GRADING HOMEWORK FOR ACCURACY TO SHOW ACHIEVEMENT IN A HIGH SCHOOL BIOLOGY CLASS

by

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ABSTRACT

This study was implemented in Biology I classes, made up of 9th and 10th graders, to help determine if grading for accurate answers and providing written feedback on homework would improve assessment scores. Time spent on homework and the amount of copying of homework was also looked at in this study. Homework, assessment grades, surveys, interviews, homework logs, and classroom observations were used. Although there was not a statistically significant change in achievement, the study did show that the number of students copying homework was lower in the treatment group.

INTRODUCTION AND BACKGROUND

Project Background

I have taught at Green High School in Uniontown, Ohio for the past eleven years. Green High School is located about ten minutes south of Akron. There are approximately 1,300 students in grades 9 through 12. The school district has been rated "Excellent with Distinction" for the past five years which is the highest rating that can be achieved by a school district in the state of Ohio. The school district population is about 2.2% African American, 1.9% Asian/Pacific Islander, 0.9% Hispanic, 2.7% Multiracial, and 92.3% Caucasian. Limited English learners make up 1.4% of our district's student population. Students with disabilities make up 12.6% of our school district. Green Local Schools is often considered a wealthy school even though we have students from many income levels. Slightly over twenty percent of our school district population is considered economically disadvantaged. (Ohio Department of Education, 2010).

In 2008, Green High School implemented an 80/20 grading policy. This meant that 80% of a student's grade came from academic achievement points such as test, quizzes, projects, and any other comprehensive assignments which showed what a student had learned. The remaining 20% of the student's grade came from academic practice, which usually included homework, quizzes, and any other assignments given to a student while they were learning and practicing a new topic. It was up to the individual teacher to decide what they considered academic achievement and academic practice. This grading policy was implemented due to the number of students who would fail most

of their tests but would still pass a class because they completed their homework assignments. There was also an issue with cheating. Even the top students in the school admitted to cheating on their homework occasionally because many teachers graded homework based on whether it was completed and not on the accuracy of answers. The 80/20 grading policy took some of the emphasis off of homework and put more emphasis on assessing what the student had learned and retained.

I chose my Biology I classes as my research groups for this study because I teach this course most frequently and the students in these classes had comparable averages in their previous science course. I had 24 students in my Block A class and 26 students in my Block B class (a mixture of freshmen and sophomores) in these two classes working at a wide variety of ability levels. I taught these classes for one block (89 minutes a day) for one semester. The freshmen in these classes chose to take two sciences during their first year of high school which was usually because they were interested in science. Typically these freshmen are very good students and contribute greatly to the class having a higher overall average.

Focus Question

The implementation of our school's grading policy led to my focus question: What effect does grading homework for accurate answers have on assessment scores in a Biology I class? My sub questions included: How does feedback on graded homework affect assessment scores? How does grading homework for accurate answers affect the amount of cheating or incomplete homework assignments by students? How does time

spent on homework affect the number of correct answers on the homework assignments and ultimately the assessment scores?

CONCEPTUAL FRAMEWORK

Homework is usually considered to be anything assigned by a teacher to be completed outside of class (Trautwein & Köller, 2003). Many teachers believe that the purpose for doing homework is to practice what has been taught in class and that learning is enhanced when students practice what has been taught in lessons (Ryan & Hemmes, 2005; Xu, 2010). The majority of research about homework agrees that homework has the ability to increase a student's achievement especially when feedback is provided. At the same time, homework can cause emotional stress, which may lead to some undesirable side effects such as cheating or simply choosing not to do the assignment (Cooper, Robinson, & Patall, 2006; Dettmers et al., 2010; Keith, Diamond-Hallam, & Fine, 2004; Reiss, 2009; Ryan & Hemmes, 2005; Thomas et al., 1993).

Keith et al. (2004) analyzed data from the National Education Longitudinal Study (NELS) which gathered information on 13,546 students during eighth, tenth, and twelfth grade. It was found that students who completed homework outside of class showed more achievement gains than when students had time to complete homework in class. It was also concluded that homework completed in class produced very little or no achievement gains for the student.

When homework becomes a part of a student's grade, homework completion itself may be a reason for the higher grade in the class and not really a measure of

achievement. This may be especially true when the teacher gives a grade for homework completion rather than accurate answers (Keith et al., 2004). Most students' success in school is determined by the grades they earn on homework and tests rather than just the scores they receive on tests. Tests, alone, may be a better indicator of what students have actually learned, but homework completion should also be taken into account when assigning grades to students (Trautwein & Köller, 2003). A study of 21,814 eighth-grade students found that those who spent more time on homework increased their levels of achievement. This was due, in part, to their parents encouraging them to focus on their academics while at home (Keith & Keith, 1993). Ryan and Hemmes (2005) found that students need to be given a grade or points for completing their homework; otherwise students will be more likely to not complete assignments.

Lam's research (as cited in Cooper et al., 2006, p. 52) suggests that the amount of time that should be spent on homework to see achievement gains for high school students should be between 1 ½ and 2 ½ hours per night for all of their classes. He surveyed over 3,000 twelfth graders about the amount of time they spent on homework each week in multiple subjects. Lam then gave those students a standardized test. The students who scored the highest on the standardized test were the same students who spent 1½ to 2½ hours on homework each night. When time spent on homework went beyond this measure, very little difference in achievement was noticed. Lam's research (as cited in Cooper et al., 2006, p. 53) was limited to Chinese Americans and Caucasian Americans and did not take into account other differences between individual students.

If homework is given to students it should also include feedback (Marzano, 2001). Grading homework can be extremely time-consuming for a teacher. It is often easier to walk around the classroom or collect homework at the beginning of class and simply give the students a checkmark for completing the homework assignment. The checkmark becomes a grade in the grade book which does not show whether the student learned from the homework, if it helped the student increase their knowledge, or the areas in which the student may need additional help.

A study carried out at the college level by Ryan & Hemmes (2005) tested the effects of giving grades and providing feedback on all homework which was turned in by undergraduate psychology students in one particular class. Students were given individualized homework schedules. The homework would only be for a grade for the weeks shown on their individual schedule, but students were asked to do all homework even if it was not on their schedule to be graded. When homework was turned in, feedback was given on the assignment and the students were required to correct and resubmit the assignment. Improved quiz scores in the class were attributed to grades being given on student homework assignments. The students that were not assigned homework for a grade usually chose not to complete the homework and, consequently, did not do as well on the quizzes when compared to students who did complete the homework. Feedback also played a role in this because the students had to correct their assignments based on the comments of their professor then resubmit the assignments to receive their homework grade.

Thomas et al. (1993) performed a study on high school biology students in the San Francisco Bay area. They found that students showed greater gains on a genetics achievement test when more feedback was provided on homework, quizzes, and tests throughout the genetics unit. A survey was given both before and after the genetics units to assess the study activities of the students. Students who were provided more feedback showed a positive correlation between effective studying and achievement.

A student's emotions over homework also play a role in achievement. Students sometimes do not want to do their homework because they find it is too difficult, too easy, too uninteresting, or there is little connection between what was learned in class and the assignment. Assignments that are only for "drill and practice" are the most likely to have a negative emotional impact on students. Teachers need to make sure that homework assignments are set at the correct level of difficulty for the students, make the homework interesting, and make the purpose of the assignment clear to the students (Dettmers et al., 2010; Trautwein, Niggli, Schnyder & Lüdtke, 2009). Fulfilling all these criteria can be difficult to do. Students need to be taught ways to cope with homework emotions such as taking breaks if the assignment becomes too tedious or by being reassured by another individual that the student can do the work (Xu, 2005).

Sometimes, when students cannot overcome their homework emotions, they will resort to other strategies to make themselves feel better. One of these is to not do the assignment. Not trying and receiving a failing grade is emotionally easier for the student than trying and receiving a failing grade. Other students may resort to cheating if the opportunity is there (Reiss, 2009). Classroom teachers know that these types of emotions

are happening in their classrooms and can help get students to see that their work is not always about a grade, but about their achievement gains.

Homework should be completed outside of the class in which it is assigned and a grade based on accurate answers should be given to the student in order to show higher achievement gains (Keith et al., 2004). Lam (as cited in Cooper et al., 2006, p. 52) also suggests that there will be higher achievement gains for the student when more time is spent on homework. In addition, as long as the purpose of homework is clear to the student, they will learn more when more time is spent on homework (Walberg, 1991). Ryan & Hemmes (2005) and Thomas et al. (1993) both conclude in their studies that homework accompanied by feedback from the teacher will lead to increased student levels of achievement. When appropriate homework assignments are given they can elicit more positive student emotions rather than negative behaviors such as cheating. This will also lead to achievement gains by the student (Dettmers et al., 2010; Reiss, 2009; Xu, 2005).

METHODOLOGY

Since the 80/20 grading policy was implemented at Green High School, I have tried to determine whether assigning a grade for accurate answers on homework actually improved assessment scores in Biology I and this was the primary focus of my study. This led to other questions such as whether students took the time to read written feedback on homework assignments and whether students who resubmitted assignments with written feedback would actually earn higher scores on chapter tests. I was also

interested in looking at whether graded homework led to more cheating and whether more time spent on homework led to greater achievement on chapter tests.

Participants

Eighteen of the twenty-four students in my Block A Biology I class agreed to participate in the research study and acted as the control group. This class met first thing in the morning from 7:25 a.m. to 8:54 a.m. with a five minute break during period class change. The control group consisted of four males and eight females in 9th grade and three males and three females in 10th grade. Two of the 10th grade males had previously taken Biology I. One of the males did not complete the course the previous year, and the other had failed the course twice before with a different teacher. Three of the 9th grade participants in Block A were considered gifted.

Twenty-four of the twenty-six students in my Block B Biology I class agreed to participate in the research study as part of the treatment group. This class met immediately after Block A from 8:59 to 10:28 also with a five minute break during period class change. The treatment group consisted of seven males and ten females in 9th grade and three males and four females in 10th grade. Six of the 9th grade participants were considered gifted. Two of the tenth graders were on Individualized Education Plans (IEPs) because they were identified as having a learning disability. Both of these students were allowed extended time when taking tests which meant that after they completed their tests in class, their tests would be sent to an Intervention Specialist to be looked over and/or completed.

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.

Intervention

Biology I at Green High School uses the Ohio Revised Science Standards and Model Curriculum for High School Biology as the guidelines for the course content of the class (Ohio Department of Education, 2011). This course is divided into four units: Heredity, Evolution, Diversity and Interdependence of Life, and Cells. Biology I uses the textbook *Modern Biology* (Postlethwait & Hopson, 2006) and follows the sequence of chapters found in the textbook beginning with Chapter 1 which is the beginning of the Cell unit. Since this entire unit is comprised of eight chapters and takes approximately nine weeks to cover, I chose to use only the first five chapters of this unit as part of my study.

Biology I is a blocked class which meets for 89 minutes every day for one semester (18 weeks). January 14th, 2013 was the beginning of the new semester which meant new groups of students started my Biology I classes. I decided to use my Block A Biology I students as my control group and my Block B Biology I students as my treatment group. The control and treatment groups remained the same throughout the study. These two classes met during consecutive blocks, first thing in the morning. Based on my past observations, there seemed to be little difference between the overall

class averages during these meeting times. The control and treatment groups covered the same material on the same days with minimal differences in instruction.

Students in both the control and treatment groups were given homework at the end of each section in each chapter at the end of the class meeting time. Each homework assignment was comprised of three sections. The first section was review questions which required students to look back at their notes to find answers. The second section contained application questions in which students needed to apply their knowledge from the lesson. The third section on the homework had students looking ahead at the topic for the next day with some exceptions for assignments with lengthy review and application sections or when it was the last section before a chapter test. The looking ahead section asked students to read the next section in their textbook and answer a few questions over what they read. Students were asked to keep track of the amount of time they put into each assignment on a homework log (Appendix E) and were verbally encouraged to keep track of the time spent on their homework to the nearest minute.

