

TESTING THE EFFECTIVENESS OF DIFFERENT MOODLE ASSIGNMENT
STYLES ON IMPROVING STUDENT COMPREHENSION OF BIOLOGY
CONCEPTS AND ATTITUDES TOWARD HOMEWORK ASSIGNMENTS

By

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STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

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ABSTRACT

Moodle is an online virtual learning environment that offers educators a wide variety of tools for promoting learning. Assignments include discussions, question/answer prompts, quizzes, glossary building exercises, and much more. The purpose of this study was to see if the level of peer to peer interaction of the different Moodle assignments influenced their effectiveness as learning tools. A goal of the study was to also determine if student preferences for particular styles of assignments on Moodle were based on the level of peer interaction involved. Pre and post assessments were given for four units of study in the biology curriculum to measure student growth under different Moodle assignment style treatments. Surveys and interviews were given toward the end of the study to determine student preferences and attitudes toward the different assignment styles. It was found that student perceptions of Moodle assignment contributions to learning were positive overall with mixed views on the different styles of assignments. Reasoning behind preferences for particular styles ranged from ease of completion to a perceived beneficial contribution to learning course content.

INTRODUCTION AND BACKGROUND

Developments in educational technology have rapidly changed the way students are taught. From the use of gadgets and media in the classroom to the application of online platforms for delivery over long distances, technology has transformed our ability to deliver knowledge. Our students are from a generation that has never lacked the internet. They get cell phones in middle school or earlier, and many of them have never been in a classroom with a chalkboard. Online learning platforms like Moodle and Blackboard give us a glimpse of where out-of-school assignments could be headed. Traditionally called homework, assignments on these platforms such as discussion forums and quizzes take on many forms.

I am a member of the faculty at Russellville High School in the town of Russellville, Arkansas. The school district is large in size for the state, and the high school itself serves approximately 1132 students. The student body has a somewhat diverse demographic with 74% being Caucasian, 16% Hispanic, 8% African-American, 2% Asian, and 1% American Indian. Being a district that serves families living in a rural setting far removed from any metropolitan area, household incomes are slightly lower than the median household income for the state. Approximately 42% of students attending the high school qualify for free or reduced-price lunches (retrieved from <http://www.greatschools.org>). The high level of free or reduced lunch allows the school to receive significant Title I funding, and much of that has been utilized for purposes of increasing access to technology both for students and faculty. Each classroom is equipped with an interactive Smart Board and a digital document camera. Students in the high school also have access to seven different computer labs, most of which are usually

available to individuals for completing assignments. When online assignments were first considered, student access was thought to be a possible barrier. Most concerns regarding students not having internet access at home were settled after considering the abundance of access to technology on campus.

Each style of assignment available through Moodle offers students a different way of learning content. These assignments generally fall into two categories. One category involves assignments requiring peer interaction such as asynchronous discussions or collaborative projects. These assignments both demand an understanding of content and an ability to effectively communicate in written language. The second category involves assignments without peer interaction such as adaptive quizzes and online modeling or mind mapping assignments. The assignments preferred by students seem to be affected by the subject of the assignment as much as such preferences are affected by the personality of the student. Of course, preference is not always indicative of effectiveness as a learning tool.

The purpose of this study was to determine if different task styles assigned within Moodle differentially contributed to student comprehension and retention of biology concepts and practices. The focus of the study was investigated over the course of four units of the biology curriculum and asked, "*How do the different styles of Moodle assignments contribute to student learning?*" Two sub-questions were identified over the course of the study:

1. What are student attitudes toward the different styles of Moodle assignments?

2. Does a correlation exist between student preference of assignment style and the assignment's effectiveness as a learning tool?

CONCEPTUAL FRAMEWORK

Over the past two decades, the ability to personally access knowledge has grown exponentially. The development of the internet has, for many reasons, been hailed as a great achievement for education. With the search of a few key words, most individuals with internet access are capable of gaining knowledge at a level of ease not fathomed just thirty years ago. Accompanying the development of these technologies has been the great potential for improving the way educators do their jobs. Student achievement can now be assisted through the use of countless technology-based resources. According to Agamba (2012), one of the most promising and versatile resources happens to be the virtual learning environment or course management system (CMS). While there are many CMSs available, one of the most used worldwide is an open-source CMS platform called Moodle.

Staying true to the definition of open source programming, Moodle is free to access and download by anyone. The fact that it is free, requires little server space, is fairly easy to maintain, and is highly customizable makes Moodle a very effective choice for an educator seeking to supplement face to face instruction with e-learning.

Supplementing a more traditional educational setting with online learning creates a form of mixed methodology (Novo-Corti, 2012). E-learning tools such as CMSs give educators the power of delivering content and focus in ways not necessarily possible in the traditional classroom (Agamba, 2012). Students currently in secondary grades have

grown up in a world wired together by various forms of media. Whether it is social media websites such as Facebook, video such as YouTube or TedTalks, texting, video chat, or simply searching Google whenever they have a question, today's students are accustomed to a level of interactivity not available in a traditional lecture-formatted classroom. Using a CMS to supplement learning not only has an ability to increase engagement with students, but it also allows students to feel more in control of what and when they learn (MacDuff, 2012). Moodle provides the needed flexibility for an educator teaching students accustomed to gaining knowledge from a variety of sources delivered both in and out of the classroom.

The styles of instruction available through systems such as Moodle can be classified into two broad categories that are based on whether or not students interact with each other simultaneously (synchronous) or at different times (asynchronous). Synchronous tools such as live chats between peers have been found to increase problem solving and collaboration skills (Lazakidou, 2010). As students participate in such activities, Moodle records all interactions for later observation by the instructor. Such records make assessment and feedback by the instructor possible after the exchange has occurred. It is also possible for bringing in guest chatters for specific topics. As with any synchronized interaction, group size should be considered. Smaller groups are easier to manage and create a more effective, cohesive learning experience (Adelstein, 2006).

CMS platforms such as Moodle owe more of their appeal to their asynchronous aspects. Asynchronous discussions offer a great way for students to carry on a dialogue with their peers under the guidance of the instructor. Such discussion forums offer students a great deal of liberty in their actions while requiring them to form coherent

statements on the subject matter being discussed. Adelstein (2006) says that such delayed discussion gives even those students uncomfortable with the material or with communicating in person time to prepare a contribution to the conversation. Such asynchronous posts also allow students to participate in learning at their own pace. Instructors have the ability to limit number of posts, the time frame of allowed posting, and the ability of students editing their own posts. With this control, instructors create a learning environment that is mixed with individual and collaborative learning. For example, Moodle provides many different styles of discussion forums. The two most commonly used forum styles are “open discussion” where students see the posts of others prior to authoring their own and the “Question and Answer” style where a student must first make a post before seeing those of others. The need for instructors to choose one style over another based is on the desired learning outcome. Not seeing other’s posts prior to posting may encourage students to put more effort into contributing toward the learning process (Agamba, 2012).

Another form of asynchronous CMS interaction is the online quiz. Quizzes through systems such as Moodle come basically in two main styles. One style, the adaptive quiz, gives students feedback as they progress through each question. The adaptive quiz provides students with immediate feedback after each answer choice on multiple choice questions. After choosing an incorrect answer, they are given a chance to choose another option for the possibility of reduced credit. Such interactive quizzes have been found to increase learning by giving students ability to reason through materials as they are being assessed. In a study on the geographical knowledge of first year Canadian college freshmen, online adaptive quizzes were found to increase their performance on a

formal assessment by 38% (Leydon, 2012). The other form of possible quiz evaluation is the deferred feedback quiz. Such quizzes are no different than any other paper test during the quiz's administration. Students choose an answer for each quiz item and submit it for grading once finished. The difference from pencil and paper quizzes becomes apparent as soon as they submit their answers. Incorrect responses are immediately made apparent, and students have the ability to review their mistakes. When assigning quizzes as homework assignments, some instructors choose to give students multiple opportunities for taking a quiz. Moodle even provides the option of forcing a certain period of time between attempts. Question order and answer option shuffling are also available. In a study on an introductory animal science lab course at North Carolina State University, 95% of students surveyed said they liked using the adaptive homework quizzes as study tools, and of those surveyed, 89% thought those quizzes contributed to better performance on course exams (Dickey, 2011). The interactive nature of adaptive quizzes allows students to evaluate their knowledge as they progress through a quiz. Spektor (2011) indicates that students are usually hard pressed to return to items on a completed quiz for review; however, the adaptive aspects of certain online quizzes force them to review misunderstandings as they progress. Such review has been found to be viewed favorably by students as a tool for studying.

One of the questions often raised regarding the different tools made available through CMSs is their true effectiveness in increasing student learning. Fulton (2012) showed that the integration of digital content (notes, homework, videos, and animations) improved academic performance. These ways of extending learning to the online environment are generally seen by students, parents, and educators as having a positive

influence on the achievement of learners. Attitude toward e-learning seems to have as much to do with the effectiveness of these tools as the tool itself (Dickey, 2011; Fulton, 2012). If students have a positive view of a CMS's effects on their achievement, they are more likely to benefit from their interactions with the platform. The task of selling the tool to students as being beneficial falls into the hands of the educator (Fulton, 2012).

