" This changed very quickly after switching to SBG. If students asked about how to get their grade up I could quickly respond by handing them a reassessment application, showing them which standards they had not mastered yet and suggesting resources they could use to review. When I was sitting in meetings with parents and they asked if there was anything their student could do to bring their grade up, I could quickly respond yes and direct the conversation to important learning objectives, helpful resources on our classroom Moodle page, and times when I was available to help students or give them reassessments. Better yet, several students no longer needed this prodding. For example during the third quarter I would instead get questions such as, "Is there information on Punnett Squares in our book?" or, "Can I come in at lunch on Thursday and review with you?" and, "Could I get help with this worksheet?" I definitely wish more students had taken advantage of it, but I think this change in student-teacher conversation was important.

While there were many positive outcomes, there are also some serious questions and challenges to be addressed. The confusion experienced by students and parents is a significant one. I was the only teacher in the high school using the SBG system, and most

of the students had never seen anything like it before. Despite repeated attempts to explain the four-point grading scale and the Level I and II learning objectives and plenty of practice determining and graphing their current scores, students still did not understand it. Worse yet, parents would need to be reminded nearly every time I talked with them how the system worked. Our school uses Power School to record student grades, but would not allow me to turn on its SBG functionality. I recorded grades in Power School, but had to calculate their overall grades manually. For example a standard score of 2 was equivalent to a C, but in the grade book this would look like a 50%. This led to confusion for students and parents about what their grades in Power School meant, and students were so used to using this system that they just kept looking there rather than on the Active Grade website that I tried to direct them to. Manually calculating the grades was also very time consuming, and had to be re-done any time students turned in late assignments. This left me wondering if I could develop a system that kept the most important points of the SBG system, such as the reassessments and the mastery learning style, while dropping the confusing four-point scale. Would simply using a ten-point rubric rather than a four-point rubric eliminate much of the confusion? Is there a way that I can record student scores on multiple assessments while still using the same basic format students and parents are used to seeing in the on-line Power School grade book?

I also have some other important questions. It was difficult to keep advanced students engaged while also giving struggling students time to master basic learning objectives. How can I provide advanced students more enrichment in the future? How can I focus on reassessment and mastery while still making class engaging and providing exciting learning opportunities? How can I better assess science process skills? Students

grew tired of the constant quizzes and tests, is there any way I can reduce the number, length, and/or frequency of tests in the future? How can I get more students to take advantage of the reassessments? Is there a way to provide additional opportunities to do so in class so that struggling students are more likely to take advantage of it? Will this cause students to further reduce their effort on homework? Is this even a serious problem? There are certainly some challenges to the implementation of this system, but overall I'm excited about the changes I'm making to my classroom and the potential I think this system has.

VALUE

I think that SBG has the potential to improve learning outcomes greatly by shifting the focus in the classroom from earning points to learning concepts and skills. As teachers we often get frustrated that students and their parents are focused on earning points, but that is exactly what we reward them for. This action research-based classroom project showed that SBG effectively changes the conversations that we have with our students. It allows teachers to redirect students immediately from questions about late-work and extra credit to questions about important skills, educational resources, and content. My research showed that SBG may help improve students' confidence in their ability to learn, increase content mastery, reduce test anxiety, as well as encourage students to come in for help outside of class.

The process of designing and implementing the SBG system led to personal and professional growth for me as a teacher. For example, the simple act of creating learning objectives to be assessed in each unit forced me to look at my instruction and assessment much more thoroughly than in the past. Choosing an assessable number of learning

objectives forced me to spend hours contemplating what the most important concepts and skills of each unit where, and which ones needed to be cut. This will be an ongoing process each year, and is one that I think most teachers would benefit from. Through completing this project I have grown much more familiar with state, district, and the Next Generation Science Standards, and have more closely aligned my instruction to them. I feel that my instruction is now more focused on the most important skills and information.

I also had to go over my assessments with a fine-toothed comb. In the past I would look through question banks and my study guide and choose questions that were related to concepts I taught. I would try to choose some relatively easy questions and some difficult questions, and then I would write some of my own questions to address specific things I had covered or to try to challenge students to think critically. However, when I started trying to tie those tests to my learning objectives I quickly realized that I would often hit one learning objective or concept over and over while completely missing others. It also made me think more critically about different types of assessments. Using SBG forced me to think hard about the best way to assess each learning goal rather than just throwing interesting questions that were related to the unit on the test. The process of tying quiz questions to specific standards makes you very aware of what you are actually assessing. It made me realize that although I personally put a lot of value on science skills such as designing experiments, interpreting evidence, and arguing effectively, most of my grades remain content based. I had planned to create a separate set of science process standards unrelated to specific content that I would assess and use to determine a significant portion of students' grades, but ended up not doing so. Science process

standards became small parts of larger content-oriented standards. I hope to change that next year. Again, this process of closely examining your assessments would be a powerful practice for any teacher.

I don't think that all teachers need to assess students through a specific SBG format, but I think that there are some components of the system that would improve the practice of many teachers that could be implemented fairly easily. For example, any teacher could take a much closer look at their learning objectives to decide what the most important goals are, and then spend time aligning their lessons and assessments to those goals. One of the more powerful and popular practices seemed to be the ability for students to reassess to demonstrate mastery. It would be simple for teachers to develop a system for allowing students to reassess over different instructional units. Even giving more formative assessments would be a step in the right direction. Teachers could take steps to encourage or require students to master different skills or content, and they could reduce the emphasis on earning points. As an example, they could reduce or eliminate the emphasis on points given for attendance, homework, extra credit, or other behavioral characteristics. Finally, I would recommend the action research process to any teacher. Going through this process has encouraged me to become a more reflective teacher. I have learned more about my students through surveys, interviews, and other data collection methods. Conducting action research has forced me to clarify my own educational philosophy and further develop the goals I have for my students and myself. The action research process has made me a more competent and confident teacher.