During Chapter 1 in the *Modern Biology* textbook (Postlethwait & Hopson, 2006), which covered *The Science of Life*, students completed four homework assignments (Appendix G), one over each section of the chapter, over seven days of class time. The control group had their homework checked for completion at the beginning of the next class meeting time and a numerical grade, which corresponded to the number of questions completed, was recorded for the student. We then went over the correct answers for the homework during class time. The treatment group had their homework assignments collected at the beginning of class and graded for accurate

answers. Their grade on the homework corresponded to the number of correct answers with the total number of possible points being the same as the points for the control group. Descriptive, written feedback was also included on the treatment groups' graded homework assignments for the individual questions or for their overall homework assignment and returned during the next class. When all sections in the chapter had been covered, students in both the control and treatment groups were given a chapter test over the material covered during Chapter 1 (Appendix J).

Next, one section of Chapter 2, *Water and Solutions*, and all of Chapter 3, which included two sections on *Biochemistry*, were covered over the course of six days. Students in both the control and treatment groups were given three homework assignments (Appendix H), one assignment over each section covered. The same procedure was followed for both the control and treatment groups as Chapter 1 with the addition of an optional opportunity to resubmit graded homework assignments with responses to the feedback for students in the treatment group. Students in the treatment group could also earn a higher grade on the homework when it was resubmitted with corrections. Students in both groups were then given a chapter test over the sections covered from Chapters 2 and 3 (Appendix K).

In order to gather more data about the effect of grading homework for accuracy and feedback on test scores, the same procedure was used for the next two chapters: Chapter 4, *Cell Structure and Function*, and Chapter 5, *Homeostasis and Cell Transport*. This material was covered in nine days. There were a total of five sections and one homework assignment (Appendix I) for each section. The same procedures were

followed for the control and treatment groups as in previous chapters including a chapter test (Appendix L). Students in the treatment group, again, had the opportunity to respond to feedback and resubmit their graded homework assignment for a higher grade. At the end of the study, homework logs were collected from each student.

Data Collection

Both quantitative and qualitative data were collected for this study using a variety of instruments. Quantitative data included grades from student homework assignments, chapter tests, and homework logs on which students were to record the time spent on each assignment. Qualitative data included student surveys, student interviews, and teacher field notes and observations. This is summarized in the triangulation matrix below (Table 1).

Students in both the control and treatment groups were given survey questions (Appendices A and B) after each chapter test. Students were told that the surveys were both optional and anonymous. These questions included whether they cheated on their homework and questions about why they may not have completed their homework assignments. Student surveys in the treatment group also included questions pertaining to the feedback on their homework assignments.

Students in the control and treatment groups were also interviewed after each chapter test using questions (Appendices C and D) similar to those found on the survey as a starting point. Initially, two high achieving, two average achieving, and two low achieving students were chosen for the interview process. One male and one female

student were chosen from each achievement level. However, due to absences and willingness to participate in the interview process, only one high achieving, one average achieving, and one low achieving student participated in the second and third interviews in each class. Those interviewed still consisted of at least one male and one female student. The student's achievement levels were based on their chapter test scores. These students were also chosen based on their willingness to answer questions. Students were told that their answers would not affect their grades in any way and that they needed to be as honest as possible with their answers.

To help determine the impact of feedback on homework assignments, I kept field notes of the observations (Appendix F) I made when graded homework was returned to the treatment group. I looked to see if they immediately put their homework away, looked over their homework briefly for the answers they missed, or if they took time to look at their missed questions and attempted to find answers immediately. I also recorded any emotions that seemed to go along with their homework grades by looking for specific behaviors.

Student homework grades were compared between both the control and treatment groups and were also compared to chapter test scores to determine the impact of grading homework for accuracy on test grades. In the treatment group, homework grades before and after feedback were also looked at along with whether responding to feedback on the homework assignment improved test scores. The average time spent on homework assignments for each chapter test was compared to the average grades on each homework assignment and average grades on the student's tests.

Table 1
Data Triangulation Matrix

Focus Question	*Data Source 1*	*Data Source 2*	*Data Source 3*
Primary Question: 1. What effect does grading homework for accurate answers have on assessment scores in a Biology I class?	Student Interviews	Student Surveys	Chapter Test Grades
Secondary Questions: 2. How does feedback on graded homework affect assessment scores?	Student Surveys and Interviews	Teacher Field Notes/Observations	Homework and Chapter Test Grades
3. How does grading homework for accurate answers affect the amount of cheating or incomplete homework assignments by students?	Homework Grades	Student Surveys	Student Interviews
4. How does time spent on homework affect the number of correct answers on the homework assignments and assessment scores?	Student Homework Logs	Homework Grades	Chapter Test Grades

DATA AND ANALYSIS

Through the collection of both qualitative and quantitative data, I tried to determine whether assigning a grade for accurate answers on homework actually improved assessment scores in my Biology I class. I also wanted to find out whether students took the time to read written feedback on homework assignments and whether students who resubmitted assignments with written feedback would actually earn higher

scores on chapter tests. I was also interested in looking at whether graded homework led to more cheating and whether more time spent on homework led to greater achievement on chapter tests.

Grading Homework for Accuracy and the Effect on Test Scores

Grading for accurate answers did not improve overall assessment scores. The treatment group did have a higher mean score on their Chapter 1 test, but only performed two percentage points higher than the control group who was graded for completion of their homework assignments. On the second and third assessments, the control group earned a higher mean score than the treatment group. T-tests showed that the difference in test scores between the control and treatment group were not statistically significant for all three of the chapter tests given to the students during the course of this study. The interviews of students in the treatment group showed that grading for accuracy on homework may have helped certain students retain more information, but created more pressure for other students.

To determine whether grading homework for accurate answers helped improve chapter test scores, I determined the mean score for each chapter test for both the control and treatment groups. The scores were rounded to the nearest whole number to reflect the grading practices of Green High School. The standard deviation was also calculated for both the control and treatment groups. Student surveys and interviews were also considered to determine whether grading for accuracy on homework improved test scores. These two groups of students were comparable based on their similar mean score

in their previous science course, Physical Science, of an eighty-three percent for the control group and an eighty-four percent for the treatment group.

On the Chapter 1 Test, the 18 students in the control group had a mean score of eighty-six (SD = 9) when homework was graded for completion. The 24 students in the treatment group, whose homework was graded for accurate answers, had a mean test score of eighty-eight (SD = 7) (Figure 1). The lowest test grade for the control group was a sixty-nine percent and the treatment group's lowest test grade was a seventy-four percent. Both the control and treatment groups had students who scored a one-hundred percent on this test.

The Chapter 2 & 3 Test showed the mean score for the control group of eighteen students as a seventy-seven percent (SD = 18). The treatment group of twenty-four students earned a mean score of seventy-five percent (SD = 20) (Figure 1). The lowest score in the control group was a forty-seven percent and the low score in the treatment group was a thirty percent. This low score in the treatment group was earned by one of the student's on an IEP. A second student in the treatment group missed a week of instruction and scored a forty percent on the Chapter 2 & 3 Test but his score was included in the sample because this was his second time taking the course. In both the control and treatment group, the high test scores were a one-hundred percent.

The Chapter 4 & 5 Test showed the mean test scores for the control group of eighteen students being higher than that of the treatment group of twenty-three students earning an eighty-one (SD = 15) and seventy-eight percent (SD = 17) respectively (Figure 1). The point spread this time showed the lowest grade in the control group at a

fifty-two percent and the treatment group at a thirty-five percent. The high grade was a ninety-eight percent for both groups.

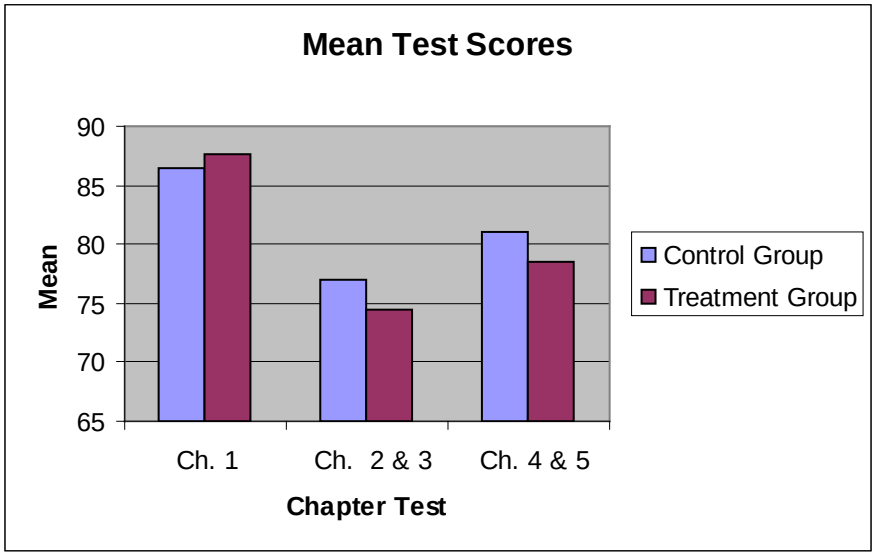


Figure 1. Mean test scores for the control group (*N* = 18) and treatment group, (*N* = 24 for Ch. 1 and Ch. 2 & 3, *N* = 23 for Ch. 4 & 5).

The lower mean scores for the Chapter 2 and 3 Test on *Water and Solutions* and *Biochemistry* could be due to these topics being completely new for the students. The other two chapter tests on *The Science of Life*, *Cell Structure and Function*, and *Homeostasis and Cell Transport* have been covered to some degree in previous science courses.

During all of the post test interviews of both the control and treatment groups, almost all of those interviewed agreed that the homework did help them prepare for the test whether the homework was graded for completion or accurate answers. One of the gifted students in the treatment group, whose mean score for all three tests was a ninety-eight, stated that there is "more pressure when [the homework is] graded for accurate answers." Another individual surveyed from the treatment group felt that she

"remembered more" when graded for accuracy on the homework. The surveys also showed that the majority of students in both groups felt that the homework prepared them for the assessments but the treatment group surveys reflected that only a little over half of students felt that having their homework graded for accurate answers helped to actually improve their test scores.

Feedback on Homework and the Effect on Assessment Scores

Student assessment scores were not significantly different when homework was graded for accurate answers and given written feedback (Figure 1). The treatment group had homework graded for accurate answers which included feedback on their homework assignments. This feedback was either a mark through an incorrect answer or included actual statements or questions to help lead the student to the correct answer without actually giving them the answer. Students in the treatment group had the option of resubmitting homework assignments with corrected answers before the assessments for Chapters 2 and 3 and Chapters 4 and 5. Students in the treatment group received the graded homework during class the following day after it was due. Students in the control group had homework checked for completion at the beginning of class on its due date and then we went over the correct answers while still in class. Teacher observations, student surveys and interviews, homework and chapter test scores were used to determine the effectiveness of feedback on graded homework.

When surveyed, eighty-seven percent of students in the treatment group claimed to have looked at feedback on their graded homework. Student surveys showed that

ninety-three percent of students in the control group corrected their homework when the answers were given in class compared to sixty-two percent of the students in the treatment group who had to correct their answers on their own time (Figure 2). Out of the twenty-four students in the treatment group, only eleven of the students resubmitted some of their corrected assignments for Chapters 2 and 3 and only eight students resubmitted some of their corrected assignments for Chapters 4 and 5. Even though students corrected and resubmitted their answers, in some cases they still did not have the correct answers.