METHODOLOGY

The focus of my research was on the effectiveness of different Moodle assignment styles as well as student attitudes toward each of the assignment style categories. The treatment involved groups of students assigned differing out-of-class assignment styles over four units of the biology curriculum. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

The total number of pre-AP biology tenth grade students was 51 with 24 in one class and 27 in the other. Students in these two classes were treated as a single group. The pre-AP biology group alternated between being assigned one of two assignment styles on the Moodle system. These two assignment styles differed in the amount of peer interaction required for completion. The goal was to determine if the peer interaction experienced in asynchronous discussions and glossary building had an effect on learning. (Figures 1 and 2)

Open Forums

Re: Plant Adaptation for Land
by CATELYN BURNHAM - Tuesday, 15 April 2014, 1:48 PM

Which adaptations were essential for surviving out of water?

The adaptations that were essential for surviving outside of the water, were animals had to be warm blooded in order to survive the changing temperature. Animals had to develop lungs of some sort, and had to eventually breath oxygen. They had to find another food source, and just adapt to their surroundings. They had to evolve to the point where they wouldn't die from a small change in their surroundings.

What are the main morphological differences between monocot plants and dicot plants?

Sum of ratings: 10 (1)

Re: Plant Adaptation for Land
by EMILY FANG - Wednesday, 16 April 2014, 11:24 AM

Angiosperms are categorized depending on many features that include whether they are monocots or dicots. If a plant is referred to as a monocot, then it has one cotyledon, or seed leaf, that is produced by the embryo. If it is a dicot, then it has two cotyledons. The leaf of a monocot displays parallel veins while a dicot flaunts branched veins. Another variation between the two is their root systems. If you've ever been pestered by weeds in your yard before, if you pluck them, you'll see that they bear fibrous roots; these are monocots. Whenever you snack on potato chips or maybe even carrot chips, those are dicots, and they are taproot plants.

MONOCOTS			
Cotyledons	Veins in leaves	Flower parts	Arrangement of primary vascular bundles in stem
One cotyledon	Usually Parallel	Usually in multiples of three	Scattered

Question: Besides being a monocot or a dicot, in what other way is a plant categorized?

Sum of ratings: 10 (1) [Show parent](#) | [Edit](#) | [Split](#) | [Delete](#) | [Reply](#)

Figure 1. The Asynchronous Open Discussion Forum Format in Moodle.

Glossary

Biochemistry Glossary

We are building a pre-AP biology glossary containing the terms we've learned so far in the class. Each of you are to enter a term and correctly define it. This glossary will continue to grow as we progress through the year. You will even have in-class quizzes over the terms your classmates have entered.

Be sure terms are spelled correctly. Once a term has been entered, it cannot be entered by another person.

Base
by COREY NOLAN - Wednesday, 11 September 2013, 6:57 PM
Any compound that increases the number of hydroxide ions when dissolved in water. Bases turn red litmus paper blue and react with acids to form salts.

Comments (0)

Biological species concept
by KATHERINE BUSCH - Tuesday, 10 September 2013, 3:54 PM
The concept that a species is a population of organisms that can interbreed but cannot breed with other populations.

Comments (0)

Biology
by STEPHEN HUNT - Tuesday, 10 September 2013, 1:47 PM
The science that deals with living things and organisms, that are divided into specific fields.

Figure 2. The Interactive Glossary Building Activity in Moodle.

These assignments with peer interaction were compared to assignments such as adaptive quizzes or question and answer forums that lacked interaction (Figures 3 and 4).

Adaptive Quizzes

The screenshot displays the iLearn adaptive quiz interface. At the top, the iLearn logo and navigation menu are visible. The main content area shows a quiz question: "Although they often live in the same habitat, the American toad breeds earlier in the spring than the Fowler's toad does. What can be inferred from this information? Select one: a. The two species do not interbreed because of geographic isolation. b. The two species do not interbreed because of temporal isolation. c. The two species interbreed throughout the spring season. d. The American toad will cause the extinction of the Fowler's toad." Below the question is a "Next" button. To the right, a "QUIZ NAVIGATION" grid shows 62 questions in a 7x9 grid. A "NAVIGATION" sidebar on the right lists menu items: Home, My home, My profile, Current course, Pre-AP Biology, Participants, Ridges, and Final Week.

Figure 3. The Adaptive Quiz Interface in Moodle.

Q & A Forums

The screenshot shows a Moodle Q & A forum post. The post title is "Post your map here." by Mark Meredith, dated Sunday, 9 March 2014, 7:11 PM. The post content asks the user to "INSERT YOUR MAP AS AN IMAGE" and provides instructions: "Use one of the following websites to construct a concept map on bacteria: https://bubbl.us/, http://www.spiderscribe.net/ (What I used below. Try it if you can.), http://beta.text2mindmap.com/, http://www.mindomo.com/". Below the instructions, it says "Sum of ratings: -". A response by KATHERINE HEFLEY, dated Wednesday, 12 March 2014, 8:43 AM, is titled "Bacteria Map". The response includes a concept map diagram with "Bacteria" at the center. The diagram branches into "Autotroph or Heterotroph", "Single-Celled Organisms", "Prokaryotic Cells", "Movement", and "Reproduction". "Autotroph or Heterotroph" is linked to "Algae". "Single-Celled Organisms" is linked to "Amoeba" and "E. coli". "Prokaryotic Cells" is linked to "Contains genetic information in nucleic acids". "Movement" is linked to "Some have flagellums" and "Flagella". "Reproduction" is linked to "Asexual Splits into two cells" and "Asexual Splitting".

Figure 4. The Non-interactive Question and Answer Interface in Moodle.

Other tasks that did not involve peer interaction included video reflections, news article summaries, and tasks including using online tools to generate visuals such as concept maps. Similar tasks could easily be turned into assignments requiring greater peer interaction by requiring an element of peer review or discussion about peer-generated components. Quizzes through the Moodle system take various forms with deterred feedback and adaptive scoring being the most commonly used. Regardless of which quiz format was used, each would be classified as an assignment lacking peer interaction.

The pre-AP biology curriculum included nine units, although the study was completed over a period of four units lasting approximately three and a half months. Each unit lasted approximately three to four weeks. Unit 2, as shown in Table 1, for example, involved giving assignments with peer interaction while Unit 3 saw assignments lacking peer interaction. Such assignments lacking peer interaction included question/answer forums or online concept mapping tasks. This pattern of alternating assignment style was repeated for Unit 5 (ecology) and Unit 6 (taxonomy and microorganisms). Various methods of assessment, to be described later, were used during each of the four units for comparing the academic performance, accomplishments, and attitudes of the student group. I also fully acknowledged that each of the four units covered different content with differing levels of difficulties. This fact was taken into consideration when analyzing the data.

Table 1
Differentiated Treatments for Pre-AP Biology

Assignment Styles	Units	
	2 (Cell Biology)	3 (Genetics)
Assignments involving peer interaction	Discussion Forums Group Lab Analysis and Reporting Peer Review of Concept Maps Peer Free Response Evaluations	
Assignments lacking peer interaction		Question and Answer Forums Adaptive Quizzes Concept Map Construction Video Question and Answer

A triangulation matrix is included below that shows how I planned to address the two main research questions (Table 2). To help account for the different content being taught in each unit, each treatment was experienced twice over the period of four biology curriculum units. Repeating the trials was a way of validating the data as being reflective of the treatments and not the content being covered.

Table 2
Data Triangulation Matrix

Research Questions	Data Sources		
	1	2	3
How do the different styles of Moodle assignments contribute to student learning?	In-class Formative Quizzes	Unit Pre- and Post- Tests	Individual Student Grades
What are student attitudes toward the different styles of Moodle assignments?	Moodle Assignment Style Survey	Moodle Poll Question	Moodle Opinion Interview

Teacher-generated quizzes, such as the Cellular Anatomy Quiz (Appendix B) were given throughout the study. Quizzes were administered either using the classroom

response system or with pencil/paper and focused on materials recently covered in class. These quizzes provided clarification on difficult topics, allowed previously learned materials to be tied into that day's lesson, and allowed for quick assessment of student comprehension. Student performance was considered individually, although treatment group comparisons were the most important aspect of this data. Data generated from instruments such as this one were used mostly as qualitative measurements of understanding. This quiz, shown in Appendix B, allowed me to assess their understanding of a particular subset of content within the study of the unit. Each question was chosen to evaluate student understanding about a particular aspect of cell organelles and their function.

The Moodle Assignment Style Survey (Appendix C), used at the close of the last unit of the study, was designed to get student opinion toward different styles of Moodle assignments as well as getting their personal view of an ideal learning environment. It was thought that this survey might reveal correlations between preferred learning environments, personality types, and preferences for Moodle assignments. Questions on the quiz were graded on a Likert scale, *strongly agree* (4), *agree* (3), *disagree* (2), *strongly disagree* (1). This scaling of responses allowed for quantifying responses and comparing responses to questions on Moodle assignments to those on personality and preferred learning environment.

Tools such as the Moodle Poll Question (Appendix D) were used to get anonymous student feedback on the usefulness of Moodle as a learning tool. Students were asked to choose a statement that best represented their thoughts toward Moodle's effectiveness in contributing to their understanding of the content studied in class. This

particular tool was used halfway through the study between Unit Three and Unit Five. Student responses were grouped into the three categories: Moodle helping them learn, indifference toward Moodle's usefulness, and Moodle not contributing to learning.

The Moodle Opinion Interview (Appendix E) was coupled with the Moodle Assignment Style Survey given at the close of the study. To allow for a greater amount of data for analysis, the entire group of fifty pre-AP biology students was asked to complete the interview and survey questions. Students agreed to complete the survey online to the best of their abilities. The survey was administered on Moodle as a free response quiz allowing students to type their responses to each question as prompted. Responses were analyzed for patterns pertaining to the students' course grades, responses to free response interview questions, and ratings given on the survey portion of the instrument. Particular attention was given to questions one, two, four, and five as they dealt with students' attitudes on the contribution of Moodle toward their learning. I was also interested in question six which asked students to suggest a particular assignment style that might be beneficial if used more frequently.