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APPENDICES

APPENDIX A

MONTANA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD
EXEMPTION

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

MONTANA STATE UNIVERSITY

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MEMORANDUM

TO: Logan Mannix and John Graves

FROM: Mark Quinn, Chair *Mark Quinn CQ*

DATE: November 15, 2013

RE: "What Are the Effects of Using Standards-Based Grading on Student Learning and Behavior?"
         [LM111513-EX]

The above research, described in your submission of November 15, 2013, 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

SAMPLE UNIT AND LEARNING OBJECTIVES

Biology Standards: Mendelian Genetics and Meiosis

		Level 1 – Students are able to:
MGM	A	Identify what an "allele" is, and explain the difference between dominant and recessive alleles, distinguish between genotype and phenotype, and identify heterozygous and homozygous genotypes.
MGM	B	Use the law of probability and Punnett squares to predict genotypic and phenotypic ratios for monohybrid crosses.
MGM	C	Make simple inferences about the genotypes and phenotypes of parents and offspring in simple crosses.
MGM	D	Identify the major differences between the results of Mitosis and Meiosis, including the number of cell divisions and cells produced, changes in chromosome number, and the similarity of the resulting cells.
MGM	E	Differentiate between diploid and haploid cells, and identify why it is important to have haploid gametes.

		Level II – Students are able to:
MGM	F	Use the law of probability and Punnett squares to predict genotypic and phenotypic ratios for monohybrid and dihybrid crosses.
MGM	G	Use knowledge of Mendelian Genetics to make more in depth inferences about genetic crosses.
MGM	H	Summarize the law of segregation and the law of independent assortment. Identify when the law of independent assortment does not apply.
MGM	I	Diagram and explain in detail the process of meiosis, identifying differences between mitosis and meiosis at each stage in the process.
MGM	J	Explain the process of Crossing Over, when it occurs, and how it leads to further genetic diversity.
MGM	K	Explain how the process of meiosis leads to diversity in sexually reproducing organisms, and identify connections between meiosis and Mendel's laws of Segregation and Independent Assortment.

		Level III – Going Beyond
MGM	L	Student goes beyond what was taught directly in class by making in-depth inferences about genetic crosses, predicting the results of complex crosses, etc.

APPENDIX C

RE-ASSESSMENT APPLICATION FORM

Re-assessment Application

Hey Mr. Mannix,

I hope you are having a lovely, wonderful day. I was thinking… I would really like to reassess over standard (s): *[Ex: Mendelian Genetics standards 1A and 1B]*

The reasons I think I didn't do well on that skill/content on the last assessment are:
*[list reasons here. Why **specifically** don't you think you had a firm understanding of the material? What didn't you do that prevented you from having a firm grasp of the material? The point is to be honest here, so that you can learn from your actions. If you didn't study, say that. If you just looked over problems, but didn't practice them, say that. Whatever.]*

Since the assessment, I have done the following specific things to make sure I understand this skill/content:
[list the different things you did to learn this material or practice this skill. Be specific… talk about who you worked with, what problems you worked on, the video/lecture you watched, online resource you used, etc]

Would it be possible to reassess over this standard on [date/time here]
Sincerely, your devoted mad scientist in training,
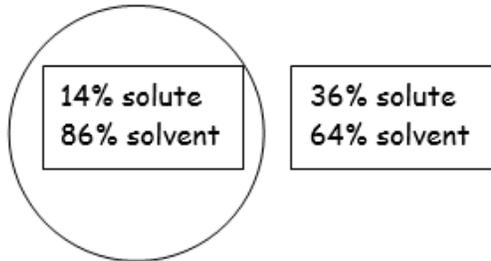*[your name]*

APPENDIX D

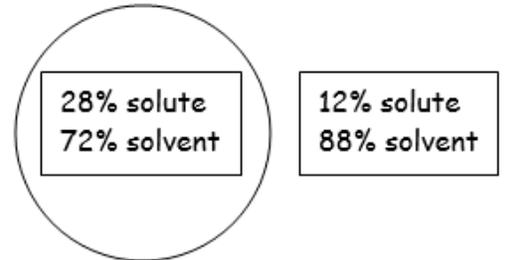SEMESTER EXAMS

Biology Semester 1 Final

Questions 1-6.
Each of the four drawings represents a separate situation. The circle represents a cell membrane with the solute/solvent concentration of the cell inside the circle (the rectangle inside), and the solute/solvent concentration of the solution outside cell (the rectangle outside circle). The solute in these cells is salt and the solvent is water.

Situation One

14% solute
86% solvent

36% solute
64% solvent

Situation Two

28% solute
72% solvent

12% solute
88% solvent

Situation Three

56% solute
44% solvent

56% solute
44 % solvent

Situation Four

27% solute

89 % solute
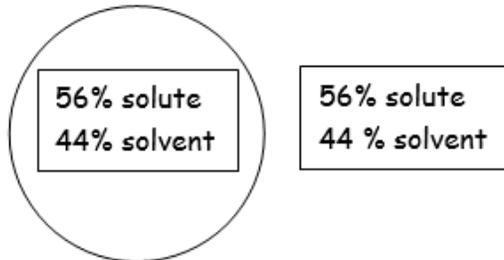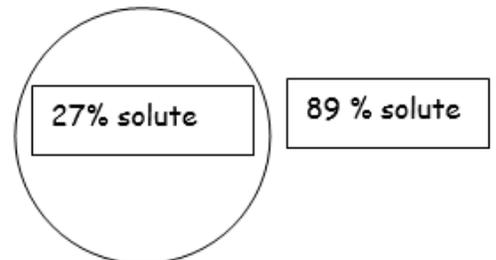
For each of the following questions, match them with the letter of the correct answer in the word bank.