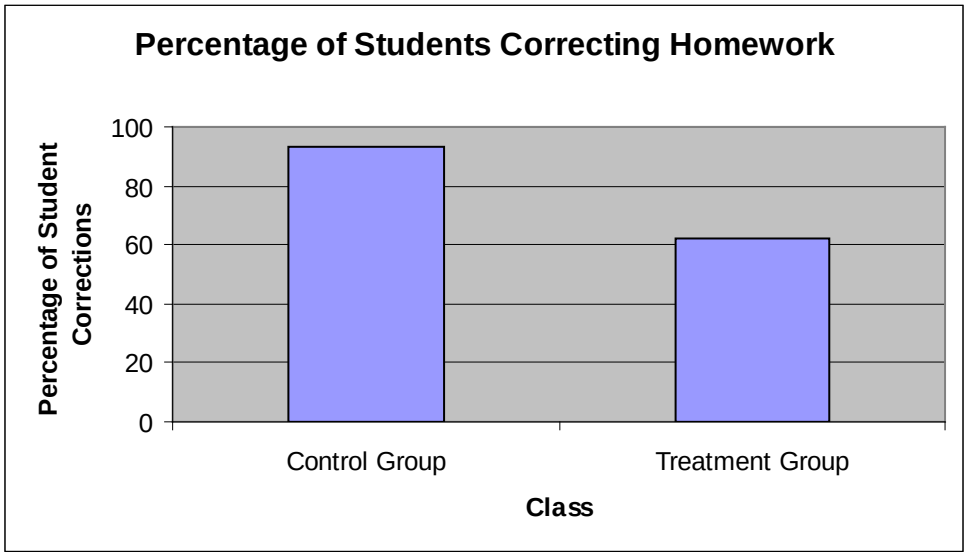


Figure 2. Percentage of students correcting homework according to surveys in the control group (N = 55) and treatment group, (N = 61).

All students interviewed in the treatment group claimed to have looked at the feedback on their homework when it was passed back. Most of those interviewed in the treatment group stated that they did respond to or correct the wrong answers on their homework at least sometimes. One exception was a student who said she “did not

respond to any feedback," when interviewed after the Chapter 4 & 5 Test. I chose to interview her based on her low performance, a sixty percent, on the Chapter 4 & 5 Test.

The observations I made when homework was returned to students at the beginning of class showed that most of my students would at least look over the wrong answers on their assignment. Some of these students would actually discuss the answers they got incorrect with other students sitting nearby or they asked me questions. Two exceptions during these observations were with one of the students on an IEP who glanced at his grade and then immediately put the assignment in his folder and another student who did not even look at the paper and put it in his folder. Students seemed more focused on the feedback on homework when it was returned at the beginning of class as opposed to the end of class.

Even though students claimed to respond to feedback in some capacity, it seems that my students need to first be taught what it means to respond to feedback and then physically do that while still in class until it becomes habit. Students then need to be made aware that they should study the homework with their corrected answers to prepare for the test. I assumed that my students would already know that this was a good study practice especially when they were given the option to resubmit their homework for a better grade. I was surprised by the small number of students who resubmitted their assignments.

Grading For Accuracy and the Impact on Cheating and Missing Assignments

Copying another student's answers on homework occurred less often by students in the treatment group than in the control group. Missing assignments in the treatment group were of greater number than that of the control group. The higher number of missing assignments did not seem to be directly related to the assignments being graded for accurate answers, but more of an issue for a few individual students that missed school when the homework was assigned or due. To determine how grading homework for accurate answers affects the amount of cheating and missing assignments, I had specific questions on the student surveys and interviews directed at the topic of cheating. I looked at whether homework assignments were turned in to answer whether missing assignments were more of an issue for the treatment group.

Treatment group surveys showed that students worked together more often, but were less likely to directly copy another student's work. When asked on the surveys whether students worked with someone else on their homework assignments the control group answered "yes" or "sometimes" fifty-six percent of the time. The treatment group answered "yes" or "sometimes" sixty-four percent of the time. Even though the homework assignments were handed out during the last five minutes of class, some students would use that time to attempt to get as many questions completed as possible. The treatment group was also in my classroom for an additional five minutes for televised student announcements which may have resulted in the higher percentage of the students working on homework together. It was encouraging to see that so many students were

collaborating on completing their homework and that many seemed to be using their time wisely by beginning homework in class regardless of the short amount of time.

Students were also asked on the surveys if they copied someone else's work. Twenty-nine percent of the control group, whose homework was graded for completion only, answered "yes" while sixteen percent of the treatment group answered "yes" or "sometimes" (Figure 3). I thought that there would be more pressure on the students in the treatment group to get the correct answers on their homework and as a result, more cheating or copying of other student's answers. The majority of students in both the control and treatment groups felt that it was important to get both correct answers and good grades on their homework.

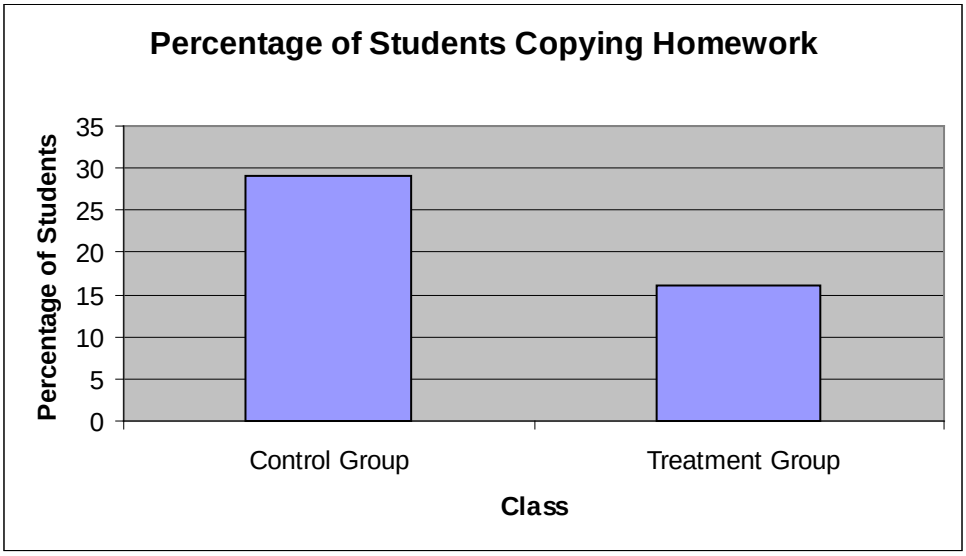


Figure 3. Percentage of students copying homework according to surveys, (N = 71).

During the interviews, the control and treatment group interviewees that commented on whether they worked with someone else said that they "asked others in class, questions about the problems." One student in the control group even asked

someone for help, outside of the class, who had already completed Biology I. This was encouraging news to hear from this particular student since he had been struggling with staying in school due to discipline and personal reasons. During the control group interviews, a few students admitted to copying someone else's work. The treatment group interviews tended to show that students copied when they "didn't know an answer." Students may need to be taught how to find answers in their notes or in their textbook. One tenth grade student had a ninth grade sibling in the same class. The tenth grader said that they "copied all the time." The interviews seemed to show that some copying is occurring to guarantee that the student actually had an answer on their paper to be graded. The treatment group interviewees had more students admitting to copying which contradicted the data from the survey.

Chapters 1, 2, and 3 yielded no missing homework assignments for the control group. In the treatment group, one individual did not complete two of the four homework assignments for Chapter 1 yet he still managed to score a ninety-one percent on the Chapter 1 test. Two individuals in the treatment group had a single missing assignment for Chapters 2 and 3. They both failed the Chapter 2 and 3 test. The number of missing assignments increased for Chapters 4 and 5. The treatment group had a total of twelve missing assignments while the control group only had three missing assignments. One thing which was not taken into consideration during this study was late work. Late work was accepted; however the grade was not differentiated from the grades of those individuals who turned their homework in on time.

Time Spent on Homework and the Impact on Assessment Scores

Spending more than the average amount of time on homework did not necessarily translate into higher homework scores (Figure 4) and ultimately higher test grades (Figure 5). Of all the students who turned in their homework logs in both the control and treatment groups, more students received higher mean homework and test scores for their class if they spent less than the average amount of time on their homework with the exception of the treatment group's Chapter 2 & 3 scores. It is possible that students who initially understood the material better spent less time on their homework than those students who struggled with the homework.

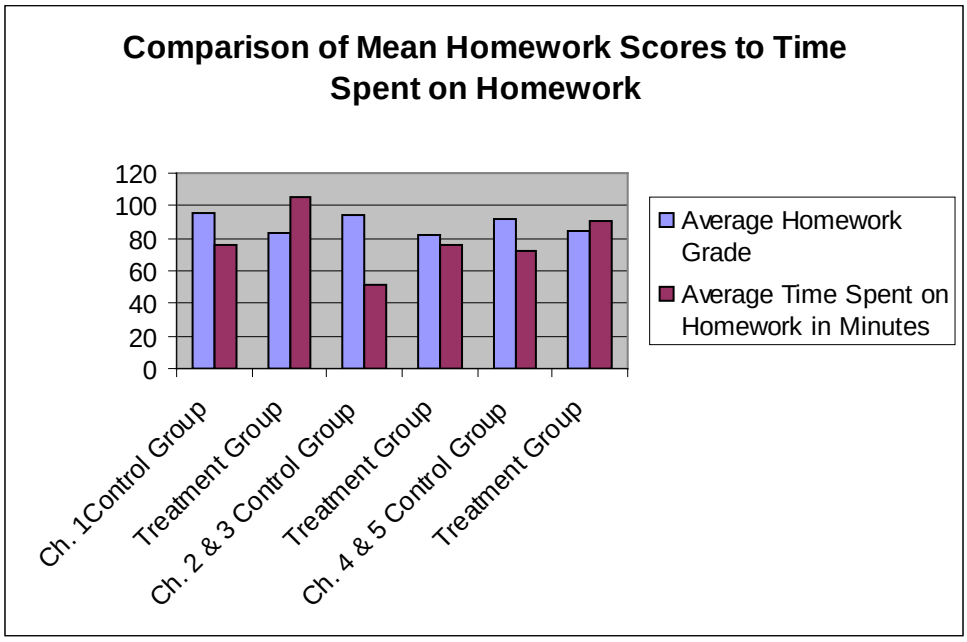


Figure 4. Comparison of mean homework scores to time spent on homework.

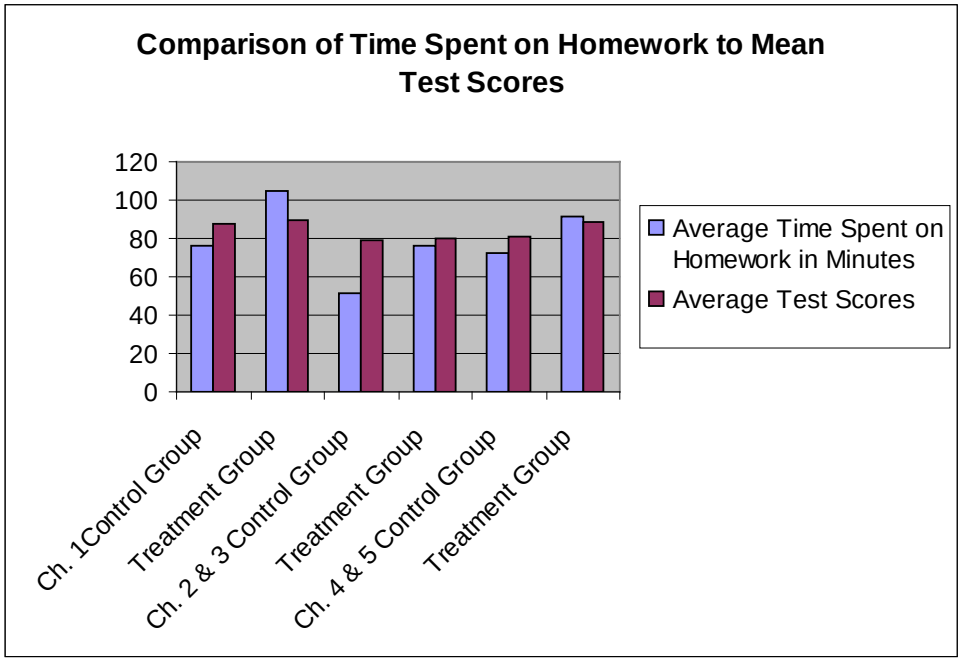


Figure 5. Comparison of time spent on homework to mean test scores.

