# INCREASING MOTIVATION OF STUDENTS IN A BLENDED LEARNING ZOOLOGY COURSE

by

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# ACKNOWLEDGEMENT

I would like to dedicate this study to my students that willingly and unknowingly participated in the generation of valuable data. They were not aware they were the subjects of my study as I did not want to skew my results. They were themselves; they decided what they would and would not complete making the study blind.

Secondly, I would like to acknowledge the administrators of Huntley High School for granting permission to engage in this study without obtaining permission from the parents. The treatment I proposed was not out of the ordinary, therefore there was no need to inform parents. My study could remain blind.

I would also like to thank my department head and Dr. Eric Brunsell for their help and guidance as there were many obstacles along the way. The topic of my study changed three times from conception to culmination. My first proposal required blended students to attend class on blended days if their grades did not meet a standard. School Administration liked this idea and decided to change the policy for all blended classes. The second option failed when I broke my ankle and was out of the classroom for eight weeks the students fell behind with the substitute. Comparing data with the previous year would not have given an accurate picture. Finally, the third topic was conceived and my department head approved the treatment for the study.

Finally, I would like to thank my husband who has suffered through my anxiety, depression, confusion, and many other moods I went through on this journey. His support and calming nature gave me the strength and initiative to keep working through the obstacles.

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# ABSTRACT

Students need teacher support to learn and assimilate complex information about zoology. Exposure to information, terminology, and anatomy on a daily basis in a classroom is one way for students to become comfortable with the information and allows them to integrate new information into their knowledge base. Blended students are not exposed to new information or the correct use of terminology and anatomy on a daily basis if they do not engage in their daily assignments. This makes integrating the information into their knowledge base more difficult. This study attempts to uncover ways this difficulty can be lessened or eliminated. The treatment used in this study exchanged the in class daily use of retrieval practice with an increase in online quizzes to hold the blended students responsible for their own learning. This study also delved into student motivation to complete assignments and the type of assignments blended students would be more likely to complete. Results indicate motivation to complete assignments increased followed by an increase in quiz scores and summative test scores.

# INTRODUCTION AND BACKGROUND

Huntley High School is a far northwestern suburban school in the Chicago area and is the only high school in Community School District 158. The district is comprised of the towns of Huntley and Lake in the Hills and part of the town of Algonquin, all towns are located in McHenry County, Illinois and are considered part of the Chicago suburban area.

According to the Illinois Report Card (n.d.), there are 9,574 students enrolled in School District 158 in 2017, with 2,996 of the students enrolled at Huntley High School. The average class size is 24 students, which is 20% higher than the state average of 20 students per class. The high school student population is made up of 75.1% white students, 11.5% Hispanic students, six percent Asian students, two percent black students and the remaining five percent of the students being of American Indian, Pacific Islander, or they identify as two or more races. Within the student population of Huntley High School, 15% are low income with one percent being homeless, 12% have Individual Education Plans, and one percent of the students are English Language Learners. The school has a two percent dropout rate. All of the previous demographics are below the averages given for the entire State of Illinois. The overall graduation rate for the school is 90%. For students with Individualized Education Plans, a graduation rate of 69% in four years for compared to the Illinois State average of 87%. Of the graduating seniors, 81% enroll in college. Two-thirds of the students are college ready as defined by scoring 21 or higher on the ACT test taken during the second semester of the junior year, whereas the state average is 51% of students are college ready. Illinois recently began using SAT

scores to determine college readiness. This was the second year we gave the SAT and our scores from the previous year showed 57% of our students meet or exceed the Illinois Learning Standards as compared to 39% of students statewide. This data would be the scores that this year's seniors produced during their junior year. Illinois has also started giving a statewide standardized Biology test to all students in the second semester of the year they take biology, a required science class. The data from spring 2016 showed that Huntley High School biology students were 66% proficient in biology compared to the state average of 51% proficient.

The Illinois Report Card (n.d.) contains the following data about the teaching staff at Huntley High School. The teaching staff is predominantly female (80%), ethnicities are made up of 95.1% white teachers, two percent are Hispanic, one percent of teachers are Asian, only two-tenths percent are black, and the remaining one and six-tenths percent did not report their ethnicity. Two-thirds of the teaching staff have their Master's degrees or higher and overall teachers are paid an average of $5,544 less per year than the average teacher salary in Illinois which is $64,516. The school district prides itself as having a low expenditure per student, $5,468, as compared to the state of Illinois average expenditure per student is $7,853. Also, the operating budget of the school is $3,204 less per year than the state average of $12,973.

I teach science at Huntley High School, and I am currently teaching two biology classes and three zoology classes, which are classes I have taught for ten years. The two biology classes are taught in the traditional classroom format with a focus on model-based curriculum following the Next Generation Science Standards. The zoology classes

also follow the Next Generation Science Standards are taught in two different formats. One class is taught in the traditional classroom format and this is the second year that the two zoology classes are taught in the blended format. Huntley High School is nationally known for their blended program and has become a model for many other districts and schools. The blended zoology classes meet two days a week and the remaining three days are online days where students are not required to be in the classroom as long as they meet the 70% grade requirement. Blended class lessons are developed and delivered through the Haiku Learning Management System. The three zoology classes are mostly seniors with very large class sizes at the beginning of the year with 28 or more students in each of the classes. The Science Department Head tries to keep the science class sizes at a maximum of 24 students to facilitate learning and lab participation. At the end of the first semester I had several students from each class graduate early and some struggling students were advised to take a different class for the second semester. This made the second semester class sizes more manageable with 19 or fewer students per class.

The change to teaching in the blended format has not come about without complications. I have noticed the students in the blended zoology classes struggle more with vocabulary, identification of anatomical structures, physiology and critical thinking than the students in the traditional format class. Many of the blended students are not completing the assignments that help them learn this information and they come to class without the background information needed to properly participate in the activities. For these reasons, I have decided to focus my research on determining a way to develop the blended zoology class curriculum to insure students make better use of the blended time

while learning the vocabulary, structures, physiological processes, and critical thinking concepts.

Over the course of the first two years of blended zoology, I have noticed that many of the students do not do the online assignments or wait until the end of the unit approaches and then rush to complete the assignments and many assignments are turned in incomplete. This leads to a lack of preparedness for the in-class activities that are designed to reinforce and expand upon the knowledge students should have gained by completing the online assignments before the in class days. Without the background knowledge students struggle more to learn the terminology, anatomy and physiology concepts. The focus of my study was to hold students accountable for the online assignments through an increased use of Google quizzes, hands on activities and retrieval practice methods when they are in class.

The first step was determining which students were not fully engaged with the online assignments. Then I determined why they did not complete the work to prepare for in class days. Knowing individual student motivation and work ethic was useful in identifying which students would require extra attention and support in getting work completed. This was determined with online quizzes that disclosed what the students have learned and retained from their online assignments prior to classroom days. Students not meeting the minimum requirement of knowledge attainment were given extra support to complete assignments and additional practice to help retain information necessary to understand and to use on the in-class days.

## Research Questions

A list of four research questions follow:

1. Some students do not complete online assignments. How can students be held responsible for their learning with online assignments?
2. What type of assignments are students most motivated to complete?
3. What skills do successful blended class students have that less successful students need to develop?
4. What additional help do the less motivated students need to develop skills to be successful?

## CONCEPTUAL FRAMEWORK

Many students take zoology as their fourth-year science elective because they have a love for and interest in animals. Zoology is a challenging yet interesting class for high school students that are interested in becoming a veterinarian, a veterinary technician, a biology teacher, a zoologist, a zookeeper, or would like to work with animals. At Huntley High School this class is offered in two different formats: one is in a traditional classroom setting, the second is as a blended class. The traditional class meets five days a week, while the blended class meets two days a week with the other days being online days. During the online days, the students work on assignments delivered through a learning management system; we use Haiku. Blended classes have become very popular at Huntley High School over the past six years since the first blended classes were offered. The number of students enrolled in all of the blended classes offered at the school has increased each year and many students take two or more

blended classes. Huntley Consolidated School District 158 recently posted an Infographic on Facebook that of the 728 seniors that graduated in 2018, 670 took one or more blended classes (Infographic, 2018). In addition, the variety of classes offered in a blended format has also increased with zoology being a recent addition to the list of classes available. This is one reason adjustments are needed for the blended zoology curriculum as the course is in the early stages and is evolving.