Pre and post-assessments for each of the four units were given. These assessments were designed to measure student knowledge on the wide range of content being covered in each unit while at the same time being relatively short and quick to take. For the purposes of being able to compare the assessments for growth in knowledge, the pre and post versions of the assessments contained identical questions and usually had no more than 20 in total.

The Unit 2 Cell Biology Pre and Post-Assessment (Appendix F) involved 15 questions each on a main concept of cellular biology. To analyze performance on

different topics of cell biology, each question was divided into one of eight different content categories. As with any quiz given through the Moodle system, statistics including a facility and discrimination index were generated on a scale from 0 to 100. The facility index is the percentage of students correctly answering the question. The discrimination index can best be described as a comparison of how students scored on a particular item correlated to how they scored overall on the quiz. A high discrimination index score indicates a good correlation between performance on the item and the quiz. A low discrimination index score could possibly indicate a question that may not fit well into the context of the assessment. In this case, student understanding of cell biology concepts would be the overarching theme of the assessment, and a low discrimination index could indicate a question falls too far outside the scope of the assessment.

The Unit 3 Genetics Pre and Post-Assessment (Appendix G) involved 18 questions divided into the two main sub-topic categories of Mendelian inheritance and molecular genetics. While the assessment in general tested student understanding on the inheritance and expression of genetic traits, the two approaches to the subject frame a traditional way of discerning early from modern levels of understanding on genetic principals. As with the Unit 2 Cell Biology Pre and Post-Assessment, facility and discrimination indexes were generated by Moodle and used in the analyzing of student performance.

Not unlike the assessments used in the first two instructional units being used in this study, the third unit used a similar assessment called the Unit 5 Ecology Pre and Post-Assessment (Appendix H). This assessment involved 20 questions over various ecological concepts and for purposes of analysis was divided into three subcategories.

Question categories included those on biotic interactions, those on levels of ecological hierarchy, and those on biotic and abiotic interactions/dependences. Facility and discrimination indexes were used for comparison of pre and post-performances.

The final instructional unit included in this study was the sixth unit in the curriculum and covered Taxonomy and Microorganisms. The Unit 6 Pre and Post-Assessment (Appendix I) included 20 questions over a fairly wide range of biology content. Because of the broad scope of this unit, the assessment analysis was broken into four different subcategories. Those categories included taxonomy, viruses, bacteria, and eukaryotes. Statistics generated by Moodle including facility and discrimination indexes were used to analyze changes in student understanding between the administrations of the two assessments.

DATA AND ANALYSIS

The Unit 2 Cell Biology Pre and Post-Assessment revealed an initial performance average of 41% indicating that students began the unit with a large need for improving their understanding of cell biology ($N = 50$) (Appendix F). This pre-assessment score was also the lowest from the four units included in the study (Figure 1).

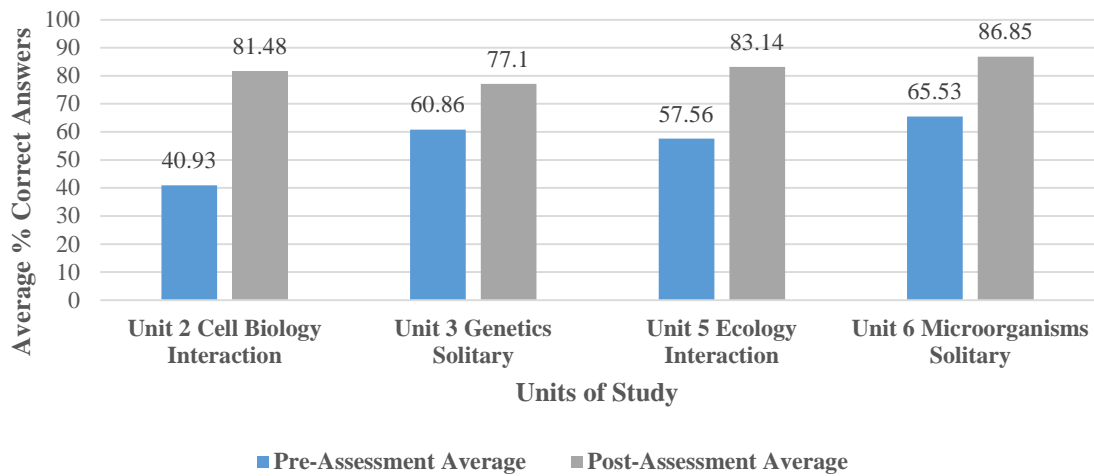


Figure 5. Average Student Performances on Unit Pre and Post-assessments, ($N = 50$).

The Unit 3 Genetics Pre and Post-Assessment revealed the second highest initial score at 61%, although the follow-up assessment for this unit found the smallest improvement in understanding when compared to the other three units of the study. The Cell Biology and Ecology units involved students being given Moodle assignments with elements of peer interaction while the Genetics and Microorganisms units had the opposite consisting of Moodle assignments lacking peer interaction. Gains shown on the post-assessments revealed a greater mean increase in understanding for those units involving peer interaction compared to those units lacking the interaction (Figure 2). The gain observed for Unit 2 Cell Biology was significantly higher than the gain experienced

by the Unit 5 Ecology that also received assignments involving high levels of interaction.

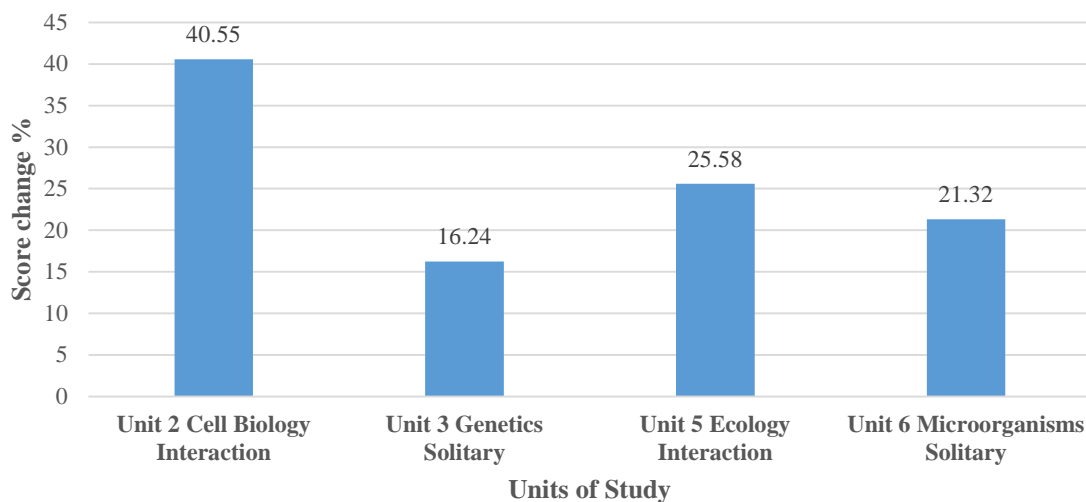


Figure 6. Observed Increases in Performance on Post-assessments as Compared to Pre-assessments, ($N = 50$).

The two units including peer interaction style online assignments experienced a mean improvement of 33.1%. This placed their gains noticeably higher than the 18.8% mean improvement experienced during the two units lacking online assignments with peer interaction (Figure 3).

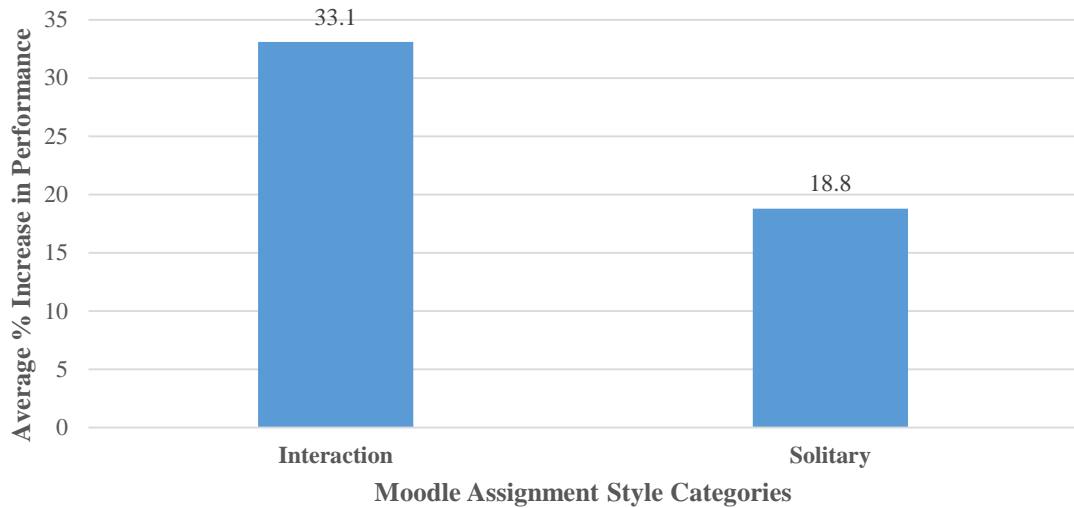


Figure 7. Mean Score Improvement in Pre and Post-assessments as Categorized by Assignment Style with Units 2 and 5 Being Classified as *Interaction* and Units 3 and 6 as *Solitary*, ($N = 50$).