Time spent on homework was determined by the student kept homework logs to see if more time spent on homework increased homework and test grades. Not all students in the study kept track of the amount of time they spent on homework and some did not keep track of time spent on every assignment. A t-test showed that the differences in tests scores for the control and treatment group were not statistically significant.

For Chapter 1 homework assignments, eleven homework logs were turned in out of the eighteen student participants in the control group. Two of the homework logs were only partially completed. Of the nine completed homework logs, the control group had a mean homework score of a ninety-six percent. The average amount of time spent on the homework assignments was seventy-six minutes over the course of four days. The mean test score for this group was an eighty-eight percent (SD = 10). In comparison, the

treatment group had sixteen homework logs completed for Chapter 1. When graded for accurate answers, the mean homework score was an eighty-three percent. More time was spent on the homework assignments with an average of 105 minutes during the same four days. The mean test score for those students completing homework logs for Chapter 1 was a ninety percent (SD = 6).

The mean score on Chapters 2 and 3 homework assignments for the control group was a ninety-four percent. Students spent almost fifty-one minutes over a three day period on the homework with a mean test score of seventy-nine percent (SD = 20). The treatment group's mean homework scores were an eighty-two percent, with time spent being seventy-six minutes, over three days, for all assignments. The mean test score was and eighty-percent (SD = 16).

The control groups Chapter 4 & 5 homework assignments yielded a ninety-two percent completion rate with seventy-two minutes spent on the assignments over a period of five days. The mean test score was an eighty-one percent (SD = 16). The treatment group averaged an eighty-five percent for their homework grade, spending ninety-one minutes on the assignments during five days. The mean test score was an eighty-nine percent (SD = 25) for those who completed the homework logs.

The students in the treatment group who turned in completed homework logs had a higher mean score for each chapter test compared to the control group students who completed homework logs. This contradicts the difference in class averages on the tests when all the students in the control and treatment groups' tests are incorporated. The treatment group, as a whole, only outperformed the control group on the Chapter 1 Test.

This is showing that some students in the treatment group who scored lower grades on their tests are also the same students not completing the homework logs even though they completed their assignments.

INTERPRETATION AND CONCLUSION

Grading for accuracy on homework does not necessarily improve test scores. For some students, knowing that their homework will be graded for accurate answers did help them "remember more," but this wasn't the case for all students. The students who were self-motivated to look at the feedback on their homework assignments and correct their answers did not always find the correct answers. If they studied their homework in preparation for the chapter tests, they may have studied some incorrect answers. It seemed to be more beneficial to go over the correct answers in class, which is what occurred with the control group. A hybridization of grading for accuracy and going over the correct answers in class could be more beneficial for the students by having them put forth a concerted effort to find the correct answers in the first place.

While most students in the treatment group claimed to look at the feedback on their homework assignments only sixty-two percent actually corrected the wrong answers compared to the ninety-three percent of students correcting their answers in the control group. Once again, there seem to be benefits in giving students the chance to write down the correct answers while in class.

Although some students said that they do copy other people's homework answers, the number of students copying when graded for accuracy was lower in the treatment

group. The students who were interviewed were very open about whether they had copied or not even at the beginning of the study when they were new to my class. Missing assignments did not seem to be a huge issue except for those who had been absent multiple days. I thought I would see more missing assignments in the treatment group due to the idea that if the student does not complete the assignment then he cannot get a bad grade on it.

It was difficult to gauge the overall outcome of the effect of time spent on homework and test grades due to many homework logs not being completed. When students who completed homework logs spent more than the average amount of time on homework, they did not show an increase in homework and test grades.

VALUE

I thought at the beginning of this study, that grading for accuracy would cause the students to put forth a more concerted effort on their homework and by putting forth more effort on homework, test scores would improve. I have found that grading for accuracy, as opposed to grading for completion, did not make an overall difference in test scores whether students looked at feedback on their assignments or not. Spending more time on homework did not seem to have a significant effect on increased test scores either. One positive aspect of grading homework for accuracy was that there seemed to be less cheating or copying of another student's work.

The Next Steps

Ryan and Hemmes' (2005) study on college psychology students had homework assignments graded for accuracy on a rotating schedule. I believe that grading some of my students' assignments or at least some of the individual questions, for accuracy, may eliminate random answers (answers that do not pertain to the topic such as song lyrics) on their assignments as long as the students do not know ahead of time when they will have their homework or individual questions graded for accurate answers. I have discussed with my colleagues their techniques for grading homework. A fellow Biology teacher said that she collects her students' homework so that she can quickly read the student's answers but still gives a grade only for completion of the assignment. For her, this has decreased the number of random answers on her students' homework. Next school year, I plan to change my grading technique to be a combination of grading for accuracy and grading for completion by collecting students' homework and then randomly choosing certain question to grade. I will collect further data from the process to see if this homework grading format improves test scores.

Marzano (2001) believes that homework should include feedback. I agree with this, but think that my students need to be taught what to do with feedback on their homework. This would be a beneficial future study with my students and would be a skill they can use in all of their courses. Only sixty-two percent of students in the treatment group claimed to have corrected their answers on their homework. The homework questions were similar to the questions on the chapter tests. What I plan to do next school year is have students correct wrong answers on graded assignments while

still in class and then encourage them to use their homework to study for the tests. During the interview process I informally asked how the students studied; did they look at their notes, homework, or a combination of the two. I would also like to take a more in depth look at how my students study to determine what helps them best prepare for tests. Formally collecting this evidence will give me better insight as to how best to help and encourage my students to become better learners and better test takers.

The evidence-based research process has helped me realize that my perception of what is happening in my classroom is not necessarily what is actually occurring. Before I looked back at my data, specifically mean test scores, I was under the impression that grading for accuracy on homework really helped my students perform better on their tests. I also thought that my treatment group was copying homework more often based on the number of students working together during the short time between homework being passed out and the end of class. However, student surveys contradicted this. Evidence-based research is important to me so I do not let my personal thoughts and beliefs about a class get in the way of what is really happening.

REFERENCES CITED

Cooper, H., Robinson, J.C., & Patall, E.A. (2006). Does Homework Improve Academic Achievement? A Synthesis of Research, 1987-2003. *Review of Educational Research, 76*(1), 1-62.

Dettmers, S., Trautwein, U., Lüdtke, O., Goetz, T., Frenzel, A., & Reinhard, P. (2011). Student's Emotions During Homework in Mathematics: Testing a Theoretical Model of Antecedents and Achievement Outcomes. *Contemporary Educational Psychology,36*, 25-35.

Keith, T.Z., Diamond-Hallam, C., & Fine, J.D. (2004). Longitudinal Effects of In-School and Out-of-School Homework on High School Grades. *School Psychology Quarterly,19*(3), 187-211.

Keith, T.Z., & Keith, P.B. (1993). Does Parental Involvement Affect Eighth-Grade Student Achievement? Structural Analysis of National Data. *School Psychology Review, 22*(3), 474-496.

Ohio Department of Education (2010). Green Local School District, Summit County: School Year Report Card. Retrieved from http://www.ode.state.oh.us/reportcardfiles/2009-2010/DIST/050013.pdf

Ohio Department of Education (2011). High School Science Revised Standards and Model Curriculum. Retrieved from http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1696&ContentID=126258&Content=135694

Marzano, R.J., Pickering, D.J., & Pollock, J.E. (2001). Classroom Instruction that Works. Alexandria, VA: Association for Supervision and Curriculum Development: p.64.

Postlethwait, J.H., & Hopson, J.L. (2006). Modern Biology. NewYork, NY: Holt, Rinehart and Winston.

Reiss, S. (2009). Six Motivational Reasons for Low School Achievement. *Child Youth Care Forum, 38*, 219-225.

Ryan, C.S., & Hemmes N.S. (2005). Effects of the Contingency for Homework Submission on Homework Submission and Quiz Performance in a College Course. *Journal of Applied Behavior Analysis, 38*(1), 79-88.

Thomas, J.W., Bol, L., Warkentin, R.W., Wilson, M., Strage, A., & Rohwer, W.D. (1993). Interrelationships among Students' Study Activities, Self-concept of Academic Ability, and Achievement as a Function of Characteristics of High-school Biology Courses. *Applied Cognitive Psychology*, *7*, 499-532.

Trautwein, U., & Köller, O. (2003). The Relationship Between Homework and Achievement - Still Much of a Mystery. *Educational Psychology Review*, *15*(2), 115-145.

Trautwein, U., Niggli, A., Schnyder, I., & Lüdtke, O. (2009). Between-Teacher Differences in Homework Assignments and the Development of Students' Homework Effort, Homework Emotions, and Achievement. *Journal of Educational Psychology*, *101*(1), 176-189.

Walberg, H. (1991). Does Homework Help?. *The School Community Journal*, *1*(1), 13-15.

Xu, J. (2005). Homework Emotion Management Reported by High School Students. *The School Community Journal*, *15*(2), 21-36.

Xu, J. (2010). Homework Purposes Reported by Secondary School Students: A Multilevel Analysis. *The Journal of Educational Research*, *103*, 171-182.

APPENDICES

APPENDIX A

TREATMENT GROUP SURVEY

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at anytime.

1. How much time did you spend on each homework assignment for this chapter(s)? Please refer to your homework log.

2. Do you feel that having your homework assignments graded for accurate answers helped to improve your assessment grade?

   Yes No

3. Did you work with someone else on any of the homework assignments?

   Yes No

4. Did you copy someone else's answers on any of the homework assignments?

   Yes No

5. Which do you feel is more important:

   Correct answers on homework A good grade on homework Both

6. Did you look at the written feedback on your graded homework?

   Yes No

7. Did you respond to written feedback in any way?

   Yes No

8. Did you attempt to correct the wrong answers on your homework?

   Yes No

9. Do you feel that your homework prepared you for the assessment?

   Yes No

10. What was your assessment grade?

***11. Did you resubmit your homework for a higher grade?

   Yes No

***This question will be asked after the first chapter test.

APPENDIX B

CONTROL GROUP SURVEY

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at anytime.

1. How much time did you spend on each homework assignment for this chapter(s)? Please refer to your homework log.

2. Did you work with someone else on any of the homework assignments?

   Yes No

3. Did you copy someone else's answers on any of the homework assignments?

   Yes No

4. Which do you feel is more important:

   Correct answers on homework A good grade on homework Both

5. Did you attempt to correct the wrong answers on your homework?

   Yes No

6. Do you feel that your homework prepared you for the assessment?

   Yes No

7. What was your assessment grade?

APPENDIX C

TREATMENT GROUP INTERVIEW QUESTIONS

1. How much time did you spend on each homework assignment for this chapter(s)? Please refer to your homework log.

2. Do you feel that having your homework assignments graded for accurate answers helped to improve your assessment grade? Why do you feel this way?