Creating a student-centered classroom that holds students responsible for their own learning is an important aspect of this process. One step towards realizing this would be to make better use of formative assessments. Online quizzes have been an effective method allowing students to gauge their individual progress towards the learning targets. In a 2015 study gauging the value of online quizzes in blended format classes showed the quiz results coupled with in class test results successfully predicted the individual student performances on the final exam (Cohen & Sasson, 2015). This study also showed that students' preference for the online quizzes changed the instructional design of the blended course as they proved to be an effective form of formative assessment.

Previously Google quizzes were used once or twice per unit to uncover misconceptions and misunderstandings. Changing the aim and frequency of these quizzes would allow me to determine who is ready for the activity prior to the in-class activity and who is moving in a positive direction towards the unit and final exam. Revealing misconceptions is an important step in learning which could be accomplished while the students are in class or through another method such as an exit slip.

One feature of Google quizzes is that students can attempt the quiz more than once and this would help them obtain a minimum score needed in order to participate in the in-class activity. This would shift the emphasis to learning information before the activity while putting the responsibility into the student's hands. Students that have not shown they are ready for the in-class activity would be grouped together and separated from the students that are prepared. The unprepared group would have to complete the assignments they did not complete prior to participating in the activity and would have to come to class on the blended days to complete the in-class activity they missed.

Allowing individuals to test their knowledge and repeat the process until they are satisfied with the results was proven to be an effective method of formative assessment in a study of high school students (Yapici & Akbayin, 2012). Allowing students to take the quiz multiple times until they felt comfortable with the information would allow students to reach the learning targets and prepare them to participate in the classroom activities. Students tend to memorize the answers when allowed to repeat the quiz until they achieve at least 80% making the randomization of questions and answers a necessity. The method of online quizzing is further supported by research comparing traditional, blended, and online blended animal science laboratory classes where online quizzes increased student success and further enriched learning from classroom activities and lecture (Rivera, 2016). There are many other formats besides Google Quizzes to use in the classroom that also offer immediate feedback to the student and allow the teacher to access scores quickly and with ease.

When students are in class on the days they would have been blended to work on attaining the skills necessary to participate in the in-class activities, they will be exposed to more retrieval practice just as the traditional zoology students engage in. Retrieval practice has been shown to be a successful method in increasing student learning and retention (Dobson, 2013). In Dobson's 2013 study of enhancing learning and retention of information learned in anatomy and physiology classes, groups participating in retrieval practice increased their scores 40% or more over the students that did not engage in retrieval practice. This is a significant gain in learning complex and challenging information much the same as what is necessary in a zoology class. There are many ways to use retrieval practice and basics are explained by a group of researchers from Washington University in St. Louis lead by Dr. Pooja K. Agarwal. The Retrieval Practice website (retrievalpractice.org) contains a wealth of information including how to use retrieval practice in your classroom through the use of bell work, exits slips, quizzes, or in class questioning using clickers or other ways of allowing all students to answer. Questions can be multiple choice, short answer or critical thinking depending upon what the goal is for student learning. But more important than the questions is feedback. Students need the correct answer explained in depth to them in order to process the information and recall at a later date (Retrieve! n.d). I started using this method in my classroom over the past two years and I have slowly moved towards incorporating it almost daily in my traditional zoology class. I have the opportunity to do this only two days a week in the blended classes and this may be one reason they are struggling more with the vocabulary related to anatomy and physiology of animals.

Student choice is one step towards a student-centered classroom which is the model that Huntley High School has begun to focus on. Blended classes are one-way students can choose to learn but student choice does not have to end there. Blended students must actively participate in their own learning making this a student-centered environment. Without the daily interaction with their teacher some students lack motivation to get the work completed. By offering students different paths to obtaining the information they need to learn, students are more likely to engage actively in their learning while attaining the same goal. Howard Gardner proposed the theory of Multiple Intelligences in 1983 and explained that "students possess different kinds of minds and therefore learn, remember, perform, and understand in different ways" (Gardner, nd). Not all students learn the same way where differentiating assignments allows students choice in how they learn. Gardner's research lead to the identification of seven different types of intelligence. For example, some students like to read, others like to listen, other prefer audio and visual as found in a movie or a drawing. Creating assignments that allow the student to choose how to obtain the information they need to learn, puts them at the center of their learning. In this way learning can be differentiated to accommodate students with different learning styles and give the student the feeling that they are in control of their learning.

Surveying students at the beginning and end of the school year provides a basis to begin differentiating learning. Students used a Likert scale combined with several open-ended questions to help determine what type of assignments were preferred and which type of assignments they found most interesting and helpful. This provided useful

information for blended classes. The Likert scale method has been studied and it has proven successful with online classes showing it is possible to obtain usable results from a survey to help determine the type of assignments and activities students prefer to complete (Brew, 2008). The Likert scale survey combined with completion rates of assignments in my blended classes helped determine which assignments students were more likely to engage in and complete.

There are always students that are more successful than other students in blended classes. Successful students have characteristics that allow this to be possible. Determining these characteristics and working to develop them in the students that need them, could turn the less successful students into more effective learners. Determining the level of motivation and self-regulation of the successful students would be the first step in helping struggling students find the path to success. This was the topic of two interesting studies. A 2009 study by Anthony R. Artino, Jr. and Jason M. Stephens determined that teachers should be cognizant of their student's abilities and adjust their teaching methods and amount of support offered accordingly. They also found that teachers need to keep in mind their "student's experience, motivational beliefs, and self-regulatory competence in online situations." When a teacher reaches out to students, the student realizes that the teacher is invested in them as a person. By talking to your students that struggle, you learn how to help them. The second study was conducted by Peter Shea and Temi Bidjerano and their work expands upon the above findings, indicating a student's self-efficacy and their commitments to a "Community of Inquiry" are essential to student achievement (2010). They also explain that a student who is confident with their

knowledge participates in the “Community of Inquiry” with more vigor and thus gains deeper knowledge than the less confident students. Helping students gain self-confidence in a subject should be a focus from the beginning of the school year. I believe a confident student is more vested in their learning, and this extends beyond my classroom into other classes and areas of life as well. Working with individual students to help them find a way to be successful builds confidence. A student’s motivational level is not all that needs to be considered. Equally important is the type of motivational beliefs each student has about their own competence (Patrick & Yoon, 2004). This shows that students need to believe they can achieve in order to achieve and by helping a student gain the skills necessary to complete blended assignments, you are helping the student believe in themselves.

Weaving a class of students into a cooperative learning group is not always an easy task, especially when it is complicated by incorporating the NGSS, Problem Based Learning, Common Core, and scientific literacy while fitting this into a blended class format that only meets in the classroom twice a week. These difficulties were realized in a study conducted with zoology students incorporating collaborative inquiry and introducing problem-based learning (Harland, 2002). Harland showed not all students move easily from one format to another and some require more time to make this adjustment (2002). I am confident that adapting my blended course to better address student needs, individualizing instruction and giving students the ability to choose how to acquire information will help reach the different types and abilities of learners. I am

hopeful this will increase online participation of the less successful students as they gain confidence and increase their participation in the class activities.

Harvey Singh, an innovator in e-learning, offers excellent advice on how to structure blended learning classes. He breaks blended classes into “dimensions” or learning strategies, to make a blended format class that fits specific student needs and is more accessible (Singh, 2003). In adapting my blended zoology class, creating different learning strategies will allow students more choice in a student-centered learning environment. Dividing students according to their motivation to complete online assignments, students were grouped to allow differentiation of their needs and provide more support to the students that struggle. Putting student’s interest first in an individualized, learner-centered experience has been shown to help students gain confidence and motivation (Rentroia-Bonito, 2015). In this study, students were divided into divided groups depending upon their learning profiles determined by each student’s attitude, motivation to learn, emotions and satisfaction with the blended learning program (Rentroia-Bonito, 2015). By differentiating students into groups based on these factors, I can effectively individualize the additional support students need. Addressing student’s individual competencies is important in creating an atmosphere of engagement in blended classes (Delialioglu, 2011). Delialioglu also adds a few more components to increase student engagement such as the use of active learning activities with the students and the establishment of high standards for student work quality (2011). Active learning and hands on activities are used in zoology during the classroom days with students in groups. Student groups are often engaged in sorting and labeling activities that allows me

to assess their level of learning and misconceptions while the students are involved in reasoning and critical thinking in an effort to reach a consensus among group members. Having high standards for work shows students their product is important and they will work to reach your standard. High standards also express the importance of the assignment to the students. Creating assignments for a blended format class should take into account the student's needs and the best methods to engage students in the learning experience.