a. hypotonic
b. hypertonic
c. isotonic
d. into the cell

e. out of the cell
f. the cell will shrink
g. the osmotic pressure will go up

_____ 1. In situation one will water initially move into or out of the cell?

_____ 2. In situation two will water initially move into or out of the cell?

_____ 3. In situation three the concentration outside the cell is _____to the cell?

_____ 4. In situation four the concentration outside the cell is _____to the cell?

_____ 5. If situation one is an animal cell, what phrase will best describe the situation?

_____ 6. If situation two is a plant cell, what phrase will best describe the situation?

_____ 7. In pea plants, tall (T) is dominant over short (t). Cross a heterozygous tall plant with a short plant. What is the expected phenotypic ratio resulting from this cross?

a. 3 tall : 1 short
b. 1 tall : 1 short

c. 1 tall : 2 short : 1 medium
d. 100% short

____ 8. Using the data from the previous question, predict the number of short plants you would find in a field of 500 plants produced by this cross.

    a. 250 short plants   c. 500 short plants
    b. 300 short plants   d. 0 short plants

____ 9. A pea farmer has a crop that consists of 1028 pea plants. Of these 1028 plants, 200 are short and 828 are tall. What are the parent genotypes that would likely produce this crop? You may need to complete multiple Punnett squares.

    a. Tt x tt   c. Tt x Tt
    b. TT x tt   d. tt x tt

____ 10. Using the principles of probability, predict the probability of a family having 3 daughters in a row.

    a. 1/2 or 0.5   c. 1/8 or 0.125
    b. 1/4 or 0.25   d. 1/16 or 0.0625

MATCHING: For problems 11-15, use the word bank to answer the questions.

    a. cell (plasma) membrane   d. nucleus
    b. mitochondria   e. ribosome
    c. chloroplast

____ 11. The site of photosynthesis in plant cells

____ 12. The organelle that holds DNA and controls the cell's activities

____ 13. Power house of the cell, provides ATP

____ 14. Protein Factories

____ 15. Semi permeable layer that surrounds the cell

Cell 1   Cell 2   Cell 3
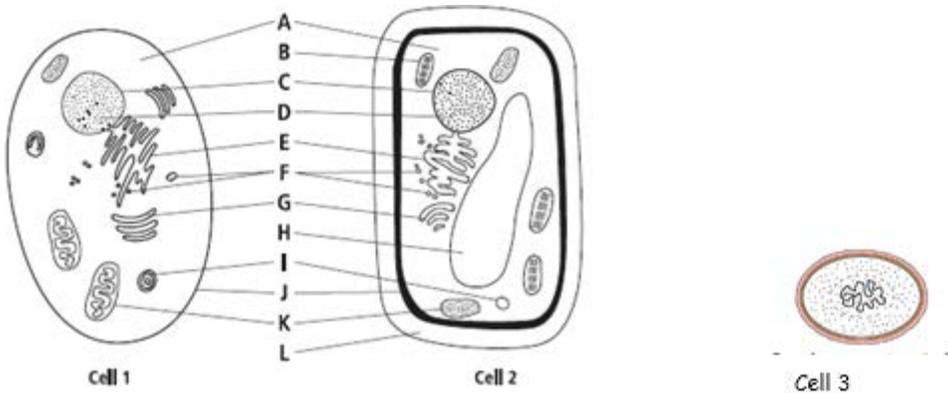
____ 16.

Cell #3 is a _____ because it _____ contain a nucleus

    a. prokaryote -does   c. eukaryote - does
    b. prokaryote - does not   d. eukaryote - does not

____ 17. What type of cell is Cell #1?

a. prokaryote - plant   c. eukaryote - plant
b. prokaryote - animal   d. eukaryote - animal

Second letter

____ 18.

Look at the DNA code below. Using the mRNA codon chart above, show what the result of transcribing and translating the segment of DNA would be. Assume that strand "A" is the template DNA strand. Show your work clearly below, and finish with the resulting protein.
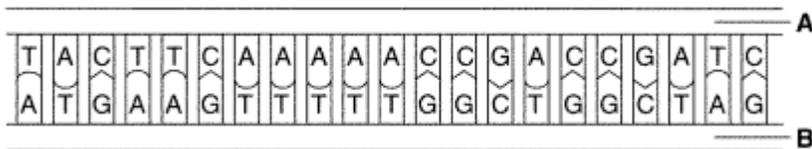
Transcribe the DNA sequence. The resulting mRNA is

a. ATGAAGTTTTTGGCTGGCTAG   c. AUGAAGUUUUUGGCUGGCUAG
b. ACGGGCCCAAAAAGCCCCGAGG   d. UACUUCAAAAACCGACCGAUC

____ 19. Translate the mRNA into the resulting protein sequence.

a. met – lys – phe – leu – ala – gly - stop   c. met – arg – thr – gly – ala – phe– stop

b. tyr – phe – lys – asn – arg – pro – ile   d. met – lys – phe –val – ala – gly – stop

____ 20. A diver measured the water depth in meters and then counted the number of sea anemones she finds at the various ocean depths. Below is a graph of her results.

water depth (meters) vs. number of sea anemones

$y = -0.6x + 14.6$
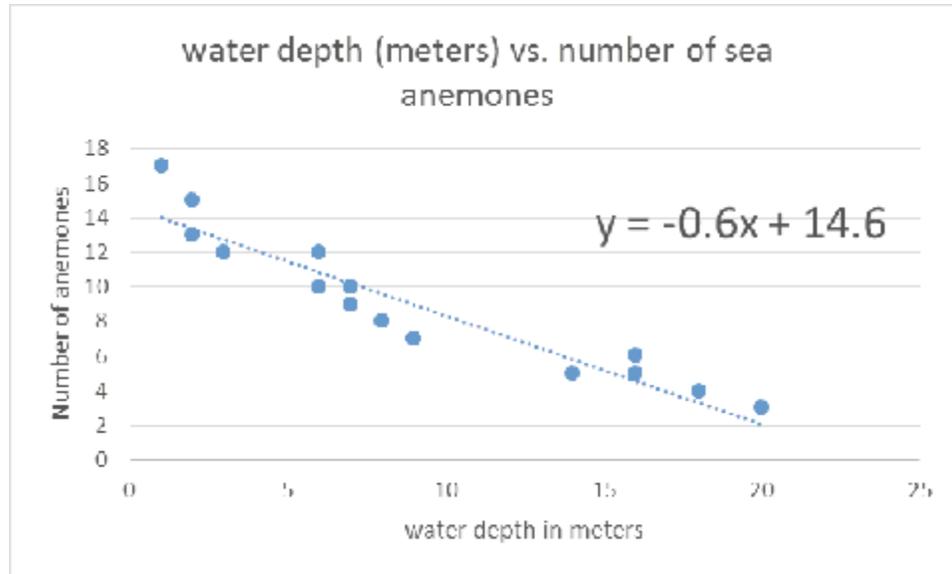
Which of the following is correct about the above graph?

a. Water depth is the independent variable and the number sea anemones is the dependent variable.

b. Number of anemones is the independent variable and the water depth is the dependent variable.