3. Did you work with someone else on any of the homework assignments? If so, then in what capacity?

4. Did you copy someone else's answers on any of the homework assignments?

5. Which do you feel is more important, correct answers on homework, a good grade on homework, or both?

6. Did you look at the written feedback on your graded homework?

7. Did you respond to written feedback in any way? If so, in what way?

8. Did you attempt to correct the wrong answers on your homework?

9. Do you feel that your homework prepared you for the assessment? Explain.

10. What was your assessment grade?

***11. Did you resubmit your homework for a higher grade? Why or why not?

***This question will be asked after the first chapter test.

APPENDIX D

CONTROL GROUP INTERVIEW QUESTIONS

1. How much time did you spend on each homework assignment for this chapter(s)? Please refer to your homework log.

2. Did you work with someone else on any of the homework assignments? If so, in what capacity?

3. Did you copy someone else's answers on any of the homework assignments?

4. Do you feel it is more important to get correct answers on homework, earn good grades on homework, or both?

5. Did you attempt to correct the wrong answers on your homework?

6. Do you feel that your homework prepared you for the assessment? Why or why not?

7. What was your assessment grade?

APPENDIX E

HOMEWORK LOG

HOMEWORK ASSIGNMENT	TIME SPENT
1-1 Review W.S.	
1-2 Review W.S.	
1-3 Review W.S.	
1-4 Review W.S.	
2-3 Review W.S.	
3-1 Review W.S.	
3-2 Review W.S.	
4-1/4-2 Review W.S.	
4-3 Review W.S.	
4-4 Review W.S.	
5-1 Review W.S.	
5-2 Review W.S.	

APPENDIX F

TEACHER OBSERVATIONS/FIELD NOTES

Homework assignment _____ Date_____

Behaviors

1. Immediately putting away homework.
2. Glancing at homework.
3. Looking at wrong answers and attempting to find the correct answers.
4. Appear happy with score.
5. Appear angry/upset with score.
6. Appear indifferent with score.

Student	Observations

APPENDIX G

CHAPTER 1 HOMEWORK ASSIGNMENTS

1-1 The Science of Life
p. 5

Review -

1. What is Biology?

2. What are the characteristics of life? How many of these must something possess to be considered alive?

3. What is the basic unit of life?

4. How do living and nonliving things grow?

5. What is homeostasis?

6. What is the sum of all chemical processes that occur in an organism? What is the example called when light energy is converted to chemical energy and what process do the products of this process begin?

7. What is the hereditary information? What are segments of this information called which code for a single trait?

8. What is cell differentiation?

9. During reproduction, genetic information is transferred from _____ to _____.

10. What is the difference between sexual and asexual reproduction? Give an example of an organism that uses each.

Application

1. Give an example of homeostasis and explain how it works.

2. If you found an unidentified object on the ground, how could you determine if it was alive? (You have access to unlimited resources.)

Looking Ahead –
1-2 Themes in Biology p. 10
Read pgs. 10- 12 and answering the following questions.

1. What are the 3 themes that help explain the living world?

2. How can life be diverse yet unified?

3. What is interdependence?

4. Why is evolution an important theme in Biology?

1-2 Themes in Biology
p. 10

Review

1. What are the 3 domains of life? What is meant by the "tree of life?" Assign each of the 6 kingdoms to the proper domain.

2. What is ecology?

3. What are all the living (biotic) and nonliving (abiotic) components of an environment called?

4. What is the theory of evolution by natural selection?

5. What is an adaptation?

Application

1. Assign the various toppings you put on pizza to the appropriate domains and kingdoms of life.

2. According to the "tree" in figure 1-5, which of these pairs are more closely related: Archaea:Bacteria or Archaea:Eukarya?

3. A female frog has a genetic trait that prevents it from producing eggs. How likely is it that this trait will spread through the frog population? Explain your answer.

4. Fossil evidence shows that bats descended from shrewlike organisms that could not fly. Write a hypothesis for how natural selection might have led to flying bats.

Looking Ahead

1-3 The Study of Biology p. 13
Read pgs. 13-19 and answer the following questions.

1. Outline the main steps of the scientific method.

2. Summarize how observations are used to form hypotheses.

3. List the elements of a controlled experiment.

4. Describe how scientists use data to draw conclusions.

5. Compare a scientific hypothesis and a scientific theory.

6. State how communication in science helps prevent dishonesty.

1-3 The Study of Biology
p. 13

Review

1. What is a statement that explains observations and data and can be tested?
2. What is a scientific theory?
3. What is the difference between quantitative and qualitative data?
4. What is used to make observations?
5. What is the variable an experimenter changes?
6. Why is it important to report your experimental findings?

Application

1. Which experimental design would provide scientists with the best data for investigating which type of feed yields the greatest gain in lean muscle mass in cattle?

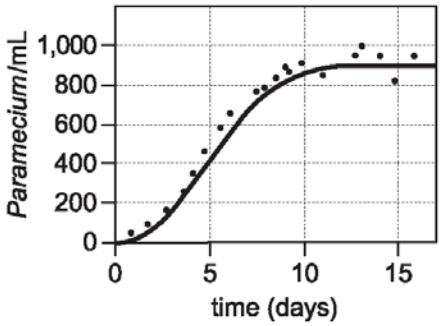
   a) Test 5 different types of cows with the same feed mixture and measure their weight gain at the end of a 6-week trial.

   b) Test 5 similar groups of cows with 5 different feed mixtures and measure their weight gain at the end of a 6-week trial.

   c) Test 5 similar groups of cows with the same feed mixture, give each group varying amounts of feed, and measure their weight gain at the end of a 6-week trial.

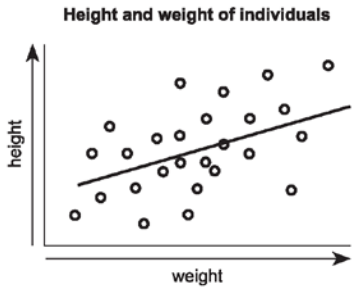
   d) Test 5 different types of cows with 5 different feed mixtures, give each group varying amounts of feed, and measure their weight gain at the end of a 6-week trial.

2. Shown below is a growth curve for *Paramecium* grown in a 1.0 L flask containing pond water at 20°C. The pond water is continually filtered to remove waste products, and nutrients are added at a constant rate.



How could the experiment be modified to determine whether temperature influences the population size of *Paramecium* ?

3. Scientists collected data on the height and weight of individuals in a population. They recorded their results in this scatter-plot.



What is the most accurate conclusion regarding the relationship between height and weight?

4. Paul and Simon want to determine who is more fit. They decide to run in place for 5 minutes and then measure their blood pressures to see whose returns to normal most quickly. They record the data in this table.

	Paul		Simon	
Physiological condition	Systole/Diasole (mm Hg)	Pulse (beats/min)	Systole/Diasole (mm Hg)	Pulse (beats/min)
Sitting	114/73	58	113/74	62
Exercise	160/75	94	170/75	100
1 min after exercise	142/72	74	158/73	76
3 min after exercise	122/72	65	139/73	70
5 min after exercise	114/73	58	121/74	66

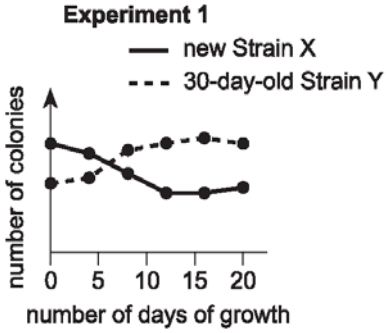
Paul told Simon that the heart pumps more blood during exercise than at rest. How do the experiment's results support Paul's statement? Ming is having trouble sleeping and decides to participate in a study to determine whether a certain medication helps people sleep. There are 30 volunteers, each of whom is assigned to 1 of 2 groups. Volunteers in group 1 are given the medication, and volunteers in group 2 are given a *placebo* (a pill with no medication). Which step is important in order to ensure scientifically valid results?

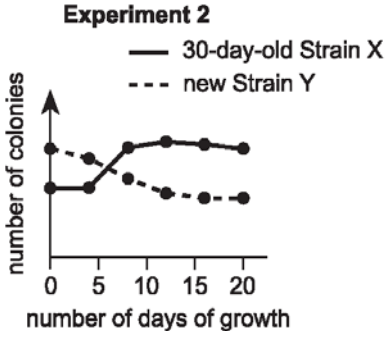
a) assigning the subjects to groups at random
b) assigning all of the subjects with sleeping problems to the placebo group
c) telling subjects if they are receiving the medicine or the placebo
d) ensuring that the researchers can determine which subjects are getting the medicine

5. Edison studies the effects of temperature on starch digestion in a test tube. He adds 2 g of starch and 1 mL of enzyme suspension to a test tube and incubates it at 25°C for 20 min. To accurately test the effects of temperature, Edison should begin a second test with 2 g of starch in a test tube and continue with which set of conditions?

a) 1 mL of enzyme suspension incubated at 25°C for 10 min
b) 1 mL of enzyme suspension incubated at 37°C for 20 min
c) 2 mL of enzyme suspension incubated at 25°C for 20 min
d) 2 mL of enzyme suspension incubated at 37°C for 10 min

6. Sunee and Jamila grow 2 distinct strains of *E. coli* bacteria following appropriate lab procedures. In Experiment 1, they use a new culture of Strain X and a 30-day old culture of Strain Y. In Experiment 2, they use a new culture of Strain Yand a 30-day old culture of Strain X. Sunee and Jamila measure the number of bacterial colonies and record the data in these graphs.





What is the most accurate conclusion about the growth rate of the bacteria?

7. A student wants to determine whether temperature affects the rate at which mold grows on bread. The student puts one piece of bread inside a Petri dish, closes the lid, and places the Petri dish in the refrigerator. Which treatment would be the best comparison for this experiment?

a) Placing another piece of bread in an open Petri dish in the same refrigerator
b) Placing another piece of bread in a closed Petri dish in the same refrigerator
c) Placing another piece of bread in an open Petri dish on the countertop
d) Placing another piece of bread in a closed Petri dish on the countertop

8. For a biology experiment, students measured the effect of caffeine on the pulse (heartbeat/min) of healthy adult women, age 18 or older. They randomly selected 40 women to attend a 2 hr lecture and asked each participant to avoid caffeinated foods and beverages in the 24 hr before the lecture. On the day of the lecture, the women met at the

same time in a conference room. The women listened to the first hour of the lecture. During a 15 min break, the students measured and recorded each woman's pulse, and then they randomly selected 20 women to drink one 12 oz cup of caffeinated soda. The remaining 20 women drank one 12 oz cup of caffeine-free soda. At the end of the second hour of the lecture, the students measured and recorded the pulse of each woman again. The student's results are presented in this table.

Effect of Caffeine on Pulse		
	Average pulse of women consuming caffeine (heartbeat/min)	Average pulse of women not consuming caffeine (heartbeat/min)
Before consumption	72	74
After consumption	86	72

Using your understanding of experimental design, evaluate the students' experiment. As part of your answer, be sure to:

- Describe the criteria the students used to select the participants for their study.
- Compare the control group and the experimental group, including the sampling size of each.
- Describe the methods the students used to limit variability in this experiment.
- Identify the dependent and independent variables in this experiment.

1-4 Tools and Techniques
p. 21

Review

1. What are the differences between the compound light microscope, scanning electron microscope, and transmission electron microscope?

2. What are the 7 fundamental SI units? What is another name for them?

Application

3. A student wants to determine how much the mass of fungus growing on a nutrient agar plate changes over an 8 hr period. What is the most appropriate unit of measure for him to use?

4. Lydia works in a flower shop after school. She notices that the hydrangeas in Container 1 have pink blossoms, while the hydrangeas in Container 2 have blue blossoms. She makes sure they all receive the same amount of light and water. Her boss tells her that the flowers were all grown from the same seed variety. Lydia discovers, after testing the soil, that although the same type of soil was used, the soil in Container 1 has a pH of 6.0, and the soil in Container 2 has a pH of 5.0. Lydia most likely conducted her investigation to answer what question about hydrangeas?