## METHODOLOGY

Students in the blended zoology classes at Huntley High School struggle more understanding and using Zoological and scientific terminology, identifying anatomical structures and physiological processes, and answering critical thinking questions when compared to students in the traditional format class. Many blended students do not complete the online assignments to learn the background information they need to fully participate in the activities. Further reorganization and development of the blended zoology curriculum to insure students make better use of the online time while learning vocabulary, anatomy, and critical thinking skills will be the focus of my research.

The students in the two blended zoology classes along with the students in the one traditional classroom environment will be the participants. Zoology is a class consisting of mostly seniors of mixed academic abilities. To enroll in the class, a student must have successfully passed Biology with a C or better, but students are placed in zoology with lower grades. The zoology students share a love of animals, while some of them are

planning on a career working with animals; others are planning on careers in a variety of different areas.

The fall semester started with larger classes ranging from 26 to 29 students in each of the three classes. At the end of the first semester about 15% of the students graduated early and another 12% were recommended to take a class a different class because of their lack of success in the first semester or the need to obtain a required credit in order to graduate. During the second semester, the traditional zoology class contained 18 students; ten males and eight females. Three of the females are juniors, one of which is graduating as a junior. Three students have a 504 plan, and two have IEPs (Individualized Education Plans). The two blended courses have a total of 29 students; 15 males and 14 females and two males are juniors. Two students have a 504 plan and one student has an IEP. There are twice as many students in the traditional class requiring additional support than in the blended classes. Attendance is the only behavioral problem encountered with the students. In the traditional classes two students have missed 11 and 17 days during the semester, while in the blended class four students have missed between 11 and 22 days. The students with the attendance issues also have lower than average grades in the class.

In order to compare the success of the change in method being explored in the blended curriculum, students need to be separated into comparison groups based on previous performance in class. Students with an Individual Education Plan or a 504 Plan will be included with the mainstream students. Students will be divided into groups depending upon completion rate of the online assignments and summative assessment

grades. There are three groups: Group 1 will include below average performing students that have 50%  or less assignment completion and exam scores below 65%, Group 2 will include average students that complete 50 to 80% of their online assignments and have exam scores between 65 and 80%, and Group 3 will include high performing students that complete more than 80% of their assignments and score above 80% on their exams. If a student falls into two different categories (one for their assignment completion rate and another based off of their exam scores) they will be placed into the lower category. The percentage of students in each group per class is shown below in Table 1.  Students will remain in the category they were originally placed in throughout the study period.

Table 1

*Breakdown per Class of the Percentage of Zoology Students in Each Group*

| | Group 1 | Group 2 | Group 3 |
|---|---|---|---|
| Traditional Class | 50% | 28% | 22% |
| Blended 1 | 31% | 46% | 23% |
| Blended 2 | 31% | 44% | 25% |

All blended zoology students are expected to meet the requirements as they progress through the curriculum. Students that are not meeting the requirements will be required to attend class on days that they would be blended until they can show they are ready for the next step. This may require exchanging one, two, or three of the blended online days for in class days depending upon how much additional support they need to meet the requirements. During this time, will received guidance to determine how they could obtain the skills needed to return to being blended on blended days. The goal for these students was to become confident enough to complete the blended online zoology

work on their while in class where additional support and guidance was available, much like the traditional classroom format. To keep from overwhelming the intervention students, the skill-based work focused on completing online assignments correctly, through the use of modeling and scaffolding as a beginning which was added to as necessary to meet individual student needs.

Students experienced retrieval practice in the classroom. As they worked on activities, dissections, and assignments, they were questioned randomly. Also exit slips and bell work were used to uncover misconceptions and understanding of online assignments in the blended classes. The bell work and exit slips are included in Appendices C and G. Students in the traditional classroom were subjected to retrieval practice on an almost daily basis while the blended students only engaged in this on the two in-class days. In order to hold the blended students responsible for their learning, online quizzes replaced retrieval practice for the blended students.

This study covered the last two zoology units; birds and mammals. Each unit began with a previous knowledge probe or quiz (Appendices A and E) to help determine the level of knowledge each student brought into the unit. Throughout the units exit slips were used to determine what the students learned that day in class. There were frequent Google quizzes aimed at determining if the students had attained an average amount of knowledge in order to participate in the discussions, activities and dissections. The students that performed below average had to work to gain the required knowledge before they completed the in-class work on another day.

Students were interviewed from each of the two class formats, traditional and blended, before, during, and at the end of the study. The interview students were a mixture of male and female students with one student from each group in each class: high, average, and below average performing students. The interviews aimed at determining student motivation level, what motivates them, how confident they were about zoology, what help they needed to learn and retain the information, how they study, what activities they believed were the most helpful in learning and how each student felt they were doing at that specific time compared to the beginning of the semester.

In addition to the above methods of gathering information, two summative assessments were used as indicators of concept and terminology attainment. The summative assessments are included in Appendices B and F. Blended students' scores were compared to the traditional students' scores, as well as responses to the short answer portion of the tests. The final comparison looked at previous student's performance on the bird and mammal summative assessments from the previous year.

At the end of the study, a Likert Scale or Likert Type Scale was used to add more depth to the interviews and help determine what type of assignments and activities students preferred and felt were most effective and which were least effective to their learning, and what type of environment was most productive for studying. This would help determine what type of activities motivated students to participate in their learning, how to motivate students to complete their work, if students preferred more than one pathway to attaining information, what could be done to facilitate learning, and what type

of learning environment was best for blended studies. This information would then be used to drive the planning process for the next school year.

The variety of instruments used to collect data and answer the primary and secondary research questions are summarized in Table 2 below.

Table 2
*Data Triangulation Matrix*

| Focus Questions | Data Source 1 | Data Source 2 | Data Source 3 |
|---|---|---|---|
| Primary Question: How can students be held responsible for their learning with online assignments? | Quizzes | Likert-Type Survey | Bell Work and Exit Slips |
| Secondary Question: What type of assignments are students most motivated to complete? | Personal Interviews | Likert-Type Survey | Inventory of completed assignments from gradebook |
| Secondary Question: What skills do students need to be successful in blended zoology? | Teacher Observation | Personal Interviews | Likert-Type Survey |
| Secondary Question: What help do students need to develop skills to be successful? | Teacher Observation | Personal Interviews | Likert-Type Survey |

## DATA AND ANALYSIS

The completion rate of online quizzes remained similar in the blended classes throughout the second semester. Prior to the study period, completion rate of online quizzes was 91.7% and during the study period the completion rate of online quizzes showed a slight increase to 92.3%. The completion rate for online assignments increased

significantly from 54.7 % to 76.2% and the average quiz scores also increased from 68.8% to 75.3%. The traditional zoology class participated in retrieval practice during class. A breakdown of average scores for the blended classes on the six quizzes is shown in Figure 1 below. Replacing retrieval practice with quizzes appears to have encouraged blended students to complete the online assignments before taking the quiz. The quizzes are shown in Appendices D and H.

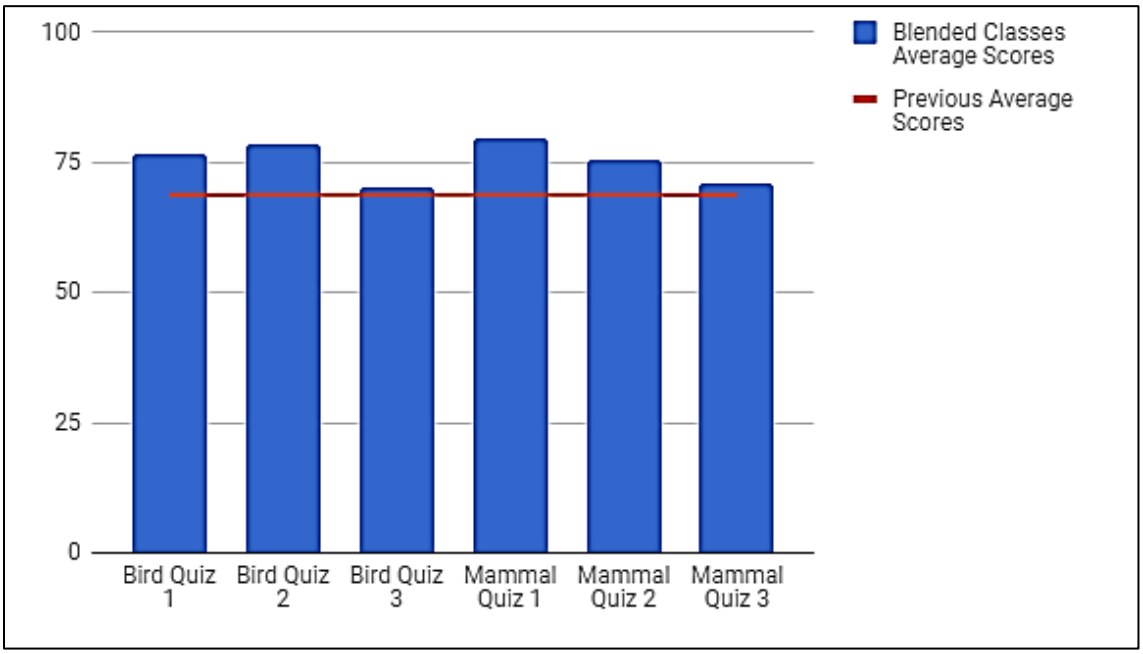


*Figure 1*. Blended class average quiz score as the study progressed as they related to the pre-study average quiz scores, (*N*=29).