____ 21. The trend line indicates a

a. Positive relationship (the deeper you go, the more anemones you find)

b. Negative relationship (the deeper you go, the fewer the anemones you find)

c. No relationship (the water depth has nothing to do with the number of sea anemones)

____ 22. The equation of the trend line above is $y = -0.6x + 14.6$. If a diver goes down to a depth of 21 meters, how many anemones can he predict to find at the depth?

a. 0

b. 2

c. 21

d. It can't be predicted

____ 23. Which of the following statements is _correct_ concerning the comparison between mitosis and meiosis?

a. Mitosis is involved in sexual reproduction and meiosis is involved in somatic (body) cell division.

b. Mitosis produces haploid cells and meiosis produces diploid cells.

c. Mitosis produces genetically identical

d. Mitosis occurs only in eukaryotes and meiosis occurs only in prokaryotes.

e. Mitosis has two divisions and meiosis has one division.

cells and meiosis produces genetically different cells.

____ 24. Which of the following is a major difference between mitosis and meiosis?

a. Interphase is present only in mitosis.

b. Homologous chromosomes associate only in meiosis.

c. DNA replication occurs only in mitosis.

d. Sister chromatids separate only in meiosis.

e. Chromosomes line up on the cell equator only in meiosis.

____ 25. A cell has the genotype AaBb. After meiosis, how many combinations of alleles will be present in the gametes?

a. 2
b. 4
c. 8

d. 16
e. 54

Capital Biology Semester II Final

Mendelian Genetics

____ 1. The different forms of a gene are called
    a. traits.
    b. pollinations.
    c. alleles.
    d. hybrids.

____ 2. If a pea plant has a recessive allele for green peas, it will produce
    a. green peas if it also has a dominant allele for yellow peas.
    b. both green peas and yellow peas if it also has a dominant allele for yellow peas.
    c. green peas if it does not also have a dominant allele for yellow peas.
    d. yellow peas if it does not also have a dominant allele for green peas.

____ 3. If a pea plant's alleles for height are *tt,* what is true of its parents?
    a. Both parents were tall.
    b. Both parents were short.
    c. Both parents contributed a recessive allele.
    d. Both parents contributed a dominant allele.

____ 4. Organisms that have two identical alleles for a particular trait are said to be
    a. hybrid.
    b. homozygous.
    c. heterozygous.
    d. dominant.

____ 5. In humans a Widows Peak (W) is dominant over a straight hairline (w). In a family Jim, the dad, has a straight hairline, while is wife Lisa has a widows peak. They have three kids. The oldest boy, Sam, has a widows peak. The second oldest, Trish, also has a widows peak. The youngest, Ross, has a straight hairline.

What is Jim's phenotype?

a. WW
b. Ww
c. ww

d. Widow's peak
e. Straight hairline
f. you can't be sure.

_____ 6. In humans a Widows Peak (W) is dominant over a straight hairline (w). In a family Jim, the dad, has a straight hairline, while is wife Lisa has a widows peak. They have three kids. The oldest boy, Sam, has a widows peak. The second oldest, Trish, also has a widows peak. The youngest, Ross, has a straight hairline.

What is Jim's genotype?

a. WW
b. Ww
c. ww

d. Widow's peak
e. Straight hairline
f. you can't be sure.

_____ 7. In humans a Widows Peak (W) is dominant over a straight hairline (w). In a family Jim, the dad, has a straight hairline, while is wife Lisa has a widows peak. They have three kids. The oldest boy, Sam, has a widows peak. The second oldest, Trish, also has a widows peak. The youngest, Ross, has a straight hairline.

What is Lisa's genotype?

a. WW
b. Ww
c. ww

d. Widow's peak
e. Straight hairline
f. you can't be sure.

_____ 8. In humans a Widows Peak (W) is dominant over a straight hairline (w). In a family Jim, the dad, has a straight hairline, while is wife Lisa has a widows peak. They have three kids. The oldest boy, Sam, has a widows peak. The second oldest, Trish, also has a widows peak. The youngest, Ross, has a straight hairline.

If Jim and Lisa have a fourth child, what is the probability that the child will have a widows peak?

a. 1/4
b. 3/4
c. 1/2

d. A little more than 3/4, because they would then have the correct ratio.
e. A little less than 3/4, because they have already have two kids with that trait.
f. A little less than 1/4, because they already have two kids with that trait.

_____ 9. In humans a Widows Peak (W) is dominant over a straight hairline (w). In a family Jim, the dad, has a straight hairline, while is wife Lisa has a widows peak. They have three kids. The oldest boy, Sam, has a widows peak. The second oldest, Trish, also has a widows peak. The youngest, Ross, has a straight hairline.

Which of the following is NOT true?

a. Jim and Lisa could have had children that all had widows peaks.
b. Jim and Lisa could have had children that all had straight hairlines.
c. Jim and Lisa could produce children with any genotype, WW, Ww, or ww.
d. Boys and Girls are equally likely to have a widows peak.

Meiosis

_____ 10. Unlike mitosis, meiosis results in the formation of

a. Four cells that are diploid.
b. Four cells that are haploid.
c. two cells that are diploid.
d. two cells that are haploid.