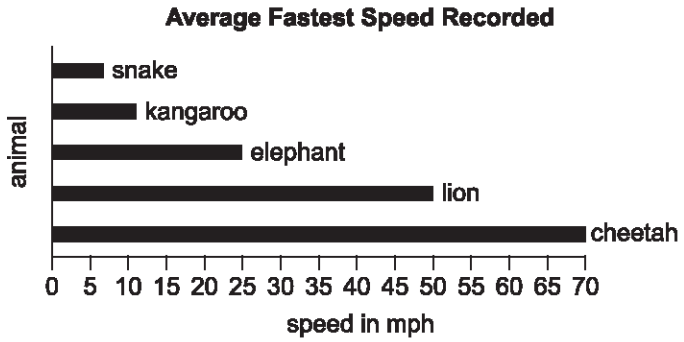
5. Ella told her sister the sun would set at 6:30 p.m. and there would be a full moon on
   Thursday night. Under which basic assumption of science is she operating?
   a) Nature is orderly. b) Knowledge is superior to ignorance.
   c) Nothing is self-evident. d) All phenomena have natural causes.

6. A researcher counted the number of eggs a single fruit fly laid in 24 hrs for 5 days and recorded the findings in this table.

Day	# of Eggs
1	10
2	14
3	7
4	8
5	11

What is the average number of eggs laid per day over the 5 days?

7. The graph represents the average fastest speed of 5 animals recorded in one study.



Based on the graph, which species is approximately one-third as fast as the cheetah?

8. Ming is having trouble sleeping and decides to participate in a study to determine whether a certain medication helps people sleep. There are 30 volunteers, each of whom is assigned to 1 of 2 groups. Volunteers in group 1 are given the medication, and volunteers in group 2 are given a *placebo* (a pill with no medication). Which step is important in order to ensure scientifically valid results?

a) assigning the subjects to groups at random
b) assigning all of the subjects with sleeping problems to the placebo group
c) telling subjects if they are receiving the medicine or the placebo
d) ensuring that the researchers can determine which subjects are getting the medicine

9. A group of scientists want to determine whether the bacteria they are studying have viruses inside them. Which type of microscope should they use? Explain your answer.

APPENDIX H

CHAPTERS 2 & 3 HOMEWORK ASSIGNMENTS

2-3 Water and Solutions
p. 39

Review

1. What is the property that combines both adhesion and cohesion and allows water to creep up the interior of a narrow tube?

2. When the pH in a stomach increases from 2 to 4, how does the hydrogen ion concentration change?

3. Which solution has the greatest concentration of hydroxide ions (OH^-) ?
   a) urine (pH 6.0)
   b) rainwater (pH 5.5)
   c) tomato juice (pH 4.0)
   d) gastric juice (pH 2.0)

4. Does oil dissolve in water? Explain why or why not.

5. Describe why a water molecule is polar in terms of electrons.

6. What is a neutral solution in terms of hydroxide and hydronium ions?

7. What is an acid on the pH scale?

8. What are the charges of: protons, neutrons, and electrons?

9. What are the properties of water that are important for life to be able to exist?

10. What is the relationship among H bonds and the forces of cohesion, adhesion, and capillarity?

Application

1. The active ingredient in aspirin is acetylsalicylic acid. Why would doctors recommend buffered aspirin, especially for those with a sensitive stomach?

2. Why is the control of pH important in living systems?

Looking Ahead

Read pages 51-54

3-1 Review
Carbon Compounds

Review

1. What key factor distinguishes organic compounds from inorganic compounds?

2. The hydrolysis of which molecule provides energy for muscle contraction?

   a) ATP b) glucose c) lactic acid d) oxygen

3. How many electrons does oxygen have in its outer energy level? How many bonds can carbon form?

4. What are the charges of protons, neutrons, and electrons?

5. What is a covalent bond?

6. What are the 4 common functional groups? What is their purpose?

7. What is a condensation reaction?

8. What are the different structures which carbon can form?

9. How are monomers, polymers, and macromolecules related to one another?

Application

1. Which functional group found in amino acids is absent from monosaccharides, polysaccharides, fatty acids, and glycerol?
   a) −COOH b) −NH2 c) –OH d) −PO4

2. Carbon dioxide contains carbon, yet it is considered to be inorganic. Explain.

3. Explain how water is produced when glucose and fructose undergo a condensation reaction.

Looking Ahead

Read pgs. 55-60

1. What are the 4 macromolecules and what are the monomers of each?

3-2 Molecules of Life
p. 55

Review

1. What is a catalyst?
2. How does a catalyst affect activation energy in a chemical reaction?
3. Are lipids polar or non-polar?
4. What is the monomer of a nucleic acid? What are some examples of nucleic acids?
5. Give examples of carbohydrates.
6. What macromolecule is a polysaccharide an example of?
7. What is the monomer of a protein?
8. Why are enzymes important? How do they work?
9. What macromolecule is glucose an example of?
10. What is glycogen?
11. What are some examples of lipids?
12. Which macromolecule(s) contains nitrogen?
13. Which macromolecule is not soluble in water?
14. Which macromolecule can be broken down into identical subunits?
15. Which macromolecule has a globular shape?

Application

1. Jenna's favorite breakfast food, papaya, contains significant amounts of the enzyme papain (a protease). What substances does papain help digest?
   a)carbohydrates b) fatty acids c) nucleic acids d) proteins

2. Pepsin is a protein-digesting enzyme in the human stomach. Antacids cause the pH of the stomach to increase and protein digestion becomes less efficient. What occurs to reduce the efficiency of protein digestion?

a) Antacids break the covalent bonds within pepsin.
b) Pepsin becomes less soluble in the gastric juice.
c) The active site of pepsin changes shape.
d) The concentration of pepsin increases.

APPENDIX I

CHAPTERS 4 & 5 HOMEWORK ASSIGNMENTS

4-1/4-2 Review
p.69

Review

1. Who discovered cells by looking at dead plant cells under the microscope?
2. What is the smallest unit of life?
3. Why is surface area an important factor in limiting cell growth?
4. What are the differences between prokaryotic and eukaryotic cells?
5. What is an example of a prokaryotic cell?
6. What structure regulates what enters and leaves the cell?
7. What is an organelle?
8. What is the organization of structures in living things from simplest to most complex?

Application

1. In our bodies we have cells which change shape. These cells travel throughout the body, often times through narrow openings. What organ system could these be part of?

2. Studying a picture of a cell taken with an electron microscope, you find that the cell has no nucleus and no mitochondria, but it does have a plasma membrane and a cell wall. What type of cell would this be?

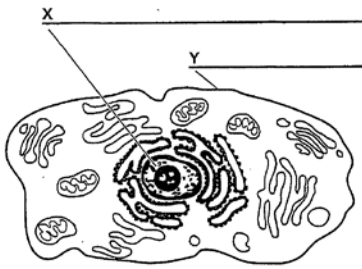
3. If you go back in time, how would you explain the cell theory to someone who has never heard of cells?

4. If an organism exists on another planet, would they consist of cells? Defend your answer.

STRUCTURES AND FUNCTIONS

1. These figures represent a eukaryotic cell and a prokaryotic cell. In the spaces below the diagrams, indicate which type of cell each diagram represents.





a _____ b _____

2. List two features that formed the basis for your identification of these cells.

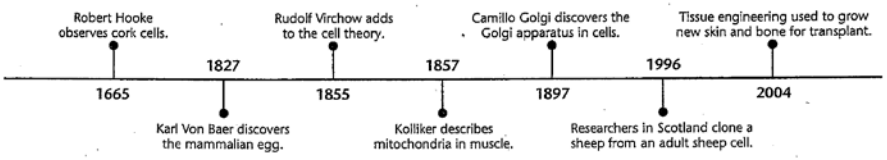
_____

_____

3. Identify the structures labeled X and Y. _____

STRUCTURES AND FUNCTIONS Use the figure to answer the following questions.

Timeline—History of Cell Biology



1. Approximately how many years elapsed between the time cells were discovered and the observation of cell parts in muscle cells?

_____

2. When was the third part of the cell theory added? What was the time interval between this event and the discovery of cells?

_____

Looking Ahead

Read pages 77-85

1. What does this section cover?

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4-3 Review
p. 77

Review

1. Which part of the cell allows materials to enter and leave, is selectively permeable, and encloses the contents of the cell?
2. Which organelle produces ATP and is considered to be the "Powerhouse" of the cell?
3. What are the numerous hairlike organelles which protrude from the surface of the cell in tightly packed rows.
4. Which organelle makes proteins?
5. What is the packing and distribution center of the cell?
6. What is the double membrane surrounding the nucleus?
7. What three things do ALL cells have?
8. What does the mitochondria look like? Sketch it!
9. In which part of the cell can chromosomes be found?

Application

1. If a cell has a high energy requirement, would you expect it to have many mitochondria or few mitochondria? Why?
2. It is not completely accurate to say that organelles are floating freely in the cytosol. Why not?
3. Megan examines a liver cell and observes an organelle with many smooth-sided channels.
   Which activity would identify this organelle as the Golgi apparatus?
   a) digestion of macromolecules and old organelles
   b) detoxification of poisonous molecules within the cell
   c) harvesting of energy from organic molecules to make ATP
   d) processing and packaging of cellular materials prior to export

4. Because the cell membrane decides what substances get to enter and leave the cell it is considered to be
a) selectively permeable b) picky c) diffuse d) strong

5. Naomi adds cycloheximide to cells grown in a test tube. Within minutes, she identifies short incomplete segments of proteins in the cells. On which organelle does cycloheximide act?
a) endoplasmic reticulum b) golgi apparatus c) nucleus d) ribosome

5. **Critical Thinking** When lipid is added to a solution of a detergent in water, the detergent breaks up large globules of the lipid into much smaller globules. What effect do you think a detergent would have on the integrity of cells? Explain your answer. _____

_____

_____

STRUCTURES AND FUNCTIONS This diagram represents a typical animal cell. Label each part of the figure in the spaces provided.

a. _____

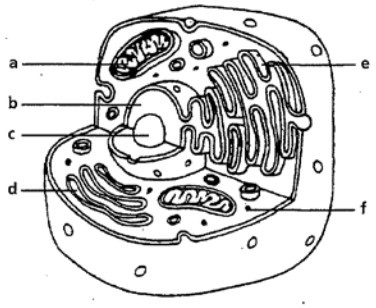
b. _____

c. _____

d. _____

e. _____

f. _____



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Looking Ahead

Read pages 87-90

1. What are the major differences between plant cells and animal cells?
2. What are the major differences between prokaryotes and eukaryotes?

4-4 Review
p. 87

Review

1. What are the large membrane-bound sacs which store water, wastes, or nutrients in plant cells?

2. Where does photosynthesis occur in the cell?

3. What are plastids?

Application

1. If you discovered a new cell, what characteristics would you use to determine which kind of cell it is? Explain.

2. Bacteria have a region called a nucleoid, in which their genetic material is located. Why, then, are bacteria classified as prokaryotes?

3. The presence of which structure indicates that cells are NOT photosynthetic bacteria?

a) cell wall b) chloroplast c) DNA d) ribosome

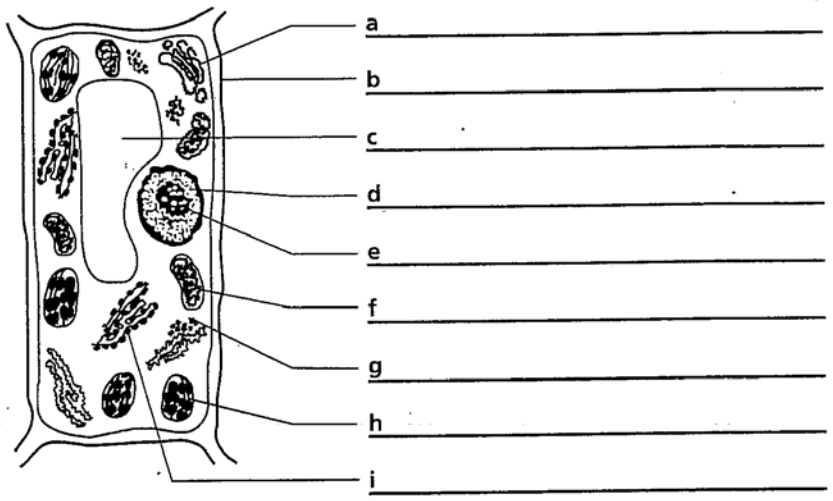
4. **Critical Thinking** Bacteria have a region called a nucleoid, in which their genetic material is located. Why, then, are bacteria classified as prokaryotes?