When the quiz grades were compared by group for the blended classes the scores increased in each group (see Figure 2). Group 1, the lower performing students, raised their average score from 58.3% to 67.6%. Group 2, the average performing students, raised their average score from 69.8% to 76.9% and Group 3, the higher performing students raised their scores from 79.8% to 82%. Each of the lower performing groups

made considerable improvements in their quiz scores when they started completing online assignments.

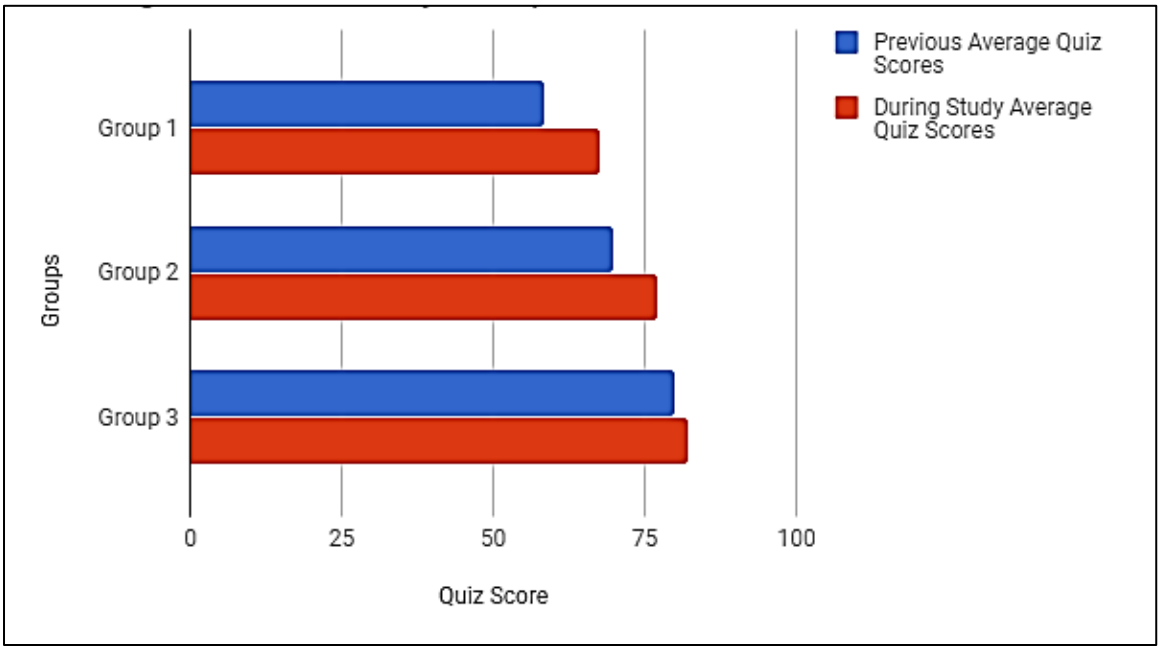


*Figure 2.* Average quiz score by group throughout the study as related to the pre-study average quiz scores, (*N*=29).

The data suggests that using online quizzes increased the student's completion rate of assignments which in turn increased their quiz scores. The Likert-type survey given all students at the completion of the study also supported the increase in homework completion as an important motivating factor in completing assignments. When asked to rate the importance of online assignments to the ability to answer questions correctly on quizzes and tests, 87.2% of the students chose this as a prime factor. Bell Work and Exit Slip answers also showed an improved understanding of the content the students were learning. All three of these factors indicate that the students were being more responsible for their learning then they had done in the past.

When unit summative scores are considered for each of the classes, the traditional class test score average increased by nine-tenths percent from 74.8% to 75.7%; one blended class score average increased from 71% to 74.1% (three and one-tenth percent), and the second blended class summative scores decreased from 74.2% to 71.6% (two and six-tenths percent). This data suggests that there may have been other factors affecting the test scores. When asked in the student interviews if the amount of time spent studying for tests had changed from prior to the study, five of the nine students said the amount of time spent studying was less because of the demands of their other classes; four of these students said Advanced Placement classes were their priority and they had less time to spend on their other classes including zoology. Three students said they had spent more time studying for zoology tests because they wanted to improve their grade and did not want to fail the class; all three of these students were in the lowest performing groups. The last student said the amount of time spent studying for tests had not changed.

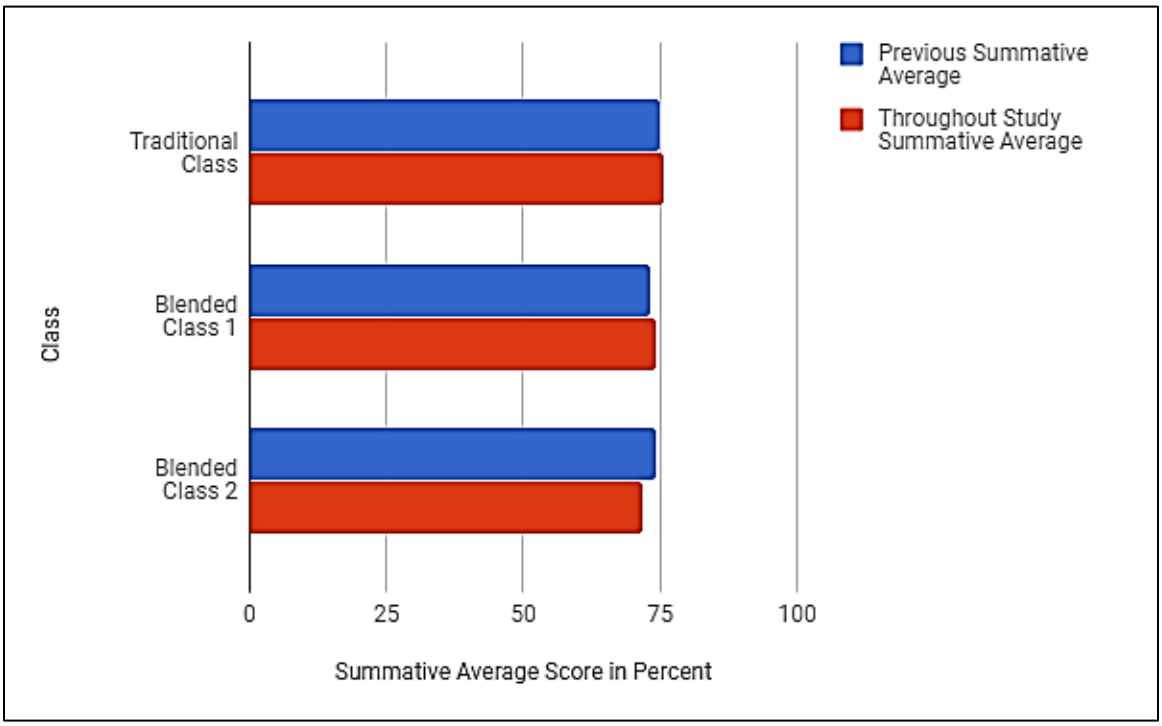


*Figure 3*. Average summative score by class throughout the study as related to the pre-study average quiz scores, (*N*=47).

Determining the type of assignments students were more likely to engage in and providing them to students, could also have been a factor in the improved quiz scores. One student from each group was interviewed at the beginning of the study; the interview questions are included in Appendix I. One question asked students how they preferred to gain the information they need to learn in zoology. Five of the nine students liked to watch videos with embedded questions to learn information, two students liked to use the slides with voice over, one student liked to read the information and the remaining student said either the videos or the slides with voice over because they did not like to read. By making sure there were options for the students to obtain information students were allowed to choose how they learned which gave them ownership over their learning.

The data from the Likert-Style survey also verified the data gathered in the interviews and is shown below in Figure 4.