____ 11. What is formed at the end of meiosis?
    a. two genetically identical cells
    b. four genetically different cells
    c. four genetically identical cells
    d. two genetically different cells

____ 12. The process of cell division called Meiosis produces Gametes that have
    a. homologous chromosomes.
    b. twice the number of chromosomes found in body cells.
    c. two sets of chromosomes.
    d. one allele for each gene.

13. What do we mean when we say that gametes (sperm and egg cells) are haploid? Why is it important for sperm and egg cells to be haploid?
_____
_____
_____
_____
_____
_____
_____

Human Genetics

____ 14. Human genetics is often more complicated than simple mendelian genetics. For example, Human blood type is determined by three main alleles, the A,B, and O alleles. This is an example of non-mendelian inheritance called
    a. Pleiotropy   c. Incomplete Dominance
    b. Multiple Alleles   d. Allele multiplication

____ 15. A father with Type B blood and a Mother with type A blood have a child. Which of the following Blood types are NOT possible in their children?
    a. Type A   d. Type O
    b. Type B   e. All of the above are possible, depending on the parents genotypes.
    c. Type AB

____ 16. A father with type AB blood has children with a mother who has Type O blood. What percentage of their offspring would you expect to have Type A blood?
    a. 25%   d. 100%
    b. 50%   e. Type A blood is not possible from this cross.
    c. 75%

17. When Gegor Mendel did his pea plant studies, he assumed that one gene controlled one trait, and that each gene was controlled by two alleles. We now know that many traits in genetics are not that simple. List AND Describe three types of inheritance that break this rule.

Hemophelia is a disease in which one or more of the normal blood clotting factors is not produced. This results in lots of bleeding from even minor cuts and injuries. Hemophelia is recessive and is carried on the X-chromosome.

Queen Victoria of England was a carrier of the gene for hemophilia. Her husband did not have the disorder. Draw a Punnette Square showing the cross of Queen Victoria and her husband. Predict the percentage of their children, (boys and girls) that would be expected to have hemophelia.

a. 0%   d. 75%
b. 25%   e. 100%
c. 50%

____ 18. Percentage of Boys with hemophelia

____ 19. Percentage of Girls with hemophelia

Natural Selection

20. What three things must be present for natural selection to occur?

____ 21. In the finch population, what are the primary changes that occur gradually over time?
   a. The traits of each finch within a population gradually change.
   b. The proportions of finches having different traits within a population change.
   c. Successful behaviors learned by finches are passed on to offspring.
   d. Mutations occur to meet the needs of the finches as the environment changes.

____ 22. Depending on their beak size and shape, some finches get nectar from flowers, some eat grubs from bark, some eat small seeds, and some eat large nuts. Which statement best describes the interactions among the finches and the food supply?

   a. Most of the finches on an island cooperate to find food and share what they find.
   b. Many of the finches on an island fight with one another and the physically strongest ones win.
   c. There is more than enough food to meet all the finches' needs so they don't need to compete for food.
   d. Finches compete primarily with closely related finches that eat the same kinds of food, and some may die from lack of food.

____ 23. How did the different beak types first arise in the Galapagos finches?
   a. The changes in the finches' beak size and shape occurred because of their need to be able to eat different kinds of food to survive.
   b. Changes in the finches' beaks occurred by chance, and when there was a good match between beak structure and available food, those birds had more offspring.
   c. The changes in the finches' beaks occurred because the environment induced the desired genetic changes.
   d. The finches' beaks changed a little bit in size and shape with each successive generation, some getting larger and some getting smaller.

____ 24. What type of variation in finches is passed to the offspring?
   a. Any behaviors that were learned during a finch's lifetime.
   b. Only characteristics that were beneficial during a finch's lifetime.
   c. All characteristics that were genetically determined.
   d. Any characteristics that were positively influenced by the environment during a finch's lifetime.
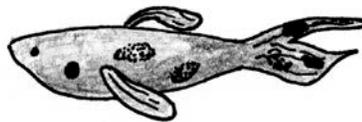
____ 25. **Venezuelan guppies**

Guppies are small fish found in streams in Venezuela. Male guppies are brightly colored, with black,

red, blue and iridescent (reflective) spots. Males cannot be too brightly colored or they will be seen and consumed by predators, but if they are too plain, females will choose other males. Natural selection and sexual selection push in opposite directions. When a guppy population lives in a stream in the absence of predators, the proportion of males that are bright and flashy increases in the population. If a few aggressive predators are added to the same stream, the proportion of brightcolored males decreases within about five months (3-4 generations). The effects of predators on guppy coloration have been studied in artificial ponds with mild, aggressive, and no predators, and by similar manipulations of natural stream environments (Endler, 1980).
Choose the one answer that best reflects how an evolutionary biologist would answer.

Fitness is a term often used by biologists to explain the evolutionary success of certain organisms. Which feature would a biologist consider to be most important in determining which guppies were the "most fit"?

a. large body size and ability to swim quickly away from predators

c. high number of offspring that survived to reproductive age

b. excellent ability to compete for food

d. high number of matings with many different females.

____ 26.

Canary Island Lizards
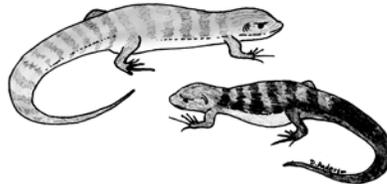
The Canary Islands are seven islands just west of the African continent. The islands gradually became colonized with life: plants, lizards, birds, etc. Three different species of lizards found on the islands are similar to one species found on the African continent (Thorpe & Brown, 1989). Because of this, scientists assume that the lizards traveled from Africa to the Canary Islands by floating on tree trunks washed out to sea. **Choose the one answer that best reflects how an evolutionary biologist would answer.**

A well-established population of lizards is made up of hundreds of individual lizards. On an island, all lizards in a lizard population are likely to . . .

a. be indistinguishable, since there is a lot of interbreeding in isolated populations.

c. be similar, yet have some significant differences in their internal and external features.

b. be the same on the inside but display differences in their external features.

d. be the same on the outside but display differences in their internal features.