The Moodle Opinion Interview asked students to rank Moodle's effectiveness as a learning tool on a scale from 1 to 10 with 10 being the most effective. Twenty students were selected as a focus group for further comparison because their responses either fell below a five or above an eight on the scale presented in the question. It was approached as if those scoring Moodle below a five were perceiving it as being a highly ineffective learning tool. Any score above an eight was seen as students ranking it within the top 20% and therefore perceiving it as being highly effective. A comparison was then done between student course grades and their ranking of Moodle's effectiveness. The mean course grade between the groups of students created using the survey question on effectiveness revealed very little difference between a student's course performance and how he or she ranked the effectiveness of Moodle (Figure 4).

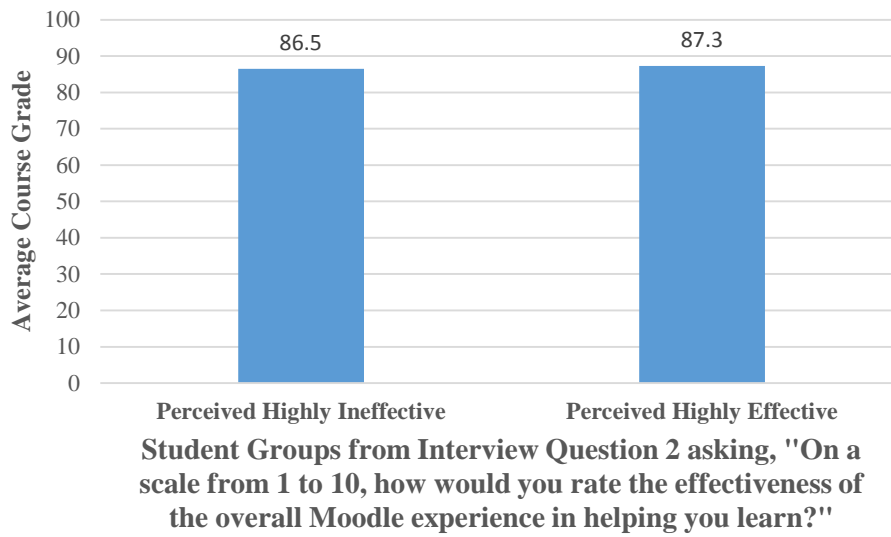


Figure 8. Student Course Grades During the Units of Study Correlated to Responses on the Perceived Effectiveness of Moodle as a Learning Tool, ($N = 20$).

After splitting the focus group students into the two groups based on their ratings of Moodle's effectiveness as a learning tool, group performances on each unit's assessments were compared. This comparison was done to see if there was a correlation in how students improved between pre and post-assessments and how they rated Moodle's effectiveness in helping them learn the course's content (Figure 5).

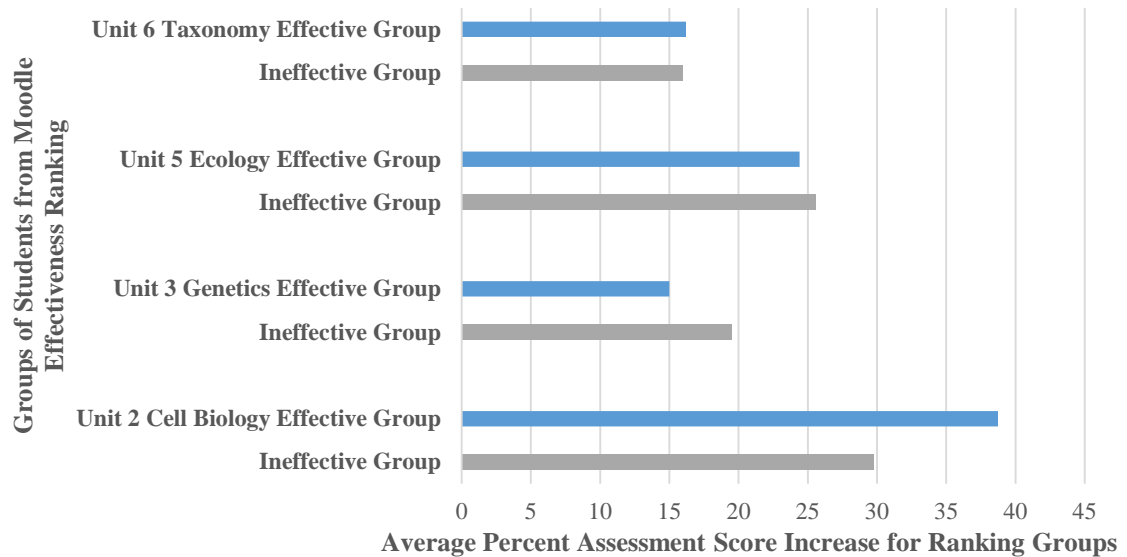


Figure 9. Groups of Students Based on their Moodle Effectiveness Ranking and their Average Performance Increases between Unit Pre and Post-assessments, ($N = 20$).

The Moodle Opinion Interview asked students to indicate which assignment formats they enjoyed completing, and at a different instance in the interview, they were asked to indicate which formats they thought most contributed to their learning. As can be seen in Figure 6, there is a clear preference for online quizzes on the basis of helping them learn and being more enjoyable to complete. It should be noted that student performances on unit pre and post-assessments indicated greater growth with assignments involving peer interactions. Quizzes were one of the major assignment styles used only during those units lacking such peer interaction. Online quizzes were ranked nearly twice as high as the second highest ranking assignment format. One student said of the quizzes, “The quizzes are usually about what we’ve learned in class, therefore it’s the most important ideas and concepts that are being reinforced. This really helps you remember the information.” Another student provided different reasoning for preferring

the quizzes over the discussion, “Quizzes require the least amount of effort. They do require effort, but just not as much as the responses and that’s why I like them more.”

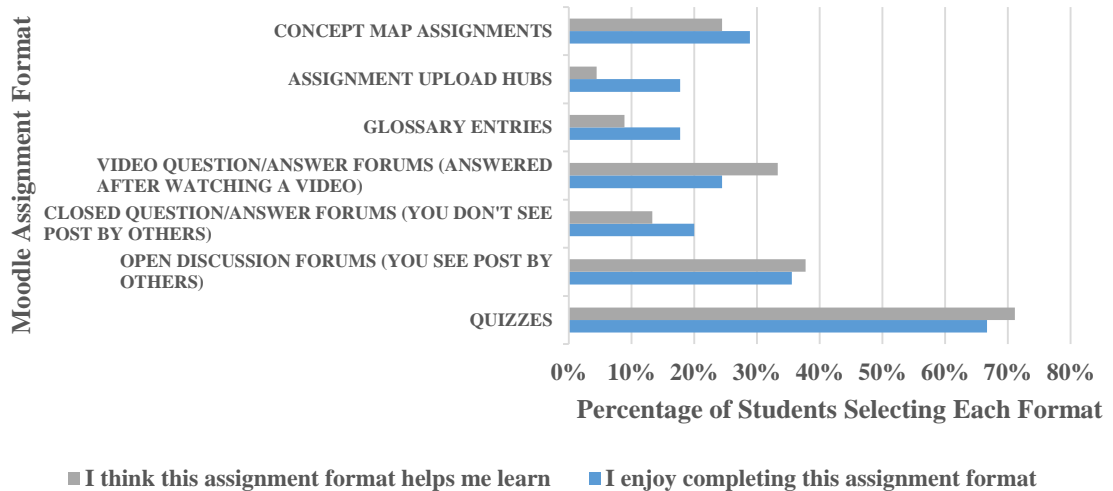


Figure 10. Student Rankings of Moodle Assignment Formats Based on Perceived Enjoyment While Completing and Contributions to Learning, ($N = 50$).

The second highest ranking format was the open discussion forum which was the key format used in the two units experiencing the greatest gains in content understanding. In favor of the open discussion forums, a student said, “I enjoyed the open discussions because I could see if I was doing it right and it helped me reading other peoples post.” For similar reasons, another student gave this as her reasoning for selecting the open forum as her preferred style of Moodle assignment, “I like the open forum because I like the discussion of the topic and being able to see what everyone really thinks.” The following student statement addresses one of the largest challenges to the discussion forum format and was given as her reasoning for choosing quizzes over the discussion forums, “Open forums tend to be like 4 kids spending hours typing and stating all of the

information (I am, I'll admit, one of these people), then a few halfhearted attempts to find something original to add, then several 2 line long copy and pasted entries.”

When asked to specify their general preference between assignments that were online and those that were a more traditional paper and pencil format, students, in two separate instances, overwhelmingly indicated a preference for online assignments (Figure 7). The data was collected using a Likert scale with varying degrees of agree, neutral, and disagree options. The figure combines the agreeable and disagreeable choices leaving the no preference option as the neutral choice.