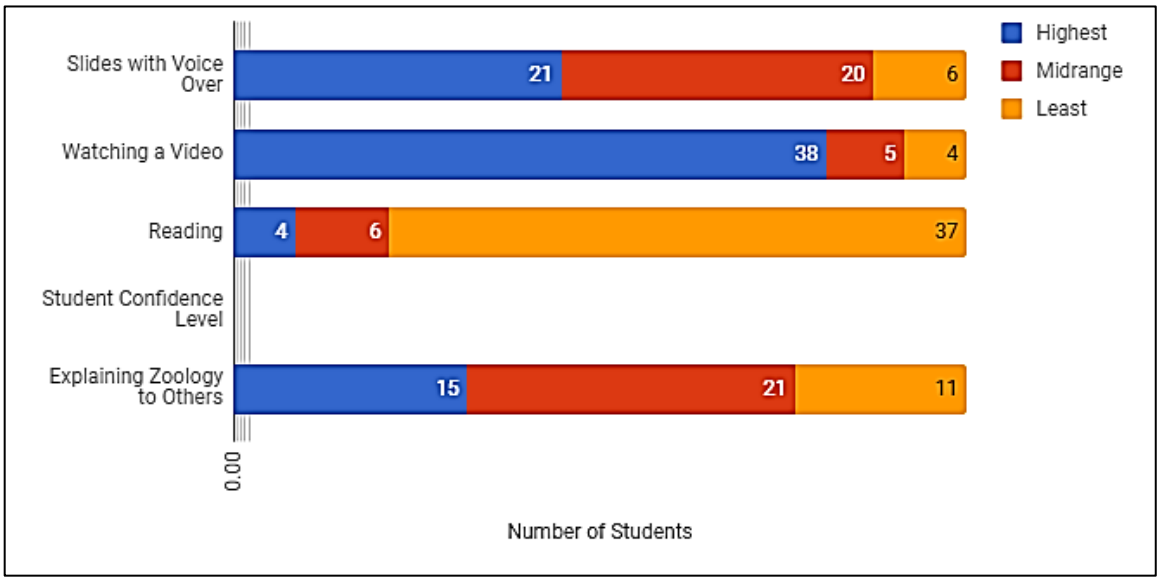


*Figure 4.* Student preference in learning and the confidence level of students in explaining what they have learned to others, (*N*=47).

Students being interviewed were asked what type of online assignment was their favorite to complete. Four of the students preferred the online discussions, three students preferred creative assignments such as building a bird and researching information about the bird they chose to create, one student liked anything involving videos, and the ninth student said they preferred group work.

Students were also asked which type of assignment was their least favorite to complete in the interviews and the answers were varied. Two male students did not like assignments where they had color, two other students did not like to have to do research, two students said they preferred not to do vocabulary work, one student did not like to color and label anatomy diagrams, another preferred not to answer questions, and the ninth student did not like graphic organizers.

The student choices of what they preferred to do and what they preferred not to do as assignments also showed similar patterns in which assignments were turned in completed and which were not in the gradebook. Students participated in online discussions 84% of the time (increase of 6%), turned in creative assignments 78% (increase of 5%) of the time compared to the lower rates of completion on vocabulary of 58% (increase of 3%), graphic organizers at 46% (increase of 2%) and incomplete assignments that involved research at 52% (increase of 4%). The Likert-type Survey, in Appendix J, also showed similar likes and dislikes of assignments in both the traditional and blended classes as shown in Figure 5 below.

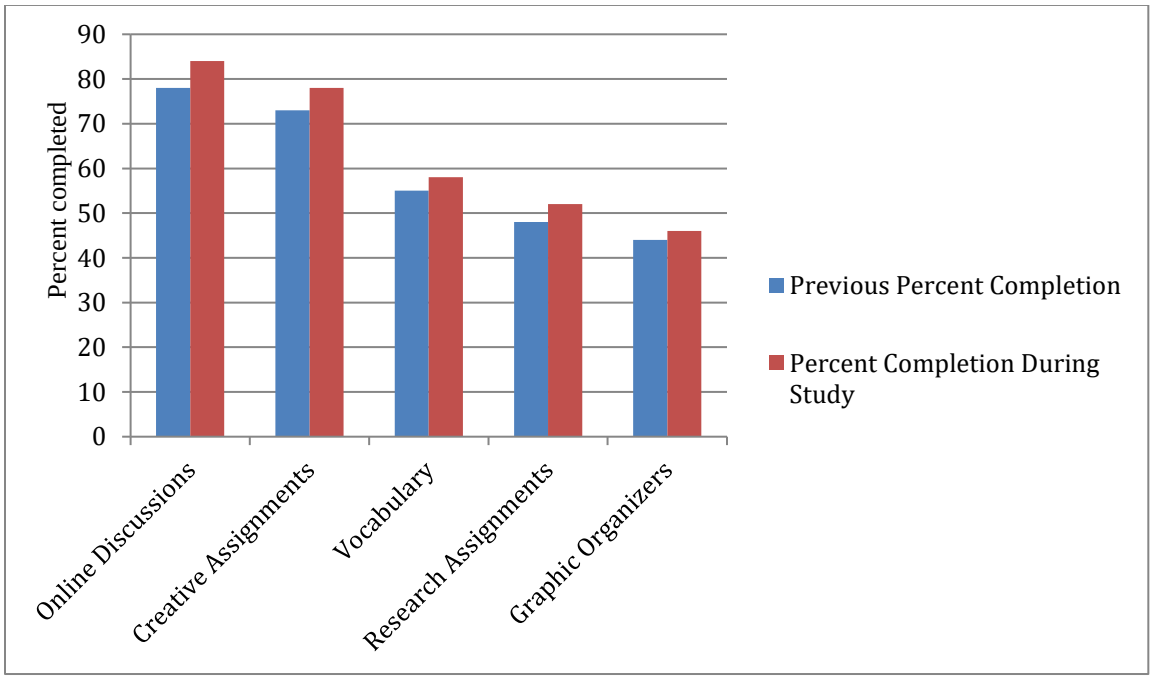


*Figure 5.* Student completion of assignments, (*N*=29).

Another area of discovery this study addressed was to determine what skills are necessary for success in zoology. Teacher observations found some obvious skills such as determination and perseverance in work ethic, but other skills not as obvious also

emerged. The ability to work together in a group lead to a greater understanding as the cooperation of the group helped the students that were not as strong or knowledgeable to gain more information. As groups worked and questions were posed to them, even the weaker students could answer the critical thinking questions whereas they previously would not have been able to do so. In groups that did not form a cohesive whole, the knowledge gained by the lower performing students was not as in-depth as in the cohesive groups. Cohesive groups that struggled with the in-class activities made larger gains in understanding then the cohesive groups that did not struggle. This could have been the result of in-class activities helping pull together bits of knowledge for the struggling students and helping them make sense of the pieces they brought to class.

In the interviews and on the Likert-style Survey, students listed many skills necessary. The data from the Likert-style Survey showed the most mentioned skills were the ability to remember information (46%), second was their motivation to learn (39%), followed by knowing how to work in a group (38%), being a self-starter/work on your own (32%), the ability to solve problems or issues (27%), finding enough time to do your work/time management (17%), and completing work on time (16%). The Likert-Style Survey data was used above to avoid duplication of skills uncovered in the interviews.