____ 27. What could cause one species to change into three species over time?

a. Groups of lizards encountered different island environments so the lizards needed to become new species with different traits in order to survive.

c. There may be minor variations, but all lizards are essentially alike and all are members of a single species.

b. Groups of lizards must have been geographically isolated from other groups and random genetic changes must have accumulated in these lizard populations over time.

d. In order to survive, different groups of lizards needed to adapt to the different islands, and so all organisms in each group gradually evolved to become a new lizard species.

____ 28. According to the theory of natural selection, where did the variations in body size in the three

species of lizards most likely come from?

a. The lizards needed to change in order to survive, so beneficial new traits developed.

b. The lizards wanted to become different in size, so beneficial new traits gradually appeared in the population.

c. Random genetic changes and sexual recombination both created new variations.

d. The island environment caused genetic changes in the lizards.

Evidence for Evolution

_____ 29. In science, theories are:

a. an educated guess

b. a known fact

c. absolute and unchangeable

d. the best explanation for a large set of data and observations

_____ 30. The tiny useless wings of a kiwi bird, the pelvis of a whale, and the appendix of a human are all examples of

a. homologous traits

b. vestigial traits

c. analogous traits

d. evolutionary traits

_____ 31. All modern primates share a variety of characteristics, but one of the most well known is the opposable thumb. This opposable thumb in all primates would be considered a

a. Vestigial structure

b. Homologous structure

c. Atavism

d. Bad design

32. Choose at least three of the following fields of study, and explain how they have provided evidence supporting evolutionary theory.

Biogeography
Fossils
Embryology
DNA and Molecular Biology
Homologies, Vestigial Structures, Atavisms, Bad Design

COMMON NAME	Meadow garlic	Yellow Widelip Orchid	Lady of the night cactus	Cultivated Garlic	Sanddollar cactus
Kingdom	Plantae	Plantae	Plantae	Plantae	Plantae
Phylum	Magnoliophyta	Magnoliophyta	Magnoliophyta	Magnoliophyta	Magnoliophyta
Class	Liliopsida	Liliopsida	Magnoliopsida	Liliopsida	Magnoliopsida
Order	Asparagales	Asparagales	Caryophyllales	Asparagales	Caryophyllales
Family	Alliaceae	Orchidaceae	Cactaceae	Alliaceae	Cactaceae
Genus	Allium	Liparis	Cereus	Allium	Astrophytum
Species	Canadense	loeselii	hexagonus	sativum	asterias

Figure 3: Classification Chart

_____ 33. Are all plants in the family Orchidaceae also in the phylum Magnoliophyta?

a. Yes, all Orchidaceae are in the same phlum

b. No, there are probably several phyla

c. Maybe, but we can't be sure, there could be some that are in a different phylum.

d. An organism's family has nothing do do

represented in the family Orchidaceae   with its phylum.

34. Which of the plants in the table are most closely related? How do you know?

35. Are the orchids more closely related to cactus like plants or garlic plants? How do you know?

36. Using the chart of plant classification, describe what you think a plant with the scientific name *Cereus hildmannianus* would be like. How do you know?

Classification

____ 37. Four students researched the classifications of the following eight whales:

• killer whale, *Orcinus orca*

• gray whale, *Eschrichtius robustus*

• humpback whale, *Megaptera novaeangliae*

• pygmy right whale, *Caperea marginata*

• fin whale, *Balaenoptera physalus*

• minke whale, *Balaenoptera acutorostrata*

• North Atlantic right whale, *Eubalaena glacialis*

• bowhead whale, *Balaena mysticetus*

 The students were asked which two whales are most closely related and why. The table below summarizes the students' answers.

Student	Whales Most Closely Related	Reason
1	killer whale and gray whale	They are both mammals.
2	humpback whale and pygmy right whale	They are both whales.
3	fin whale and minke whale	They are both in the same genus.
4	North Atlantic right whale and bowhead whale	They are both in the same family.

 Based on the classifications, which student gave the correct answer to the question?

a. Student 1   c. Student 3
b. Student 2   d. Student 4

____ 38. Based on their names, you know that the baboons *Papio annubis* and *Papio cynocephalus* do NOT belong to the same
a. class.
b. family.
c. genus.
d. species.

____ 39. For many species, there are often regional differences in their
    a. common names.
    b. scientific names.
    c. taxa.
    d. binomial nomenclature.

____ 40. In an evolutionary classification scheme, species within one class should
    a. be more closely related to one another than they are to species in other classes
    b. be less closely related to one another than they are to species in other classes
    c. be limited to species that can interbreed.
    d. all be mammals

Figure 4-3 Evolutionary Analysis, 4/e
© 2007 Pearson Prentice Hall, Inc.
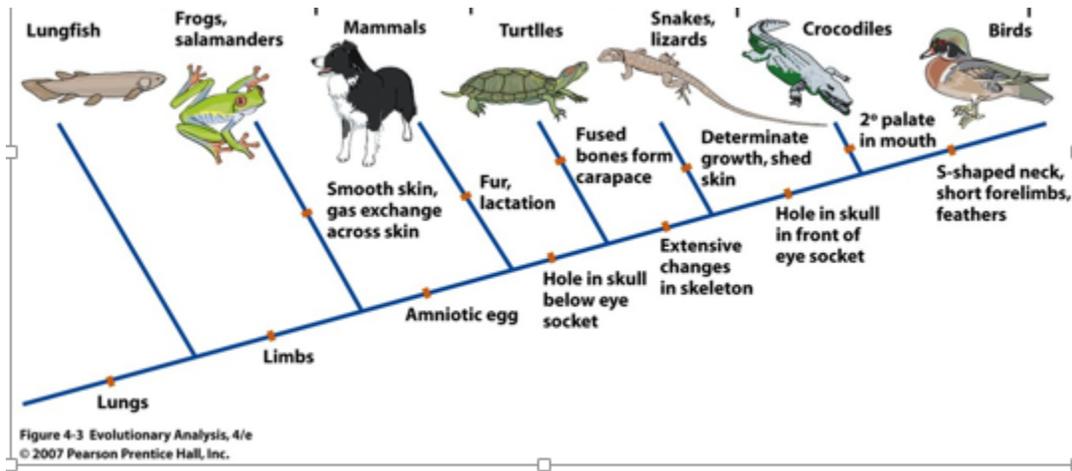
____ 41. True or False? According to the cladogram, Turtles, Dogs, Crocodiles, and Lungfish all share a common ancestor.