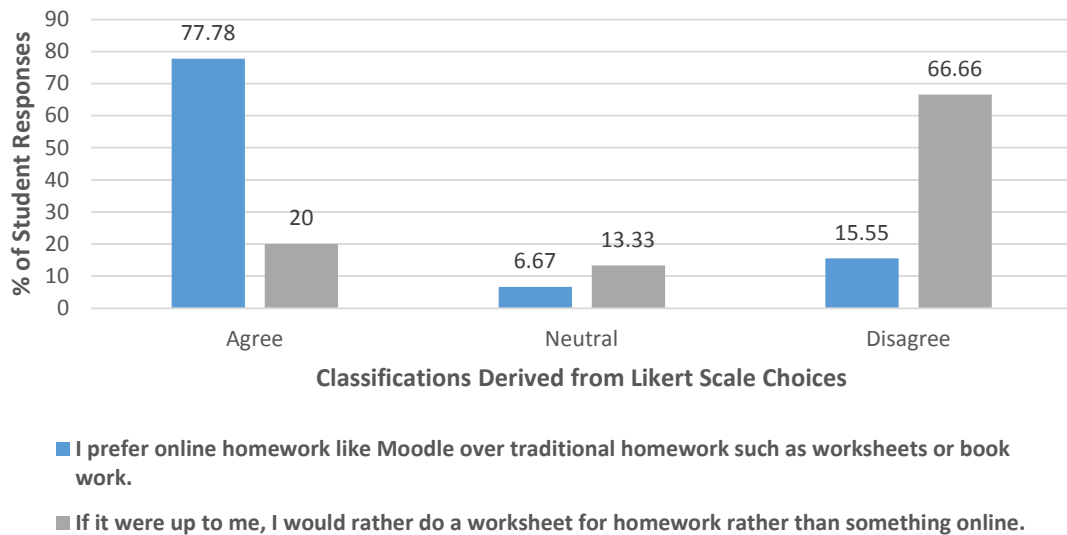


Figure 11. Student Reactions to Statements on Traditional Versus Online Homework Assignments, ($N = 50$).

INTERPRETATION AND CONCLUSION

The survey and interview questions left little room for doubt on my students' preferences for online versus traditional homework and the particular type of online assignments they thought best helped them learn. A disconnect between student preference and performance assessments began to become clear as the data was analyzed. What students thought was most enjoyable and beneficial to their learning seemed to be an integral part of the units experiencing the least amount of growth in understanding. In addition to this disagreement in perceptions, student justifications for electing online quizzes as the most enjoyable type of assignment were beginning to carry a mixed message of benefit and ease of completion. It was almost as if laziness and the speed at which homework could be completed with minimal effort was the priority in the rating of an assignment style's effectiveness. Not all data created strife in this manner, and as I will demonstrate, much of what I have done with Moodle has been validated with this project.

The measured gain in understanding for each of the four units was noteworthy and obviously more discernible in the units experiencing assignments involving peer interaction. As a person looking at the numbers, I see 33.1% average gain with peer interaction and 18.8% gain without it, and I want to immediately say peer interaction is the way to go. In good conscious I cannot do that with much certainty. As a biology teacher, I look at the topics of each unit and realize that no two units in the biology curriculum are the same. My pre-AP students always come to me with varied backgrounds, giving them strengths and weaknesses that are diverse and obvious when learning certain parts of the biology curriculum. The units involving peer interaction

covered the topics of cell biology and ecology while those with assignments lacking peer interaction covered genetics and taxonomy. Cell biology is not particularly easy, and ecology is considerably less difficult for tenth graders to grasp. In addition to the ease of learning ecological concepts, my students came to me with a very weak background in cell biology. This allowed for a great deal of potential growth in understanding, and I saw such growth in the Pre and Post-assessment scores of Figure 1 for Unit 2 Cell Biology. Had the Unit 2 Cell Biology Pre-assessment shown an average score nearer the other units, the difference between compared sets of units would have been greatly reduced making it appear as if the style of assignment on Moodle had little differentiating effect on student learning.

With the second research question being focused on student attitudes toward the different styles of Moodle assignments, I thought it important to look more closely at how students ranked the different assignments while considering their reasoning behind the rankings. Students ranked quizzes overwhelmingly as their preferred form of Moodle assignment (Figure 6). Open (peer interaction) forums came in at a distant second. Their reasoning for the rankings were mixed between claiming true benefits to learning to the assignment simply being easier and quick to complete. One student justified her choice by saying, "I enjoy the quizzes because they are quick. I know that makes me seem like a lazy high school student... but in reality that's why I like them." This might seem discouraging for the confidence deserved by the survey, but for every justification such as this, I had a student saying things similar to "I most enjoy the quizzes, because I find satisfaction in seeing exactly what I do and do not know so that I may better learn."

The focus group of twenty students chosen from the original fifty students rated Moodle at the extremes of the range presented on the survey. These students rated Moodle as either a system not contributing to their learning or one that seemed to greatly contribute to their completion of the biology curriculum. Sixty percent of the focus group ranked Moodle favorably. After finding an absence of an apparent correlation between their course grades and marked ratings of Moodle's effectiveness (Figure 4), I then looked into how the two groups performed between the pre and post-assessments. My initial thought was that I would find the group not feeling helped by Moodle to have a smaller gain in understanding. I expected these kids may have pre-assessed higher than the pro-Moodle group; as can be seen with the data in Figure 5, this seemed to be the case. Only in the instance of the genetics unit did the group giving Moodle low ratings gain a noticeably higher amount between the pre and post-assessments. Scores from Unit 2 Cell Biology Pre-assessment indicated that these students started the unit with a stronger understanding of the content in comparison to the above 8 group. This explained the smaller gain in understanding by the highly ineffective group during the cell biology unit. Performance by both groups on each of the other three units produced no discernible difference between the two groups (Figure 5).

As I see it, there are several possible interpretations of the data I collected. The first possibility that comes to mind is that the students claiming Moodle contributed little to their learning were correct. Even if these students were right in thinking it contributed little to their learning of biology, it could be that those seeing a positive impact on learning truly were helped and would have grown less as biology students without this tool. It could be that Moodle was the element leveling the field between these two

groups of students. The information presented in Figure 5 does seem to suggest a fairly synchronized gain in understanding from both groups. Another scenario I entertained was that Moodle contributed to both groups of students with only one group being aware of its contributions to their learning. Because both groups equally completed their online assignments, I find it difficult to dismiss the possibility of equal contribution to learning regardless of student perceptions. Regardless of which scenario is most accurate, I feel student confidence in the benefit of online assignments must be recognized as representing a positive influence on learning. While this study failed to reveal a clear benefit for one assignment style over another, it made apparent a clear student preference for online learning over more traditional extensions of learning outside of the classroom.

VALUE

This project has unfolded alongside my role in the development of our school's move to a 1 to 1 technology initiative, so I find it difficult to express how important such scrutiny of Moodle's effectiveness has been over the past school year. As one of the lead teachers involved in preparing our faculty to be ready for each student being issued a computer, we want a universally available online platform that is vetted and proven to work. While my research here has fallen short of showing a clear mandate for Moodle's effectiveness, it has shown a desire from our students, the customers in this business, for receiving part of their education through a digital medium. Completing this action research-based classroom project as part of my MSSE degree has been the perfect way of building my confidence in the usefulness of this online learning environment.

In addition to the benefits gained for myself and other faculty, my students feel as if they have a voice that is respected and considered to be a part of decisions made in the

implementation of their education. Such elements have helped build an atmosphere of respect and seriousness toward online learning and the upcoming technology initiative.

The familiarity I have gained on the different learning tools of Moodle has also translated into a stronger ability to meet the needs of diverse learning styles in my students.

Because of this familiarity, I feel better capable of tailoring assignments for specific learning intelligences. This project has finally allowed me to go beyond the boundaries I had unintentionally set for myself in the use of Moodle, and because of this expansion in confidence, knowledge, and skills, my students are ultimately the greatest beneficiaries.

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APPENDICES

APPENDIX A
INSTITUTIONAL REVIEW BOARD EXEMPTION



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

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MEMORANDUM

TO: Mark Meredith and John Graves
FROM: Mark Quinn, Chair *Mark Quinn CJ*
DATE: November 14, 2013

RE: "Testing the Effectiveness of Different Task Styles Assigned within the Online Learning Environment Moodle to Improving Student Comprehension of Biology Concepts and Their Attitudes toward Homework Assignments" [MM111413-EX]

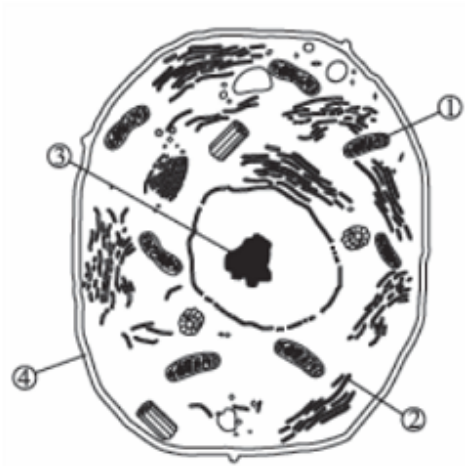
The above research, described in your submission of November 14, 2013, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- X (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- X (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- _____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- _____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- _____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- _____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

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

APPENDIX B
CELLULAR ANATOMY QUIZ

- Which statement best describes how cell theory relates to stem cell's ability to change into specialized cell types?
 - Metabolism occurs in cells.
 - Some organisms are unicellular.
 - Stem cells result from viral infections of healthy cells.
 - All cells in an organism have the same hereditary material.
 - Which is a true statement about mitochondria and chloroplasts?
 - They contain chlorophyll.
 - They capture light energy.
 - They are found in animal cells.
 - They have a double membrane.
 - How are bacteria **different** from viruses?
 - Bacteria lack a nucleus.
 - Bacteria are microscopic.
 - Bacteria are classified as living things.
 - Bacteria can cause diseases in humans.
-
4. This figure below shows an animal cell.



Which number corresponds to the organelle that produces cellular energy?