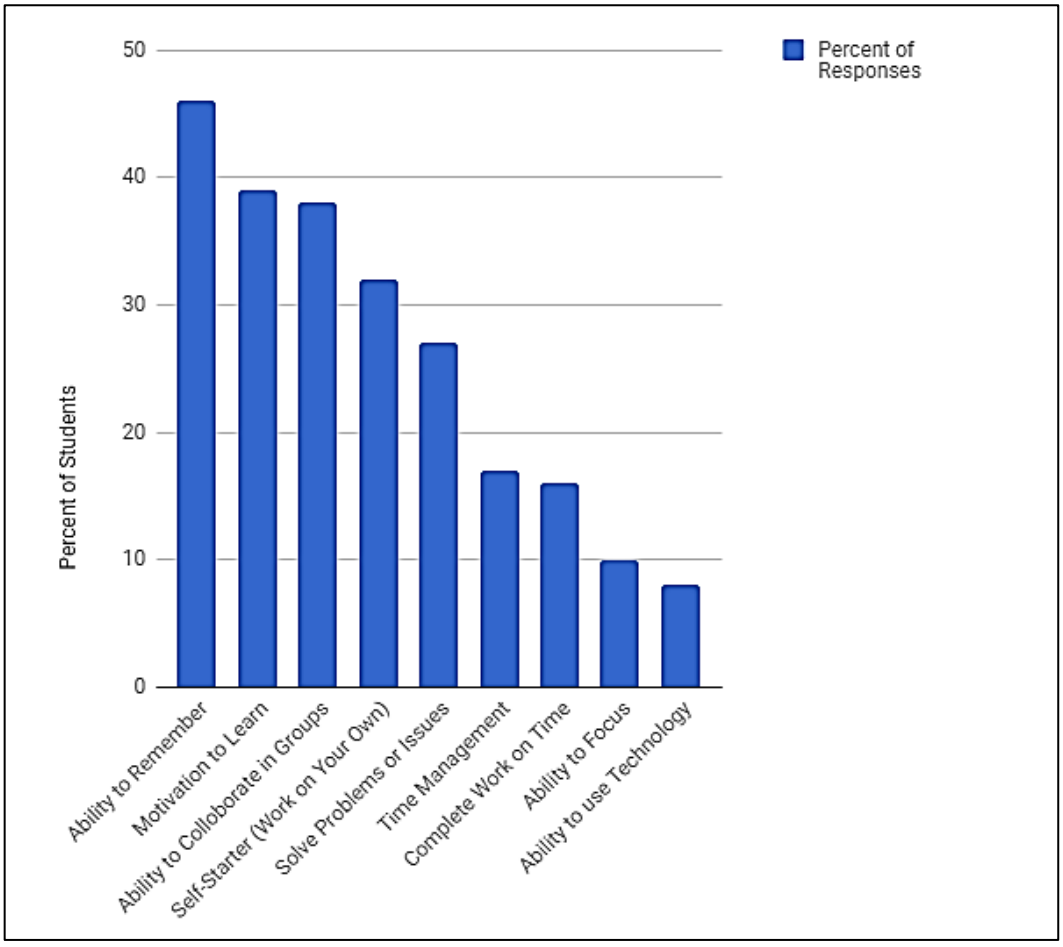


*Figure 6.* Skills necessary to be successful in zoology class as chosen by students, (*N*=47).

The final question this study sought to answer was "what additional help do students need to develop the skills necessary to be successful in zoology?" Giving students the chance to practice the skills was the most mentioned answer at 28%. Helping a student solve a problem was the second most mentioned response at 25% in interviews and through the Likert-Style Survey. Observations of the students also showed introducing students to skill through modeling and support was helpful in convincing a student to try a new skill. Many students (22%) chose not to answer this question on the Likert-style survey or they answered "idk" (I don't know).

# INTERPRETATION AND CONCLUSION

The focus of this study was to determine a way to improve the bended zoology curriculum to allow students to maximize their time learning. Blended students struggle with concepts, vocabulary, physiological processes, anatomy, and critical thinking abilities. This is evident by the lack of completion of online assignments before coming to class not allowing students to fully engage in the in-class activities that will enhance their understanding and substantiate their learning.

Holding students responsible for their learning was the first step in this study. Through the use of online quizzes, students were held accountable for their leaning and provided data on determining the effect of increased assignment completion rates. Students in the traditional classes are exposed to retrieval methods on a daily basis while the students in the blended classes only experience retrieval methods on the two days they are in class. This appeared to have an effect on the ability of students to learn the vital concepts necessary to be successful in zoology. Students in the blended classes are typically higher performing students as was shown in Table 1 with 31% of the students being placed into the lower performing group, while 50% of the students in the traditional class shared the same characteristics. The blended students in the middle performing group averaged 45% of the students while only 28% of the traditional class students fit this category. Both groups were similar in the breakdown of higher performing students with 24% average for the blended classes and 22% for the traditional class. With this discrepancy in mind, the blended classes would be expected to boast higher summative

test averages, but this was not the case; the averages were similar to those of the traditional students (shown in Figure 3).

The format of the blended class online assignments was changed to include more quizzes with the expectation that it would hold the students more accountable and encourage them to complete their assignments. The increase in completion rate of assignments, from 54.7% to 76.2%, and improvement in average quiz scores, from 68.8% to 75.3%, supports the action. The increase in frequency of online quizzes held the students responsible for their own learning and motivated them to do their work on time so they could fully participate in the in-class activities. Students are more likely to complete quizzes, even though they are a formative grade in zoology, because they are conditioned to think that it is more important than an assignment, even though in grade calculation it is not. In Zoology, 75% of the students' overall grade comes from summative tests and projects, while 25% comes from formative assignments, activities, labs, and quizzes. The point values of the quizzes were similar to the point values of an assignment; therefore there was no greater impact to the student's grade from a quiz than from an assignment.

Motivation to do work is a very important life skill to develop. A motivated student puts in more effort, gains more from their effort, is more efficient at working, and attains the goals they have set for themselves. Just as important is motivating a student to do their work and encouraging them to do their best. Students prefer being given a choice in how to obtain the information they need. Prior to the study students had less choice in how to obtain necessary information, they could choose between reading the Zoology

Guide, PowerPoint slides with voice over or a compilation of videos. Most students chose the videos but they were not getting the information they would need. Prior to the study students were exposed to Ed Puzzle videos with questions embedded in the video to show understanding of the key points towards the end of the unit to help student pull concepts together. During the study, the compilations of videos were changed to Ed Puzzle videos with questions embedded to focus the students learning and they were used throughout the unit instead of at the end of the unit. Students had three ways to access information and could choose which to use. The Ed Puzzle videos appeared to be an option many students preferred with almost twice as many students choosing it as a highly rated option for gaining information over the slides with voice over and students were ten times as likely to choose Ed Puzzle videos over reading.

The last topic this study included was the skill set zoology students required to be successful. Through the interviews and Likert-style survey students listed the necessary skills they had and the skills they may not have had but thought were important. In analyzing the data from these two sources, the data from the Likert-style surveys was used since the information uncovered in the interviews was likely to have been repeated in the survey by the interview students which would askew the data. The highest rated skill was the ability to remember. In the interviews I asked the students to elaborate on their answers and the most common response was that zoology has a lot of terminology related to anatomy and physiology that were completely new and that learning the terminology was necessary to understanding. Some students are more motivated to learn when compared to other students. The motivation can come from a variety of reasons, but

the most mentioned reasons were that the student wanted a career working with animals, their grades were important to them or their parents were also common responses.

Much of the classroom time is spent on activities, often group activities. Students valued the ability to work as a group and collaborate because as a group they would gain a deeper understanding of concepts, learn how to use the terminology, and make connections between problems and issues. They respected the other student's ideas and enjoyed the interaction of the group. The blended students said that they had to be able to motivate yourself to work as well and manage time. Many students have jobs after school and the blended classes offer them the opportunity to work on school assignments when they have time. Several of the interview students mentioned that they could not always focus on what they need to do. When asked they said it was their lack of focus that prevented them from completing assignments or even get started on assignments. Reasons for lack of focus were often friends and video games, though some students had medical reasons listed on their IEP or 504 Plan. When blended students are not required to be in class, they have several locations in the school that they are allowed to be. Many gather with their friends and talk or play video games instead of doing their work. Unfortunately, this is more common in the groups of students that struggle with learning. They avoid doing the work and get behind making it difficult to get caught back up.

Students were not as clear on what help they needed to develop the skills they were lacking or needed to improve. Twenty-two percent of the students chose not to answer this question. Supporting students when they struggle is an important strategy teacher can use. Helping a student uncover an answer with guided questions lets them

work through their struggle and build self-confidence by composing an answer with guidance. When a student has confidence they are more willing to take risks in their learning. Working in a group also helps build this confidence when everyone in the group adds to the result.

Even though the data indicates the improvement in quiz scores, summative test scores, and assignment completion rate came about from students taking more responsibility for their learning, there is another factor that could be a larger motivating factor for the improvements. Zoology students are mainly seniors with a few juniors in the group. With graduation approaching, many struggling seniors start working harder to make sure they pass classes. This was uncovered in the student interviews. Three of the nine students interviewed stated that they were studying more for their tests during the time this study was conducted because they did not want to fail the class. Prior to the beginning of the study, one third of all of the students in both the blended and traditional classes were in danger of failing the semester with grades of 65% or lower. At the end of the semester only two students failed, one of the students did not take the final exam because they were not at school. This student has the opportunity to take the final exam over summer break and will no longer be failing. Failing a class is a very strong motivation factor and cannot be ignored as a possibility for the increase in success of the students.