_____

_____

STRUCTURES AND FUNCTIONS Label each part of the figure in the spaces prov

This diagram represents a typical plant cell.



Looking Ahead

Read pages 97-102

1. What are the 4 types of passive transport discussed in this section?

5-1 Review

p. 97

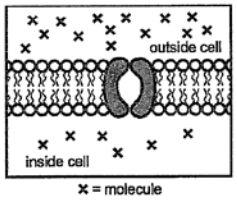
Review

1. What is the ultimate goal of diffusion?
2. How can sugar molecules, such as glucose, enter a cell?
3. What is osmosis?

Application

1. Bob drops a cube of sugar into a beaker of water. What type of passive transport is occurring when the sugar cube dissolves in the water?
2. Using what you know about osmosis, explain what would happen to a jellyfish placed in freshwater lake.
3. A scientist places a cell in a solution, and over time the cell gains mass and swells. What is the most likely explanation for the cell's gain in mass?
   a) The solution is hypertonic to the cell.
   b) The solution is hypotonic to the cell.
   c) The solution and the cell have equal concentrations of solutes.
   d) The solution and the cell have equal concentrations of water.

4. The diagram shows a cell membrane composed of a phospholipid bilayer with a channel protein. Each x represents the same type of molecule inside or outside the cell. Facilitated diffusion moves these molecules across the cell membrane.



In what direction do these molecules move and through which structure?

a) into the cell through the channel protein

b) into the cell through the phospholipid bilayer

c) out of the cell through the channel protein

d) out of the cell through the phospholipid bilayer

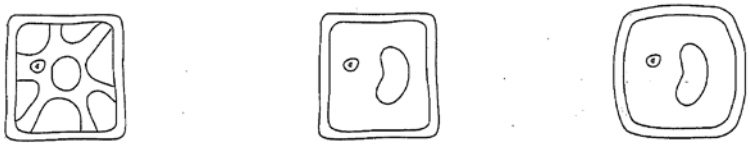
STRUCTURES AND FUNCTIONS The drawings below show the appearance of a red blood cell and a plant cell in isotonic, hypotonic, and hypertonic environments. Label each environment in the spaces provided.

RED BLOOD CELL



a _____ b _____ c _____

PLANT CELL



d _____ e _____ f _____

Looking Ahead

Read pages 103 – 106

1. Name one type of cell membrane pump and two types of movements in vesicles.

5-2 Review

p. 103

Review

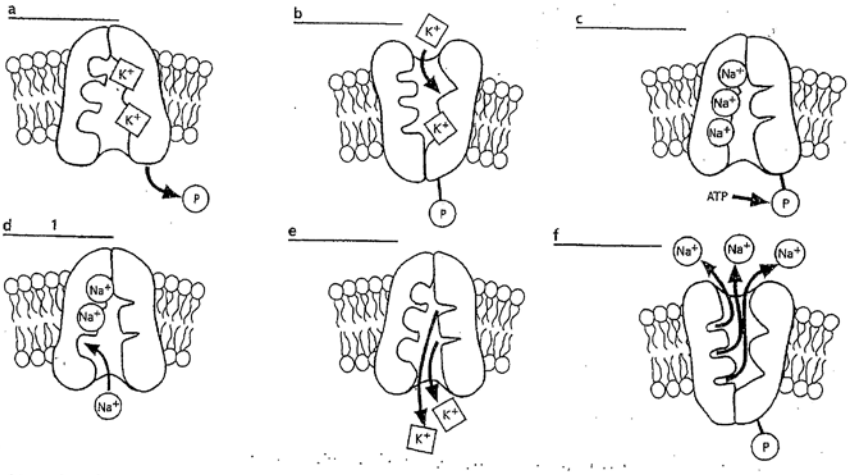
1. What are the types of passive transport which do not expend energy?
2. What enters and leaves the cell in a sodium-potassium pump?
3. What is endocytosis? What are the two types?
4. What is exocytosis?

Application

1. Describe the process of endocytosis and exocytosis. How are they similar? How are they different?

STRUCTURES AND FUNCTIONS Use the figure to answer the following questions.

1. The diagrams below represent the six steps in one cycle of the sodium-potassium pump. The order of the steps has been scrambled. Beginning with diagram *d* (numbered *1*), sequence the remaining diagrams by writing the appropriate numeral in each blank.
2. On which side of the membrane are Na^+ ions released from the pump? _____
3. On which side of the membrane are K^+ ions released from the pump? _____



Looking Ahead – STUDY FOR CH. 4 & 5 Test!!!!!!!

APPENDIX J

CHAPTER 1 TEST

Name: _____ Class: _____ Date: _____ ID: A

Biology Ch. 1 Test Fa. '09

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Biology is the study of
a. minerals.
b. life.
c. the weather.
d. energy.

____ 2. All organisms possess DNA. DNA
a. creates energy for cells.
b. allows sensitivity to environmental stimuli.
c. contains information for growth and development.
d. captures energy from the sun.

____ 3. Instructions for traits that are passed from parents to offspring are known as
a. a species plan.
b. organ codes.
c. genes.
d. natural selections.

____ 4. Homeostasis means
a. a change over long periods of time.
b. keeping things the same.
c. rapid change.
d. the same thing as evolution.

____ 5. Ecology
a. refers to change in species over time.
b. refers to a delicate internal balance within organisms.
c. is inconsistent with evolution.
d. is the study of communities or organisms in relation to their environment.

____ 6. Which of the following is *not* necessarily a characteristic of living things?
a. homeostasis
b. metabolism
c. complexity
d. reproduction

____ 7. The smallest units that can carry on all the functions of life are called
a. molecules.
b. cells.
c. organelles.
d. species.

____ 8. Living things
a. need energy for life processes.
b. have the ability to reproduce.
c. are composed of cells.
d. All of the above

____ 9. All organisms are composed of
a. diatoms.
b. cellulose.
c. cells.
d. None of the above

____ 10. A scientist noticed that in acidic pond water some salamanders developed with curved spines. This was a(n)
a. hypothesis.
b. theory.
c. observation.
d. control.

Name: _____ ID: A

____ 11. The English physician Ronald Ross wanted to try to find the cause of malaria. Based on his observations, Dr. Ross suggested that the *Anopheles* mosquito might spread malaria from person to person. This suggestion was a
a. prediction.
b. hypothesis.
c. theory.
d. scientific "truth."

____ 12. The English physician Ronald Ross knew that the parasite *Plasmodium* was always found in the blood of malaria patients. He thought that if the *Anopheles* mosquitoes were responsible for spreading malaria, then *Plasmodium* would be found in the mosquitoes. This idea was a
a. prediction.
b. hypothesis.
c. theory.
d. scientific "truth."

____ 13. Scientific hypotheses are most often tested by the process of
a. communicating.
b. inferring.
c. experimenting.
d. analyzing data.

____ 14. A hypothesis is
a. a definite answer to a given problem.
b. a testable possible explanation of an observation.
c. a proven statement.
d. a concluding statement.

____ 15. A unifying explanation for a broad range of observations is a
a. hypothesis.
b. theory.
c. prediction.
d. controlled experiment.

____ 16. A hypothesis that does not explain an observation
a. is known as an inaccurate forecast.
b. often predicts a different observation.
c. is rejected.
d. None of the above

____ 17. Scientists usually design experiments
a. with a good idea of the expected experimental results.
b. based on wild guesses.
c. in order to develop new laboratory tools.
d. All of the above

____ 18. Which of the following components of a scientific investigation would benefit from communication between scientists?
a. observing
b. measuring
c. analyzing data
d. All of the above

____ 19. Typically, the order in which the steps of the scientific method are applied is
a. observations, predictions, hypothesis, controlled testing, theory, verification.
b. predictions, observations, hypothesis, theory, controlled testing, verification.
c. observations, hypothesis, predictions, controlled testing, theory, verification.
d. observations, hypothesis, predictions, controlled testing, verification, theory.

____ 20. A light microscope that has an objective lens of 10× and an ocular lens of 20× has a magnification of
a. 30×.
b. 200×.
c. 300×.
d. 2000×.

Name: _____ ID: A

____ 21. Which of the following is *not* an example of good laboratory practice?
a. working alone in the lab
b. asking permission before using equipment
c. working with a partner in the lab
d. wearing goggles in the lab

____ 22. Scientists share their research results by
a. publishing in scientific journals.
b. presenting at scientific meetings.
c. avoiding conflicts of interest.
d. Both a and b

____ 23. What resource gives safety information about products being used for cleaning?
a. OSHA
b. MSDS
c. CRT
d. AARP

____ 24. What is the correct exit strategy during a fire or fire drill in room 220 (Mrs. Wagar's classroom).
a. Turn right, go down the stairs and out the exit door.
b. Turn right, go down the stairs and head to the office.
c. Turn left, go down the stairs and out the exit door.
d. Turn left, go down the hallway to Mr. Brubaker's room.

____ 25. What should you do if you spill acid on yourself?
a. Don't tell anyone because you will get in trouble.
b. Use water from the sink to rinse off the acid.
c. Running screaming down the hall.
d. Go to the safety shower and begin to disrobe.

Problem

26. Some scientists conducted an experiment in which they evaluated various measurements of human health in people who drank at least one cup of coffee a day. They found no significant differences in these health indicators between the subjects who drank no coffee, only one cup of coffee a day and those who drank 20 cups a day. They concluded that coffee has no adverse effects on human health. Write your answers to the following in the spaces below.
a. What were the independent and dependent variables in this experiment?

b. What were the control and experimental groups?

Essay

27. Name four characteristics that are considered distinct properties of all living things.

28. Why is it important to study biology even if you are not planning a career in biology?

APPENDIX K

CHAPTERS 2 & 3 TEST

Name: _____ Class: _____ Date: _____ ID: A

Ch. 2 & 3 Test Sp. '11

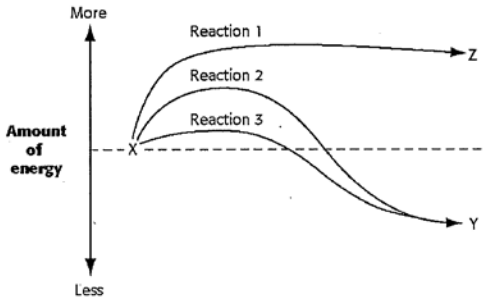
Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Atoms are composed of
a. protons with a positive charge.
b. neutrons with no charge.
c. electrons with a negative charge.
d. All of the above

____ 2. Because carbon has four electrons in its outer energy level,
a. it can form bonds with carbon atoms only.
b. these atoms are naturally chemically stable.
c. it can react with up to four other atoms to form covalent bonds.
d. it cannot react with anything other than organic molecules.

____ 3. The bond formed when two atoms share a pair of electrons is called a
a. hydrogen bond.
b. nonpolar bond.
c. covalent bond.
d. water bond.

____ 4. An atom that has gained or lost electrons is called a(n)
a. molecule.
b. nucleon.
c. ion.
d. element.



____ 5. Refer to the graph above. Reaction 3 in the graph
a. probably occurred in the presence of a catalyst.
b. requires a greater activation energy than reaction 2.
c. is the same as reaction 1, but faster.
d. takes longer than reaction 2.

____ 6. A neutral solution has an equal number of
a. hydrogen and hydronium ions.
b. hydroxide and hydronium ions.
c. hydrogen and hydroxide ions.
d. oxygen and hydrogen ions.