- 1
- 2
- 3
- 4

APPENDIX C
MOODLE ASSIGNMENT STYLE SURVEY

	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Undecided	5 Somewhat agree	6 Agree	7 Strongly agree
MOODLE ASSIGNMENT STYLE SURVEY							
I always complete my homework regardless of the assignment type.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Biology seems to be easy for me to learn.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I take good and thorough (complete) notes in this class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I prefer online homework like Moodle over traditional homework such as worksheets or book work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I enjoy doing the homework that is assigned on Moodle regardless of the type of assignment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If it were up to me, I would rather do a worksheet for homework rather than something online.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When it comes to online work, I prefer assignments like quizzes that don't require me to interact with other students such as in the discussions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When it comes to online work, I prefer assignments like discussions that have some element of interaction between my classmates.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
One of my highest scoring multiple intelligence areas was <i>social</i> (interpersonal).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel I learn more from the interactive assignments rather than those lacking interaction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
One of my highest scoring multiple intelligence areas was <i>self</i> (intrapersonal).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel I learn more when I work alone on assignments like quizzes or question/answer forums.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have access to a computer with internet at home most of them time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
MOODLE ASSIGNMENT STYLE SURVEY							
	1 Strongly disagree	2 Disagree	3 Somewhat disagree	4 Undecided	5 Somewhat agree	6 Agree	7 Strongly agree

APPENDIX D
MOODLE POLL QUESTION

[View 46 responses](#)

Do the activities we do on Moodle help you gain an understanding of what we study in class? *Responses will be anonymous.*

*(Scale of 1 to 5 with 1 being **Not at all**, 3 being **Not sure**, and 5 being **Definitely**)*

- 1 - Moodle doesn't help me at all.
- 2 - Moodle helps me very little.
- 3 - I'm not sure if Moodle helps me.
- 4 - I'm fairly sure Moodle helps me.
- 5 - I'm confident that Moodle helps me.

[Save my choice](#)

APPENDIX E
MOODLE OPINION INTERVIEW

MOODLE OPINION INTERVIEW

1. How do you feel that biology assignments on Moodle have affected the way you learn the material being presented in class?
2. On a scale from 1 to 10, how would you rate the effectiveness of the overall Moodle experience in helping you learn? Justify your rating.
3. Which type of Moodle assignment do you most enjoy completing? Justify your choice.
4. Which type of Moodle assignment do you feel best helps you gain a better understanding of the course's content? Justify your choice.
5. Are there any types of assignments we've done rarely that you thought were helpful and should be used more often?
6. Do you have any suggestions for using Moodle in ways not seen in this course?
7. When during the week do you usually complete your Moodle assignments?
8. How many times on average would you say you log into Moodle per week?
9. Where are you most often located when you log on to do your Moodle work?
10. Is there anything else you'd like me to know?

APPENDIX F

UNIT 2 CELL BIOLOGY PRE-ASSESSMENT

Name: _____ Class: _____ Date: _____

ID: A

Unit 2 Cell Biology Pre-Assessment

Multiple Choice

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

- _____ 1. Which is a true statement about mitochondria and chloroplasts?
- | | |
|-------------------------------|------------------------------------|
| a. They contain chlorophyll. | c. They are found in animal cells. |
| b. They capture light energy. | d. They have a double membrane. |
- _____ 2. This figure below shows an animal cell.



- Which number corresponds to the organelle that produces cellular energy?
- | | |
|------|------|
| a. 1 | c. 3 |
| b. 2 | d. 4 |
- _____ 3. Which list shows the phases of mitosis in the correct order?
- | | |
|---|---|
| a. prophase, metaphase, anaphase, telophase | c. anaphase, metaphase, prophase, telophase |
| b. prophase, anaphase, metaphase, telophase | d. metaphase, prophase, telophase, anaphase |
- _____ 4. The presence of which cell structure can be used to differentiate between Bacteria and Eukarya?
- | | |
|--------------|--------------------|
| a. nucleus | c. ribosome |
| b. cell wall | d. plasma membrane |

Name: _____

ID: A

- _____ 5. Which set of organelles would be found in both human cells and plant cells?
- | | |
|--|--|
| a. chloroplast, nucleus, and cell wall | c. mitochondria, nucleus, and endoplasmic reticulum |
| b. nucleus, endoplasmic reticulum, and cell wall | d. mitochondria, chloroplasts, endoplasmic reticulum, and centrioles |
- _____ 6. Which structure can be used to differentiate eukaryotic cells from prokaryotic cells?
- | | |
|-------------|--------------------|
| a. nucleus | c. nucleic acid |
| b. ribosome | d. plasma membrane |
- _____ 7. Which process would be directly affected if all of a cell's ribosomes were weakened?
- | | |
|--------------------------|--|
| a. replicating DNA | c. metabolizing glucose to produce ATP |
| b. producing new protein | d. transporting nutrients across the cell membrane |
- _____ 8. Which **best** distinguishes between a plant cell and an animal cell?
- | | |
|---|---|
| a. Plant cells have cell membranes, while animal cells have cell walls. | c. Plant cells contain chloroplasts, while animal cells contain centrioles. |
| b. Plant cells contain centrioles, while animal cells contain chloroplasts. | d. Plant cells have small vacuoles, while animal cells have large vacuoles. |
- _____ 9. Which describes the process of photosynthesis?
- | | |
|--|--|
| a. carbon dioxide + water → glucose + oxygen | c. water + oxygen → glucose + carbon dioxide |
| b. glucose + oxygen → carbon dioxide + water | d. glucose + carbon dioxide → water + oxygen |
- _____ 10. Which serves as the outer boundary of a cell?
- | | |
|--------------------|--------------------------|
| a. Golgi apparatus | c. nuclear membrane |
| b. plasma membrane | d. endoplasmic reticulum |
- _____ 11. Which is present **only** in plant cells?
- | | |
|------------------|------------------|
| a. nucleus | c. mitochondrion |
| b. large vacuole | d. cell membrane |
- _____ 12. Which would explain why green algae are classified as plant-like protists?
- | | |
|--------------------------------------|--|
| a. They are heterotrophic. | c. They contain photosynthetic pigments. |
| b. They live off of decaying matter. | d. They use pseudopods to move and capture food. |

Name: _____

ID: A

- _____ 13. What is the function of mitochondria?
- a. to make new DNA through DNA replication
 - b. to make protein through the process of translation
 - c. to convert sunlight into glucose through photosynthesis
 - d. to convert pyruvate into ATP through cellular respiration
- _____ 14. An amoeba can take in a large food particle by surrounding it and creating a vacuole. What is this method of feeding called?
- a. lysis
 - b. osmosis
 - c. exocytosis
 - d. phagocytosis
- _____ 15. What is one way viruses are similar to all nonliving things?
- a. They are microscopic.
 - b. They are not contagious.
 - c. They do not reproduce on their own.
 - d. They do not contain genetic material.

APPENDIX G

UNIT 3 GENETICS PRE-ASSESSMENT

Genetics Pre-Assessment

Multiple Choice

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

- _____ 1. A red rose bush cross-pollinates a white rose bush. The offspring have white flowers with red streaks. What type of inheritance is this?
- | | |
|------------------|-------------------------|
| a. codominance | c. multiple alleles |
| b. crossing over | d. incomplete dominance |
- _____ 2. What was one contribution Gregor Mendel made to science by performing his experiments on plants?
- | | |
|--|--|
| a. showing that traits are inherited | c. showing that the structure of DNA is a double helix |
| b. proving that acquired traits can be inherited | d. proving that random mutations cause the creation of new species |
- _____ 3. Which of Gregor Mendel's discoveries is represented when a black dog and a white dog mate, and all the resulting puppies are black?
- | | |
|----------------|---------------------------|
| a. dominance | c. segregation |
| b. sex-linkage | d. independent assortment |
- _____ 4. The offspring of two chickens have a 1 out of 4 chance of being white, which is a recessive trait. Which cross could produce the probability of such offspring?
- | | |
|------------|------------|
| a. YY x YY | c. Yy x Yy |
| b. YY x Yy | d. yy x yy |
- _____ 5. If one parent is homozygous recessive for attached earlobes and the other is heterozygous, what is the probability that their children will have attached earlobes?
- | | |
|--------|---------|
| a. 25% | c. 75% |
| b. 50% | d. 100% |
- _____ 6. Which blood genotype is an example of codominant inheritance?
- | | |
|---------------------|----------------------------------|
| a. I ^b i | c. I ^A I ^A |
| b. I ^A i | d. I ^A I ^B |

Name: _____

ID: A

- _____ 7. Which statement **correctly** describes the number of chromosomes in body cells and gametes?
- | | |
|--|---|
| a. body cells and gametes are both diploid | c. body cells are diploid and gametes are haploid |
| b. body cells and gametes are both haploid | d. body cells are haploid and gametes are diploid |
- _____ 8. Which term describes the failure of homologous chromosomes to segregate properly during meiosis?
- | | |
|------------------|---------------------------|
| a. polyploidy | c. nondisjunction |
| b. recombination | d. independent assortment |
- _____ 9. What is an advantage of crossing over during meiosis?
- | | |
|-------------------------------------|---|
| a. It increases genetic variations. | c. It keeps maternal and paternal chromosomes intact. |
| b. It decreases genetic mutations. | d. It allows dominant genes to be expressed more often. |
- _____ 10. Which base sequence **cannot** occur in RNA?
- | | |
|-----------|-----------|
| a. TGCTAT | c. CCUAAC |
| b. GCUAGG | d. AAGCCC |
- _____ 11. A DNA strand with the sequences of bases shown below is transcribed to mRNA.