## VALUE

Developing new ways to motivate students to learn and to support their learning are the building blocks of teaching. Building an environment where students feel safe to

be themselves and engage in active learning with their classmates is essential to the health of the classroom setting. Students need to know they can count on their teacher for guidance and support to form a connection to the class and be motivated to excel. Giving students the opportunity to choose how they will learn is one way a teacher can let the students know they are important and that there are at the center of their learning. This study opened possibilities for students to take ownership of their learning and to use their individual learning styles to their advantage. Asking students their opinion on different topics opens new paths that the teacher can access for student learning. When students are part of the learning process they are empowered and gain confidence in their abilities. This extends beyond the classroom into their daily lives.

Learning can be fun and interesting. Zoology is a class students take because they have a natural curiosity about animals and it is usually thought-provoking, interesting, and enjoyable for the students. Zoology quickly becomes a favorite class of many students. Part of this is the topic of the class and the awareness students have for animals. They are eager to learn about animals and are concerned for the future of many different species. Willing participants makes the job of teaching easier and allows for more freedom in how learning is accomplished.

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# APPENDICES

# APPENDIX A

## PREVIOUS KNOWLEDGE FOR BIRD UNIT

Birds Previous Knowledge

1. What is the first thing you think of when you picture a bird?
2. What adaptations do birds need for flight?
3. Do you know of any internal adaptations a bird has for flight?
4. List all the characteristics you can think of for birds.
5. Write down anything else you know about birds that you want to add.

# APPENDIX B

## SUMMATIVE ASSESSMENT FOR BIRDS UNIT

## Animal Science Birds 2018

**Test Instructions: Choose the best answer from the choices given. Multiple Choice: 2 pts each**

1. Birds are different from lizards in that they

   A. are endothermic. B. feathers cover their body rather than scales.

   C. have four chambers in their hearts. D. all of the above

2. The microscopic hooks that interlock to give a feather its sturdy, flexible shape are called _____

   A. vanes B. follicles C. barbs D. barbules

3. Birds excrete most of their nitrogenous wastes as

   A. uric acid. B. ammonia. C. urea. D. urine.

4. Which of the following characteristics of birds in ***not*** found in *Archaeopteryx*?

   A. Feathers B. furcula (wishbone) C. short tail D. ability to fly

5. The first wings appearing on animals are thought to have been used

   A. For movement on the ground or gliding in the air. B. To capture prey.

   C. For stabilization. D. All of these

6. Which of the following is ***not*** a function of contour feathers?

   A. flight B. coloration C. food capture D. aerodynamic/streamlined

7. The bones of birds

   A. are composed primarily of keratin. B. are thick and solid.

   C. are found sparingly throughout the body. D. are thin and hollow.

8. The function of the crop in a bird is

   A. temporarily store and moisten food. B. the last digestive chamber of its stomach

   C. to aid in flight. D. to grind up food with small stones to aid in digestion

9. Birds retain many reptilian features, including

   A. teeth. B. a long, bony tail. C. scales on their feet and lower legs. D. All of these

10. Food consumed by a bird is ground up in the bird's

    A. mouth. B. crop. C. gizzard. D. stomach.

11. A bird's respiration is very efficient because

    A a bird's lungs are small and hollow. B. only one lung functions at a time.

    C. Birds have a special set of blood vessels. D. air sacs allow air flow into the lungs on inhalation and exhalation

12. A bird's heart has

A. 2 atria & 2 ventricles. B. 1 atria & 2 ventricles
C. 2 atria & 1 ventricle D. 1 atria & 1 ventricle.

13. Talons would most likely be found among birds that

A. eat seeds. B. capture their prey. C. live in water. D. drink the nectar of flowers.

14. Melodious songs are characteristic of _____ songbirds.

A. female B. male C. female and male D. young

15. The syrinx, located in the trachea, functions in a birds ability to

A. capture prey. B. fly. C. produce songs. D. reproduce.

16. Long incubation times are associated with _____ young, such as mallard ducks, who are relatively independent with they hatch, while short incubation times are associated with _____ young, such as kangaroo joeys, who are dependent for some time after they hatch.

A. precocial; altricial B. altricial; precocial C. paltricial; precocial D. precricial; altricial

17. All of the following evolved from early reptiles **except**

A. fish. B. birds. C. dinosaurs. D. mammals.

18. The function of the preen gland is to

. produce digestive enzymes. B. control salt balance in the body
C. release scents that help attract mates. D. produce an oily substance used to condition feathers.

19. Short, thick beaks would be found on birds that eat _____, while long, pointed, **strong** beaks would be found on birds that eat _____, and long, **thin** beaks would be found on birds that eat _____.

A. seeds; insects; nectar B. animals; seeds; nectar
C. nectar; seeds; animals D. seeds; nectar; shrimp

20. Trace the path of blood through the body of a bird. Blood enters the _____, then travels to the ____, then to the _____, followed
by the _____, next it moves into the _____, and then it returns to the body.

A. right ventricle, right atrium, lungs, left ventricle, left atrium
B. right atrium, right ventricle, lungs, left atrium, left ventricle
C. left ventricle, left atrium, lungs, right ventricle, right atrium
D. left atrium, left ventricle, lungs, right atrium, right ventricle

21. Birds reproduce by the process of _____.
A. Viviparity B. Ovoviviparity C. Oviparity D. All of the above.

22. The structures responsible for osmoregulation in a bird are the
A. Liver B. Spleen C. Pituitary D. Kidneys

23. The structure responsible for storing vitamins and glycogen, making bile, and processing toxins is the
A. Liver B. Spleen C. Pituitary D. Kidneys

24. Path of air when a bird exhales is
A. posterior air sacs to lungs to anterior air sacs then exits body
B. anterior air sacs to posterior air sacs to lungs exits body
C. lungs to posterior air sacs to anterior air sacs then exits body
D. posterior and anterior air sacs and lungs all exit the bod

25. Birds find their direction when they migrate by using all of the following except
A. sonic frequencies
B. the position of the sun stars, and topographical landmarks like rivers and mountains
C. changes in air pressure
D. changes in the magnetic field and low frequency sounds

26. As an embryo moves down the oviduct _____ and _____ are added before the egg is laid.
A. yolk; allantois B. yolk; albumen
C. albumen; shell D. albumen; yolk

27. The pygostyle of a bird is the
A. attachment site for flight muscles B. wishbone
C. bare patch above the beak D. fused vertebrae of the tail

28. Structure missing on a bird to make it lighter for flight is the
A. keel B. liver C. air bladder D. urinary bladder

**Short Answer:**

29. Birds live in the arctic while reptiles do not. Explain this fact using what you know about birds? (2 points)

30. Birds, compared to other vertebrates, are poorly represented in the fossil record. What is a possible explanation for this. (2 pts)

31. Why do some birds have eyes on the front of their heads, while other birds have eyes on the sides of their heads? Use examples in your answer. (4 points)

32. Explain how bird beak and foot types are adaptations for life. Use at least 2 examples in your answer. (6 points)

33. Write out the path that food takes through a bird digestive tract from entrance to exit. (6 points)

**Lab Practical Score:**
**Identified Structures _____ / 6 x 3 = _____**

**Lab Practical Structures: Locate the structures on the list you randomly choose and identify the structure on the pigeon specimen for your instructor.**

**Name:**

**Lab Practical Structures**
____ External Nares
____ Esophagus
____ Crop
____ Gizzard
____ Duodenum
____ Heart

_____/6

**Name:**

**Lab Practical Structures**
____ Vent
____ Trachea
____ Proventriculus
____ Liver
____ Large Intestine
____ Lungs

_____/6

**Name:**

**Lab Practical Structures**
____ External Nares
____ Trachea
____ Gizzard
____ Liver
____ Duodenum
____ Cloaca

_____/6

**Name:**

**Lab Practical Structures**
____ Contour Feather
____ Esophagus
____ Proventriculus
____ Gizzard
____ Large Intestine
____ Heart

_____/6

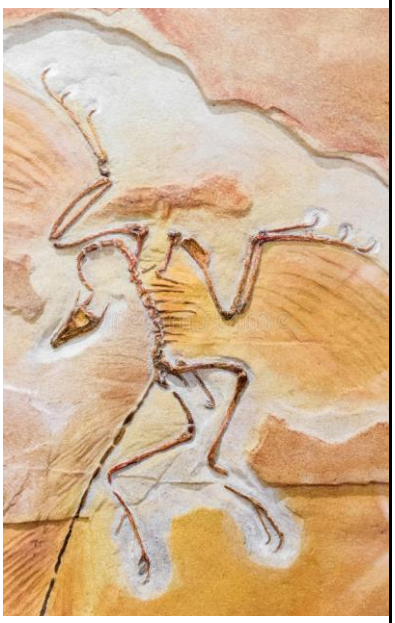
# APPENDIX C

## BELL WORK AND EXIT SLIPS FOR BIRD UNIT

**1. Origin of Birds**
Birds evolved from dinosaurs _____ million years ago. List three similarities between birds and dinosaurs.