____ 42. According to the cladogram, which of the following is a true statement?
    a. It is likely that a frog would lay an amniotic egg.
    b. Frogs share a more recent common ancestor with lungfish than with snakes.
    c. Birds share a more recent common ancestor with snakes than with turtles.
    d. Birds do not share a common ancestor with lungfish.

____ 43. The most recent common ancestor of turtles and crocodiles probably shared which of the following derived characters?
    a. Determinate growth, shed skin
    b. Fused bones from carapace
    c. hole in skull in front of eye socket
    d. amniotic egg

____ 44. True or False. According to the cladogram, dogs are more closely related to salamanders than to birds.

____ 45. In biology, a trait that arose in an ancestor and is passed along to its descendants is referred to as a
    a. derived character.
    b. taxonomic group.
    c. molecular clock.
    d. physical similarity.

____ 46. Which of the following is a correct explanation of a derived character?
    a. The presence of a backbone is a derived character of mammals because all mammals have

a backbone.

b. The presence of four limbs is a derived character of snakes because the ancestors of modern snakes had limbs, even though modern snakes do not.

c. The presence of hair is a derived character of mammals because all mammals have hair and no animals other than mammals have it.

d. Retractable claws are a derived character of carnivores because some of the animals that are carnivores have retractable claws.

APPENDIX E

STUDENT MOTIVATION AND ATTITUDE SURVEY

Student Motivation and Attitude Survey (Pre and Post-Treatment)

For each of the following statements, select how often you normally did this during this semester.	Very Often (more than once per week)	Often (once per week)	Sometimes (once every two to three weeks)	Rarely (only a few times all semester)	Never
I come in outside of class to get help from my teacher.					
I ask for help from friends to learn science concepts.					
I ask for help from my parents or other adults.					
I read my textbook outside of class and use it to study					
I use online resources such as the classroom Moodle page, YouTube videos, or educational websites to review or learn more about a topic.					

For each of the following statements, select how strongly you agree or disagree.	Strongly Agree	Somewhat Agree	neutral	Somewhat Disagree	Strongly Disagree
My grade is fair.					
I understand how my grade is determined.					
I am confident that I can improve my grade.					
My grade motivates me to work harder in class.					
My grade accurately reflects what I know.					
I know how to improve my grade.					
I do homework because it helps me learn the material.					
I do classwork because I think it is important.					
I do my homework because it is worth points and improves my grade.					
Completing homework thoroughly and on time should be an important part of my grade.					
If I know the material, my homework completion and					

punctuality (turning it in on time) shouldn't matter.				
I can learn even the hard concepts in science if I don't give up and have enough time.				
I don't try very hard in science.				
My science skills and knowledge have improved a lot in this class.				
Some science concepts are just too hard for me to learn.				
I enjoy learning				
I am motivated to work hard in science class.				
I care about my science grade, it is important to me.				
I enjoy science class.				

For each of the following statements, select how often you think you did this during the last semester.	Always	frequently	sometimes	rarely
I worked hard on homework assignments.				
I completed homework assignments on time.				
I worked hard on assignments and activities done in class.				
I paid attention in science class.				
I participated in class discussions.				
I contributed to group work.				

Open Response Questions	
If you wanted to improve your grade in this class, what could you do?	
Do you think your grade is fair? Why or why not?	
Do you think your homework completion should be a part of your overall grade? Why or why not?	
If you get a bad grade on a test or an assignment, what do you do? Why?	
Do you work hard on homework? Describe why you do or do not give your best effort.	
Is there anything else you would like me to know?	

Questions only given on Post-Treatment survey second semester

For each of the following statements, select how strongly you agree or disagree.	*Strongly Agree*	*Somewhat Agree*	*neutral*	*Somewhat Disagree*	*Strongly Disagree*
My grade improved under the Standards-Based Grading system used second semester.					
The Standards-Based Grading system used second semester helped me to learn more.					
The Standards-Based Grading system used second semester was more challenging than the regular Points-Based Grading system.					

Open Response Questions	
What do you like about the Standards-Based Grading system?	
What don't you like about the Standards-Based Grading system?	
Do you think I should continue to use the Standards-Based Grading system next year. Why or Why not?	
Is there anything else you would like me to know?	

APPENDIX F

STUDENT INTERVIEWS

Student Interview Questions:

1. Please explain as accurately as you can how your grade is determined in this class under the Standards-Based Grading system.

2. What were the best or most helpful characteristics of the Standards-Based Grading system? Explain.

3. What were the worst or most challenging characteristics of the Standards-Based Grading system? Explain.

4. Did the Standards-Based Grading system change the way you approached this class, in-class work, or homework? Why or Why not?