ATT CGA GTT

Which is the **correct** base sequence in the mRNA?

- | | |
|----------------|----------------|
| a. ATT CGA GTT | c. TUU GCT CUU |
| b. TAA GCT CAA | d. UAA GCU CAA |
- _____ 12. In order to sequence their genomes, a scientist wants to separate protists from a sample of pond water. Which would be most helpful in removing the protists from the water?
- | | |
|---------------|------------------------|
| a. centrifuge | c. gel electrophoresis |
| b. microscope | d. computer hardware |
- _____ 13. Which lists the components of an RNA nucleotide?
- | | |
|-------------------------------|-------------------------------------|
| a. ribose, phosphate, uracil | c. deoxyribose, phosphate, uracil |
| b. ribose, phosphate, thymine | d. deoxyribose, phosphate, cytosine |

Name: _____

ID: A

- _____ 14. Which statement describes a structural difference between DNA and RNA?
- | | |
|--|---|
| a. DNA is a single strand and RNA is a double strand. | c. DNA has cytosine amino acids and RNA has guanine amino acids. |
| b. DNA has thymine nucleotides and RNA has uracil nucleotides. | d. DNA is made up of nucleotides and RNA is made up of amino acids. |
- _____ 15. When viewing a karyotype, which evidence provides the strongest support that an individual body cell has the condition of trisomy?
- | | |
|--|--|
| a. The cell has an odd number of chromosomes. | c. One chromosome appears shorter than its match. |
| b. The cell has an even number of chromosomes. | d. One chromosome appears to be inverted in comparison to its match. |
- _____ 16. Which describes the use of pieces of chromosomes to replace faulty or absent pieces that cause disease?
- | | |
|-----------------|-----------------------|
| a. karyotyping | c. nondisjunction |
| b. gene therapy | d. DNA fingerprinting |
- _____ 17. Nucleotide sequences from two strands of DNA are shown below.

Old DNA strand: ATG CGC GAT TCG

New DNA strand: ATG CGC AAT TCG

A mutation occurred during replication. What type of mutation is shown?

- | | |
|----------------------|-------------------------|
| a. point mutation | c. inversion mutation |
| b. deletion mutation | d. frame shift mutation |
- _____ 18. The body cells of one plant contain 40 chromosomes. How many chromosomes are found in the gametes of this plant?
- | | |
|-------|-------|
| a. 20 | c. 60 |
| b. 40 | d. 80 |

APPENDIX H

UNIT 5 ECOLOGY PRE-ASSESSMENT

Ecology Pre-Assessment

Multiple Choice

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

- ___ 1. A rodent population leaves an ecosystem due to decreased temperatures and increased rain. Which best explains why the rodents left?
- | | |
|---------------------------|------------------------------|
| a. increase in predation | c. change in biotic factors |
| b. decrease in parasitism | d. change in abiotic factors |
- ___ 2. Which event would occur before primary succession?
- | | |
|--------------|----------------|
| a. tornado | c. lava flow |
| b. hurricane | d. forest fire |
- ___ 3. Which completely describes the components of an ecosystem?
- | | |
|--|---|
| a. all the living things on Earth | c. a community of organisms and their physical environment |
| b. a group of populations living in one area | d. all the organisms of one species that live together and interbreed |
- ___ 4. Which list shows the correct order of organization from simple to complex?
- | | |
|--------------------------------|------------------------------------|
| a. cell, community, organism | c. organism, community, population |
| b. cell, population, community | d. community, population, organism |
- ___ 5. Which is a biotic factor in an Arkansas pine forest ecosystem?
- | | |
|-------------|-------------|
| a. rainfall | c. minerals |
| b. bacteria | d. nitrogen |
- ___ 6. Which biome has low temperatures, small amounts of precipitation, and permafrost?
- | | |
|-----------|--------------|
| a. taiga | c. tundra |
| b. forest | d. grassland |
- ___ 7. Which human activity is a major part of the carbon cycle?
- | | |
|-------------------------|--|
| a. building dams | c. using inorganic fertilizers |
| b. burning fossil fuels | d. removing species from their habitat |
- ___ 8. A deer tick feeds on the blood of a host and can transmit bacteria that can cause disease. The deer tick and the host are an example of what type of symbiotic relationship?
- | | |
|---------------|-----------------|
| a. predation | c. mutualism |
| b. parasitism | d. commensalism |

9. A fish species lives in the coral-like tentacles of a primitive invertebrate. Scientists believe that fish droppings and scraps of food provide nutrients for the invertebrate. What additional information would make this a mutualistic relationship?
- a. The fish protects the invertebrate from predators.
 b. The fish uses the invertebrate as a nest for their eggs.
 c. The invertebrate reproduces less often because of the fish.
 d. The invertebrate grows more slowly in the presence of the fish.
10. A biology class is conducting a year-long field study on animals in a nearby pond.

The chart below shows each group's topic.

Group	Topic
I	Competition among turtles for mates
II	The predator-prey relationship between turtles and fish
III	Length of time required by frogs to complete metamorphosis
IV	The effects of water temperature on the hatching success of toad eggs

Which group will provide the most information about a community?

- a. Group I
 b. Group II
 c. Group III
 d. Group IV
11. Below is an example of a segment of a natural cycle.



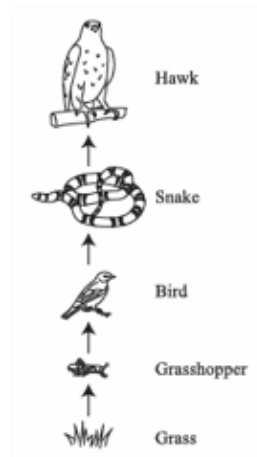
Which cycle is represented by this segment?

- a. water
 b. nitrogen
 c. phosphate
 d. carbon dioxide
12. Which biome has the greatest amount of biodiversity?
- a. boreal forest
 b. tropical savanna
 c. tropical rain forest
 d. temperate grasslands
13. Which technology was specifically developed to lessen the effects of human population growth on the environment?
- a. hybrid cars
 b. medical forensics
 c. stem cell research
 d. digital video and television

Name: _____

ID: A

- ____ 14. What is a difference in how primary and secondary succession begin?
- Only secondary succession begins on bare rock or new land.
 - Only primary succession begins in a previously inhabited area.
 - Only secondary succession begins with larger trees and bushes.
 - Only primary succession begins with pioneer organisms such as lichens.
- ____ 15. The diagram below shows a simplified food chain.

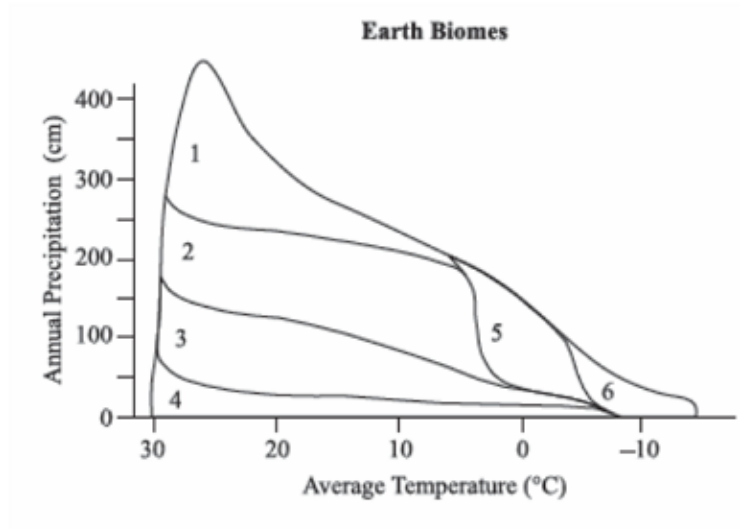


- Which level of the food chain has the **greatest** amount of biomass?
- hawk
 - bird
 - grasshopper
 - grass
- ____ 16. Increased reliance on which energy source would likely have the **most** negative effects on global climate change?
- coal
 - wind
 - nuclear
 - hydroelectric

Name: _____

ID: A

17. The graph below compares and contrasts the annual rainfall and temperature of several biomes.



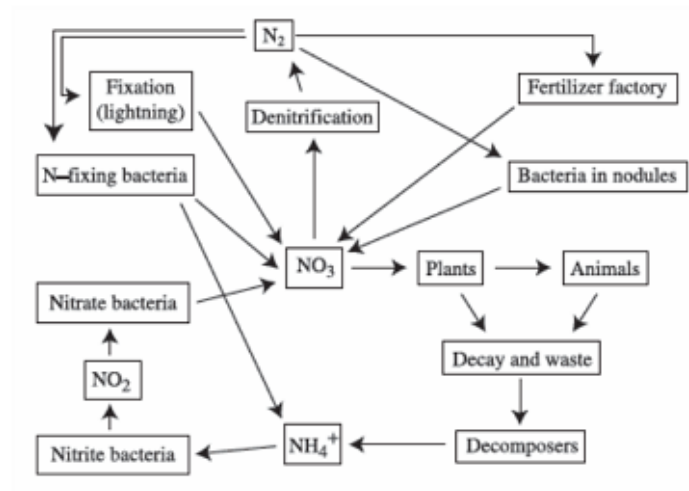
Which biome is represented in section 4 of the graph?

- | | |
|-----------|---------------------|
| a. taiga | c. rainforest |
| b. desert | d. temperate forest |

Name: _____

ID: A

18. The diagram below shows a biogeochemical cycle.



Which cycle is shown?