Name: _____ ID: A

____ 7. A solution with a pH of 11 is
a. acidic.
b. alkaline.
c. neutral.
d. a buffer.

____ 8. Acidic solutions have a pH that is
a. less than 7.
b. between 0 and 14.
c. a negative number.
d. more than 7.

____ 9. A water molecule is polar because its hydrogen and oxygen atoms
a. both lose electrons.
b. become ions.
c. both gain electrons.
d. do not share the electrons equally.

____ 10. Water molecules break up other polar substances
a. such as salts.
b. because of the uneven charge distribution that exists in water molecules.
c. thus freeing ions in these substances for use by the body.
d. All of the above

____ 11. Which of the following characteristics of water is *not* a result of hydrogen bonding?
a. adhesive strength
b. capillarity
c. cohesive strength
d. All of the above are a result of hydrogen bonding.

____ 12. All organic compounds contain the element
a. C.
b. N.
c. Ca.
d. Na.

____ 13. Breaking down ATP into ADP by the addition of water is called
a. condensation
b. polymerization
c. hydrolysis
d. oxidation

____ 14. Which organic molecule below is classified as a carbohydrate?
a. amino acid
b. CH_2 chain
c. nucleotide
d. sugar

____ 15. Animals store glucose in the form of
a. cellulose.
b. glycogen.
c. wax.
d. lipids.

____ 16. Polysaccharides are
a. carbohydrates.
b. lipids.
c. proteins.
d. unsaturated fats.

____ 17. Amino acids are monomers of
a. disaccharides.
b. proteins.
c. nucleotides.
d. steroids.

____ 18. Lipids are
a. polar molecules.
b. similar to water molecules.
c. protein molecules.
d. nonpolar molecules.

____ 19. All of the following are examples of lipids *except*
a. saturated fats.
b. starch.
c. cholesterol.
d. earwax.

Name: _____ ID: A

____ 20. Which organic molecule below is most closely related to nucleic acids?
a. amino acids
b. CH_2 chains
c. nucleotides
d. sugars

____ 21. Nucleic acids include
a. chlorophyll and retinal.
b. DNA and RNA.
c. lipids and sugars.
d. glucose and glycogen.

____ 22. All of the following are functional groups *except*
a. a hydroxyl group.
b. an amino group.
c. a carboxyl group.
d. a carbonate group.

____ 23. Without enzymes, the chemical reactions in the body would
a. happen too fast.
b. occur at much the same rate as they do with enzymes.
c. require a different pH.
d. occur too slowly to support life processes.

____ 24. Carbon atoms can bond together to form all of the following *except*
a. ring structures.
b. inorganic structures.
c. straight chain structures.
d. branched structures.

Problem

25. You are given four test tubes containing purified biological macromolecules. The test tubes are unlabeled except for a number between 1 and 4. You are told that one test tube contains a protein, one contains a lipid, one contains a carbohydrate, and one contains a nucleic acid. You then perform some tests on the macromolecules and collect the following information:
1) Test tubes #2 and #4 contain nitrogen, but the other tubes do not.
2) The contents of test tube #3 are not soluble in water, but the contents of the other test tubes are soluble in water.
3) The contents of test tube #1 can be broken down into subunits that are all exactly identical to each other.
4) The macromolecule in test tube #2 is found to have a globular shape.

What are the identities of the macromolecules present in the four test tubes? Write your answer in the space below.

Essay

26. Define *enzyme*, and describe how an enzyme can function in speeding up a chemical reaction within a cell. Write your answer in the space below.

APPENDIX L

CHAPTERS 4 & 5 TEST

Name: _____ Class: _____ Date: _____ ID: A

Ch. 4 & 5 Fa. '12

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Hooke's discovery of cells was made observing
a. living algal cells.
b. living human blood cells.
c. dead plant cells.
d. dead protist cells.

____ 2. The smallest units of life in all living things are
a. cells.
b. mitochondria.
c. cytoplasm.
d. Golgi apparatus.

____ 3. Surface area is an important factor in limiting cell growth because
a. the cell can burst if the membrane becomes too large.
b. materials cannot enter the cell if the surface is too large.
c. the cell may become too large to take in enough food and to remove enough wastes.
d. waste products cannot leave the cell if the cell is too small.

____ 4. A cell that can change its shape would be well suited for
a. receiving and transmitting nerve impulses.
b. covering the body surface.
c. moving to different tissues through narrow openings.
d. All of the above

____ 5. One difference between prokaryotes and eukaryotes is that
a. nucleic acids are found only in prokaryotes.
b. mitochondria are found in larger quantities in eukaryotes.
c. the Golgi apparatus is found only in prokaryotes.
d. prokaryotes have no nuclear membrane.

____ 6. Which of the following is an example of a prokaryotic cell?
a. an amoeba
b. a virus
c. a bacterium
d. a liver cell

____ 7. Studying a picture of a cell taken with an electron microscope, you find that the cell has no nucleus and no mitochondria, but it does have a plasma membrane and a cell wall. You conclude that the cell is probably from a(n)
a. animal.
b. plant.
c. prokaryote.
d. extinct organism.

____ 8. The structure that regulates what enters and leaves the cell is called the
a. nucleus.
b. cell wall.
c. nuclear membrane.
d. plasma membrane.

____ 9. The plasma membrane
a. encloses the contents of a cell.
b. allows material to enter and leave the cell.
c. is selectively permeable.
d. All of the above

____ 10. A structure within a cell that performs a specific function is called a(n)
a. organelle.
b. organ tissue.
c. tissue.
d. biocenter.

Name: _____ ID: A

____ 11. In which of the following organelles is a cell's ATP produced?
a. mitochondrion
b. endoplasmic reticulum
c. Golgi apparatus
d. lysosome

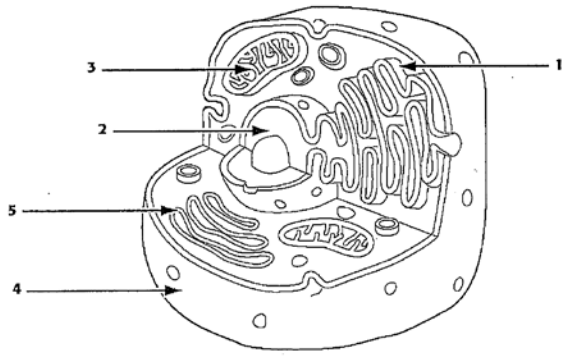
____ 12. Numerous hairlike organelles that protrude from the surface of a cell and are packed in tight rows are called
a. flagella.
b. microtubules.
c. actin filaments.
d. cilia.

____ 13. Proteins are made on the
a. mitochondria.
b. ribosomes.
c. nucleus.
d. plasma membrane.

____ 14. The packaging and distribution center of the cell is the
a. nucleus.
b. Golgi apparatus.
c. central vacuole.
d. nuclear envelope.

____ 15. The double membrane surrounding the nucleus is called the
a. nucleolus.
b. nuclear wall.
c. nucleoplasm.
d. nuclear envelope.

____ 16. All cells have
a. a covering called a plasma membrane that surrounds the cell and controls what information and materials enter and leave it.
b. an internal fluid that gives shape to the cell and supports the other things within it.
c. either a central zone or a nucleus that contains the cell's genes.
d. All of the above



____ 17. Refer to the illustration above. The cell uses structure 3
a. to transport material from one part of the cell to another.
b. to package proteins so they can be stored by the cell.
c. as a receptor.
d. to transfer energy from organic molecules to ATP.

____ 18. Refer to the illustration above. This cell's chromosomes are found in
a. structure 1.
b. structure 2.
c. structure 3.
d. structure 5.

Name: _____ ID: A

____ 19. All of the following are found in both plant and animal cells, *except*
a. a cell wall.
b. a plasma membrane.
c. mitochondria.
d. the endoplasmic reticulum.

____ 20. The organelles associated with photosynthesis are the
a. mitochondria.
b. chloroplasts.
c. Golgi apparatus.
d. vacuoles.

____ 21. Plant cells have a large membrane-bound space in which water, waste products, and nutrients are stored. This place is known as a
a. mitochondrion.
b. chloroplast.
c. Golgi apparatus.
d. central vacuole.

____ 22. Which of the following is the correct order of organization of structures in living things, from simplest to most complex?
a. organ systems, organs, tissues, cells
b. tissues, cells, organs, organ systems
c. cells, tissues, organ systems, organs
d. cells, tissues, organs, organ systems

____ 23. As a result of diffusion, the concentration of many types of substances
a. always remains greater inside a membrane.
b. eventually becomes balanced on both sides of a membrane.
c. always remains greater on the outside of a membrane.
d. becomes imbalanced on both sides of a membrane.

____ 24. Diffusion takes place
a. only through a lipid bilayer membrane.
b. from an area of low concentration to an area of high concentration.
c. only in liquids.
d. from an area of high concentration to an area of low concentration.

____ 25. The dispersal of ink in a beaker of water is an example of
a. diffusion.
b. osmosis.
c. active transport.
d. endocytosis.

____ 26. Sugar molecules can enter cells through the process of
a. exocytosis.
b. facilitated diffusion.
c. osmosis.
d. ion pumps.

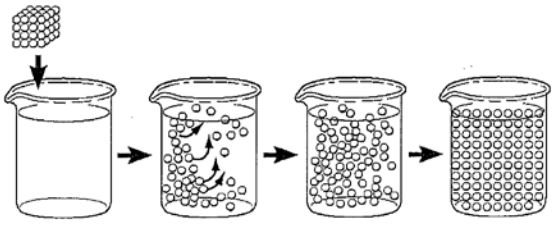
____ 27. Which of the following does *not* expend energy?
a. diffusion
b. endocytosis
c. active transport
d. a sodium-potassium pump

____ 28. Which of the following enters a cell by active transport?
a. glucose
b. water
c. lactose
d. potassium ion

____ 29. The process by which water passes into or out of a cell is called
a. solubility.
b. osmosis.
c. selective transport.
d. endocytosis.

Name: _____ ID: A

____ 30.



Refer to the illustration above. The process shown is called
a. osmosis.
b. facilitated diffusion.
c. active transport.
d. diffusion.

____ 31. The sodium-potassium pump usually pumps
a. potassium out of the cell.
b. sodium into the cell.
c. potassium into the cell.
d. only a potassium and sugar molecule together.

____ 32. Ridding the cell of material by discharging it from sacs at the cell surface is called
a. pinocytosis.
b. phagocytosis.
c. exocytosis.
d. endocytosis.

____ 33. Molecules that are too large to be moved through the membrane can be transported into the cell by
a. osmosis.
b. endocytosis.
c. lipid carriers.
d. diffusion.

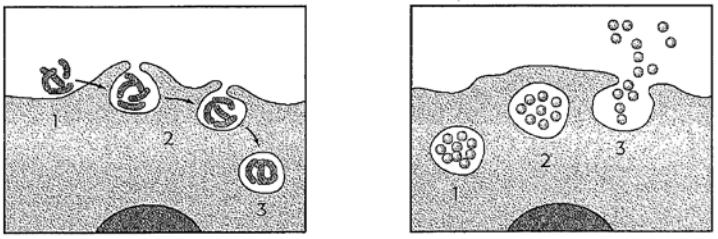
Problem

34. A living cell has certain characteristics in common with a working factory. In a factory, products are assembled according to specified plans, energy is used in the assembly process, products are packaged and taken out of the factory, and a supervisor directs and oversees all of the activities occurring in the factory. Draw a model of a factory, labeling areas where the following important activities would occur: main office where supervisor keeps the plans and oversees activities, assembly line, electricity generator, packaging center, and factory doors. Next to each of your labels, write the name of the cellular organelle or structure that has a similar function. Choose the cellular organelles and structures from this list: nucleus, cytoplasm, cell membrane, mitochondrion, endoplasmic reticulum, Golgi apparatus, vacuole. Write your answer in the space below.

Name: _____ ID: A

Essay

35.



X **Y**

Refer to the illustration above. Identify and explain the processes taking place in Figure X and Figure Y. Write your answer in the space below.