5. Do you recommend continuing the Standards-Based Grading system? Why or Why not?

APPENDIX G

TEACHER FIELD NOTES

TEACHER FIELD NOTES

2nd Quarter		
Date	Student	Summary of conversation
	Selena	She asked if she was missing anything, how to get her grade up.
	Hannah Anastasia Naomi, others?	I forgot to record two or three conversations about whether or not students were missing any work, what they could do to get their grade up, and if there was any extra credit.
12/13	Hannah	Wanted help with volcanoes unit, finding the difference between composite, shield, cinder cone, and caldera volcanoes.
12/17	Kendall French	What was the identifying substance of genes worksheet? Can I still turn it in?
12/17	Isabelle Taylor	What am I missing? Can I still turn it in? (We had already taken the test over this unit, she was missing 4 assignments.)
1/6	Naycia Berry	Brought in a packet of late work after Christmas break, wanted to know if it would still be accepted for points. I agreed to give her 80% credit on the most recent missing assignments and 50% credit on the much older assignments.
1/6	Aaron Rau	Brought in a packet of late work after Christmas break, wanted to know if it would still be accepted for points. I agreed to give him 80% credit on the most recent missing assignments and 50% credit on the much older assignments.
1/7	Hannah	Asked to come in at lunch to review volcanoes, turned in a reassessment application
1/10	Bailie, Taylor, Mary, jeremiah, nick	Over the last week Bailie, Taylor, Mary all brought in assignments from before Christmas break…..
1/15	Ryan Dorvall	Wanted to know if he could turn in any latework or do any extra credit to bring his grade up. I told him that instead he could review our last unit (DNA to Protein) and retake that test. I would rather he learned the material than did extra credit.
1/17	Matt Harnett	Wanted to know what he could do to bring his grade up, asked if he could turn in missing work, including assignments that were graded over a month ago. I told him that the last day of the quarter was too late to care about his grade. I offered to accept some of the more recent missing work for partial credit if he got it done by the semester test.

SECOND SEMESTER		
2/11	Andrew Richard	Was in at lunch…worked on his worksheet assignment, asked for help on one of the questions, asked what sections of the book to review because he only had a "2" on one of the Mendelian genetics objectives….
2/11	Coral Schulz /Savannah Bignell	Review for test
2/12	Rafael Gonzalez	Asked what his grade was. He asked how he could improve it. We talked about reassessing over the objectives and he wanted to know when you could retest. He then asked what he needed to know for the quiz and if it was covered in his textbook. I explained that it was in the textbook, that there were videos and simulations on the moodle, and that he could come in for help if he needed it.
2/14	Bailie Walker	Bailie Came in at lunch to ask about some of the level II questions that she struggled with on the previous Mendelian Genetics quiz. We reviewed from about 15 min during lunch to prepare for the last quiz.
2/19	Kim Bolan	Came in at lunch to ask for help on some worksheet problems and review some of the material. Student has missed quite a bit of school.
2/21	Bailie Walker	Came in at lunch for help on her Non-mendelian genetics worksheet. We have a quiz over this topic later today. Spent about 15 doing practice problems.
2/27	Coral Schulz	Came in at lunch to review over Human Genetics Unit. Stayed for entire lunch period.
2/28	Coral Schulz	Came in again at lunch to review over Human Genetics Unit. Stayed for entire lunch period.
3/3	Rex Chapman	Came in after school for about 40 minutes to complete practice problems and get help in genetics. We reviewed Mendelian genetics and worked on Non-Mendelian genetics practice problems.
3/4	Rex Chapman	Came in after school for help on a worksheet (pedigree analysis), retested over one of his learning objectives.
3/4	Casee Conant	Emailed me, asked if she could do any extra credit, asked how else she could bring up her grade.
3/13	Carly Thomas	Came in at lunch and reviewed over Mendelian genetics learning objectives. Her grade is suffering and I've been emailing back and forth with her mom about how to bring it up. According to her mom Carly is shy and has been hesitant to

		come in for help. Carly plans to set up a reassessment over Mendelian genetics soon.
3/14	Mary Shaw	Asked if she could see her grade, and if there was anything she could do to bring it up. I explained that she could, and that she could both turn in some missing assignments to get her Work Ethic grade up, and more importantly that she could review some of the learning objectives and re-assess over them. We discussed which learning objectives she might set up a reassessment over and talked about what she could do to work on them.
3/14	Isabelle	I asked Isabelle to stay after class. She had not been participating and gave some attitude when I offered to help her in class. She was good after class, explained that she didn't understand anything, and that's why she doesn't participate. I talked to her about possibly coming in for help, and the need to participate to improve.
3/14	Mackenzie Dexter	Asked if she could reassess over some of the standards, I gave her a reassessment sheet and explained the process.
3/17	Carlie/Mackenzie/Andrew	All talked to me about setting up a time to reassess over standards.
3/18	Mary Shaw	Asked if she could retest over some learning objectives to improve her grade. I asked which ones and she didn't know. I discussed with her that she needed to review which learning objectives she needed to improve on, and that she had to fill out the reassessment form with what she did to improve on them before re-testing.
3/18	Isabelle	Isabelle had filled out a reassessment form, but was not detailed and had not done anything to improve on the material she wanted to test over. I called her over after class and discussed with her what she could do to improve and what she had to do to qualify for a retake.
3/19	Mackenzie Dexter Andrew Carly	Took reassessments over Mendelian/human genetics at lunch
3/19	Mackenzie Dexter	Stayed after school to see how she did on the assessment. She then reviewed with me for about ½ hour so she could reassess tomorrow over the level II standards.
3/20	Mackenzie Dexter	Came in at lunch and took a reassessment over level II standards for Mendelian genetics, got a 97%! Set up a time to retake human genetics on Friday.
3/21	Athena Fremont	Is there anything I can do to bring my grade up? I talked to her briefly about the work ethic standard and how to set up a reassessment over learning objectives.

3/31	Madisen Omara	Maddi came in and asked if she could reassess over the climate change unit, we set up a time to review at lunch tomorrow and scheduled a reassessment Wednesday.
4/1	Brook Baerlocher	At the request of his parents, Brook met with me after class about setting up a review session, and then possibly setting up a reassessment later.
4/2	Madisen Omara	Came in for test retake
4/8	Coral Schulz	Came in at lunch to review
4/8	Molly	Came in to make up earth science test
4/23	Mimi powell	Came in to review over small scale weather (she came in after school last week with her grandmother to talk about her grade)
4/24	Andrew Richards	Came in at lunch to finish some assignments
5/13	Coral	Reviewing for frog practical