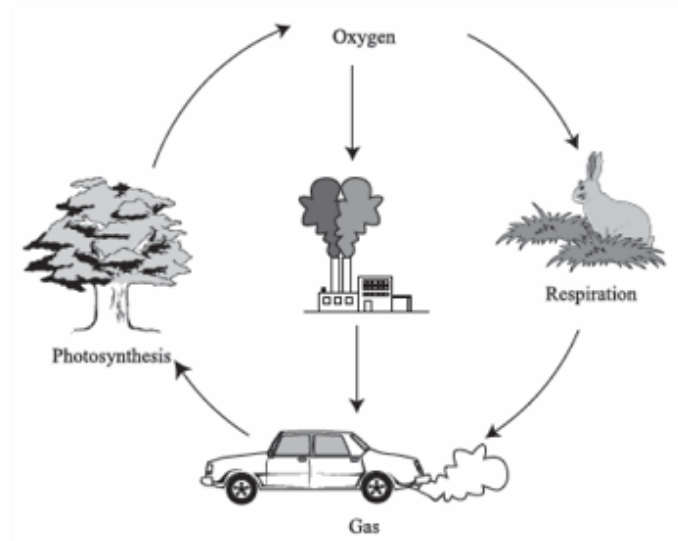
- a. water
- b. carbon

- c. nitrogen
- d. phosphate

Name: _____

ID: A

___ 19. The diagram below shows a specific nutrient cycle in nature.



Which nutrient is being recycled?

- | | |
|-----------|----------------|
| a. water | c. nitrogen |
| b. carbon | d. phosphorous |

___ 20. The Egyptian Plover bird is allowed to fly into the mouth of a crocodile and eat food scraps found there. Which term **best** describes this relationship?

- | | |
|---------------|-----------------|
| a. predation | c. mutualism |
| b. parasitism | d. commensalism |

APPENDIX I

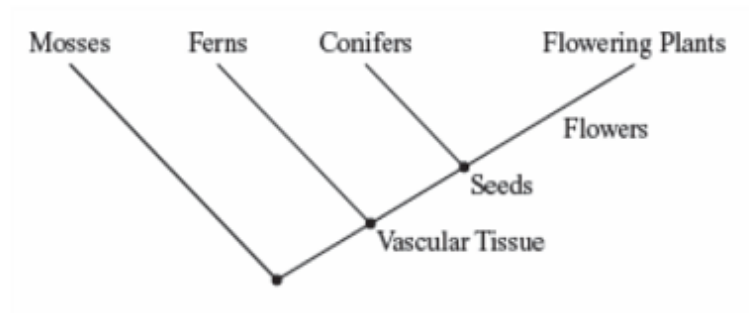
UNIT 6 TAXONOMY AND MICROORGANISMS PRE-ASSESSMENT

Unit 6 Pre-Assessment on Taxonomy and Microbes

Multiple Choice

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

- ___ 1. Examine the cladogram below.



Based on the cladogram, which describes the difference between ferns and flowering plants?

- a. Ferns have seeds and flowering plants do not.
 b. Flowering plants have seeds and ferns do not.
 c. Ferns contain vascular tissue and flowering plants do not.
 d. Flowering plants undergo photosynthesis and ferns do not.
- ___ 2. Which set of taxonomic categories is ordered from largest to smallest?
 a. species, genus, order, class
 b. class, order, phylum, species
 c. genus, family, class, kingdom
 d. kingdom, class, family, genus
- ___ 3. The H1N1 Virus, commonly known as the swine flu, was declared a pandemic by the World Health Organization in 2009.

Which approach is **most** effective in preventing the spread of the virus?

- a. vaccination
 b. sterilization
 c. use of antibiotics
 d. use of fungicides
- ___ 4. Animals and plants are classified into which domain?
 a. Archaea
 b. Bacteria
 c. Eukarya
 d. Prokarya

- ___ 5. Which would explain why green algae are classified as plant-like protists?
- | | |
|--------------------------------------|--|
| a. They are heterotrophic. | c. They contain photosynthetic pigments. |
| b. They live off of decaying matter. | d. They use pseudopods to move and capture food. |
- ___ 6. Streptococci are the organisms that cause strep throat. Strep throat can be successfully treated with antibiotics.
- Which type of organisms are streptococci?
- | | |
|------------|-------------|
| a. fungi | c. protists |
| b. viruses | d. bacteria |
- ___ 7. The presence of which cell structure can be used to differentiate between Bacteria and Eukarya?
- | | |
|--------------|--------------------|
| a. nucleus | c. ribosome |
| b. cell wall | d. plasma membrane |
- ___ 8. Into which domain would one classify bacteria that live in hydrothermal vents?
- | | |
|-------------|------------|
| a. Archaea | c. Eukarya |
| b. Bacteria | d. Extrema |
- ___ 9. Which two types of molecules are found in all viruses and all protists?
- | | |
|-----------------------------|-------------------------------|
| a. lipids and nucleic acids | c. nucleic acids and proteins |
| b. carbohydrates and lipids | d. carbohydrates and proteins |
- ___ 10. An amoeba can take in a large food particle by surrounding it and creating a vacuole. What is this method of feeding called?
- | | |
|------------|-----------------|
| a. lysis | c. exocytosis |
| b. osmosis | d. phagocytosis |
- ___ 11. Which correctly describes fungi?
- | | |
|---|--|
| a. multicellular autotrophic eukaryotes that get their energy from sunlight and can only reproduce asexually | c. multicellular heterotrophic eukaryotes that get their energy from consuming other organisms and can only reproduce sexually |
| b. unicellular autotrophic eukaryotes that get their energy from sunlight and can reproduce both sexually and asexually | d. multicellular or unicellular heterotrophic eukaryotes that get their energy from absorption and can reproduce both sexually and asexually |
- ___ 12. Organisms from which kingdom can cause amoebic dysentery?
- | | |
|------------|-------------|
| a. Fungi | c. Protista |
| b. Plantae | d. Animalia |

Name: _____

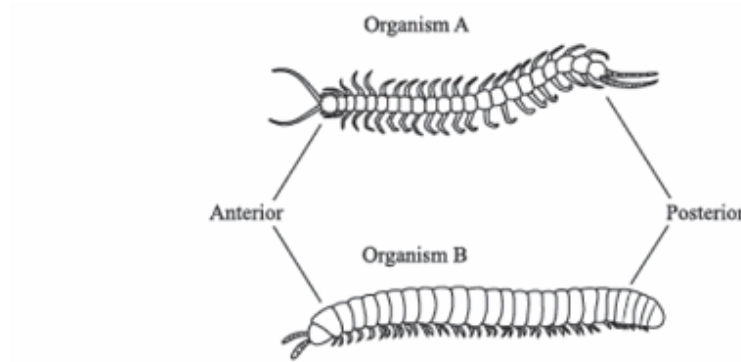
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- _____ 13. A microscopic, multicellular organism gets its nutrients through absorption from its environment and reproduces by spores. To which category does this organism most likely belong?
- a. plant
 - b. fungi
 - c. animal
 - d. bacteria
- _____ 14. Which **best** explains why bacteria are classified as living and viruses are classified as nonliving?
- a. Bacteria are heterotrophic, while viruses are autotrophic.
 - b. Bacteria are able to reproduce on their own, while viruses cannot.
 - c. Bacteria contain cellular organelles, while viruses contain nucleic acids.
 - d. Bacteria require sunlight to survive, while viruses can live with or without sunlight.
- _____ 15. Which type of bacteria has a round or spherical shape and can be found in large clumps or long chains?
- a. coccus
 - b. bacillus
 - c. spirillum
 - d. polyhedral
- _____ 16. What is one way viruses are similar to all nonliving things?
- a. They are microscopic.
 - b. They are not contagious.
 - c. They do not reproduce on their own.
 - d. They do not contain genetic material.

Name: _____

ID: A

_____ 17. Based on the figure and key below, what sequence of steps is needed to identify Organism A?



KEY:

1. Unsegmented antennae go to 2
1. Segmented antennae go to 3
2. Rear appendage absent..... go to 3
2. Rear appendage present go to 4
3. Pair of legs per body segment..... go to 4
3. Pair of legs on few body segments go to 4
- 4a. Rear appendage segmented.....done
- 4b. Rear appendage unsegmented.....done

- | | |
|---------------|---------------|
| a. 1 - 2 - 4a | c. 1 - 3 - 4a |
| b. 1 - 2 - 4b | d. 1 - 3 - 4b |

- _____ 18. Yeasts ferment when they undergo anaerobic respiration. Which industry relies **most** on a by-product of yeast metabolism?
- | | |
|----------|---------------|
| a. dairy | c. soft drink |
| b. bread | d. biomedical |
- _____ 19. A student used a microscope to study a tissue sample. Each cell had a cell wall. Which organism was studied?
- | | |
|---------|----------|
| a. fern | c. coral |
| b. deer | d. shark |

Name: _____

ID: A

- _____ 20. Based on the table below, which taxa do the human and armadillo have in common?

Taxonomic Table

Human	Armadillo
Animalia	Animalia
Chordata	Chordata
Mammalia	Mammalia
Primata	Cingulata
Hominidae	Dasypodidae
<i>Homo</i>	<i>Dasyus</i>
<i>sapiens</i>	<i>novemcinctus</i>

- a. kingdom, order
b. order, family, genus
c. family, genus, species
d. kingdom, phylum, class