List three differences between birds and dinosaurs.

**2. Evolution of Birds**
What is the name of the earliest known fossilized bird shown on the right and projected in the front of the classroom?

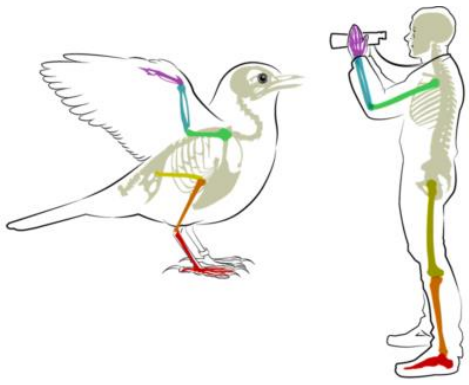


What reptilian characteristics are evident in this fossil?

What avian characteristics are evident in this fossil?

How are modern birds different from the extinct bird in the fossil image above?

**3.** Looking at the image on the left (or the color image projected in the front of the room), explain your observations.



**4. Bird Metabolism**
What type of metabolism do birds have (endothermic or ectothermic)? Explain your answer.

How do birds maintain their very high metabolic rate?

Compare and contrast the food requirements of reptiles and birds.

**5. Digestive System**
Birds have no teeth. What is the reason for this?

Since teeth are used to grind up food, how do birds accomplish this job without teeth?

List the structures and organs that food passes through as it enters and leaves the birds body and each of their functions. An example has been given as well as a few structures/organs in the correct order.

| **Name of Structure/Organ** | **Function of structure/organ** |
|---|---|
| Oral Cavity | moisten and manipulate food to be swallowed |
| | |
| | |
| Proventriculus | |
| | |
| | |
| Large intestine | |
| | |

**6. Excretory System**

How do birds eliminate nitrogenous waste?

Why is this beneficial?

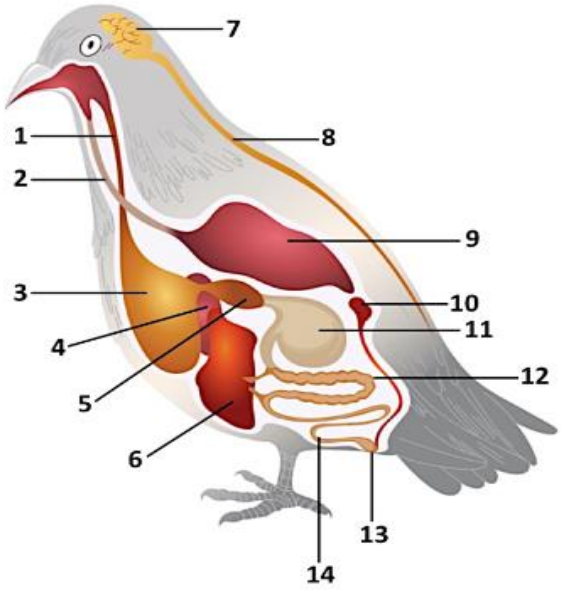
What organ do birds not have in their excretory system?

Why is this organ missing?

**7. Respiratory System**
Birds have a unique respiratory system. Why?

Describe the unique features of the bird respiratory system.

**8. Bird Internal Anatomy**
The diagram below shows the major organs found in birds. Label the structures.




1._____ 8. _____

2. _____ 9. _____

3. _____ 10. _____

4. _____ 11. _____

5. _____ 12. _____

6. _____ 13. _____

7. _____ 14. _____

**9. Migration and Ecology**
Define migrate.

Why do birds migrate?

List the methods birds use for navigation during migration.

List ways birds are important to the ecosystem.

**10.** If you were a bird, what kind of bird would you like to be and why? Give specifics relating to birds in your justification.

# APPENDIX D

# BIRD QUIZZES

Bird Quiz 1

1. List three similarities between birds and dinosaurs.

a.

b.

c.

2. List three ways modern birds are different from their reptilian ancestors.

a.

b.

c.

3. List and describe the seven characteristics of birds below.

a.

b.

c.

d.

e.

f.

g.

4. Describe Archaeopteryx and explain why this fossil is important to scientists.

5. Modern birds do not have teeth. Explain why this trait might have evolved.

Bird Quiz 2

1. What are the two primary functions of feathers?

a.

b.

2. Birds have many adaptations for flight. List and explain 3 of them.

a.

b.

c.

3. Some baby birds are born helpless and require the parent feeds them very often. This type of bird is called _____. Other baby birds can leave the nest and feed themselves as soon as they hatch and this type of bird is called _____ .
4. Contrast the gizzard with the crop.
5. How does air move through a bird's respiratory system?
6. Describe and label a contour feather.
7. Why is the brood patch featherless?

Bird Quiz 3

1. During the bird beak and foot activity, you learned that beak shape is related to food source. List two different types of beaks and explain what food source they work best with and why.

2. Also during the bird beak and foot activity, you learned that there is a relationship between the type of foot a bird has and the habitat it is best suited for. List two different types of bird feet and explain what habitat they are best suited for and why.

3. Describe three methods of navigation that migrating birds use.

a.

b.

c.

4. What is a syrinx? What is its function?
5. Why are birds found in more diverse habitats than reptiles?

# APPENDIX E

## MAMMAL PREVIOUS KNOWLEDGE

Mammals Previous Knowledge

1. What is the first thing you think of when you picture a mammal?
2. What adaptations do mammals have for survival?
3. Where in the world can you find mammals?
4. List all the characteristics you can think of for mammals.
5. Write down anything else you know about mammals that you want to add.

# APPENDIX F

# MAMMAL SUMMATIVE

# Mammals Test 2018

**Instructions: Choose the best answer from the choices given. DO NOT WRITE ON THIS TEST! Multiple Choice: 2 point each**

1. The first mammals and dinosaurs appeared about the same time during the
   A. Jurassic period. B. Triassic period.
   C. Tertiary period. D. Permian period.

2. The structure responsible for storing vitamins and glycogen, making bile, and processing toxins is the
   A. Liver B. Spleen
   C. Pituitary D. Kidneys

3. The structures responsible for osmoregulation in a mammal are the
   A. Liver B. Spleen C. Pituitary D. Kidneys

4. Which digestive organ concentrates wastes by absorbing water?
   A. small intestine B. large intestine
   C. cecum D. rumen

5. The sheet of muscle at the bottom of the rib cage of mammals is called the
   A. secondary palate. B. placenta.
   C. diaphragm. D. mesentery.

6. Carnivorous mammals have
   A. long, sharp canine teeth B. large, flat molars
   C. short, square canine teeth D. no teeth

7. Hair and fur of most mammals function in
   A. keeping the animal warm B. identifying the animal as male or female
   C. keeping the animal cool D. helping the animal blend in to its environment
   E. all of these F. A, C, and D

8. Gills are to fish as
   A. skin is to reptiles B. blood vessels are to circulation
   C. tree is to plant D. lungs are to mammals

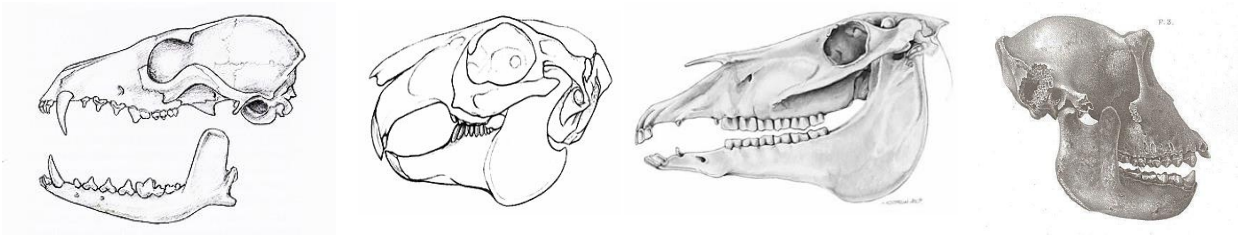
9. The major difference between marsupials and placentals is
   A. their ability to maintain a steady body temperature.
   B. their teeth.
   C. their pattern of embryonic development.
   D. the size of their eggs.

10. Offspring remain inside the mother until development is essentially complete in
A. placental mammals. B. monotremes.
C. marsupials. D. birds.

11. The placental mammals are animals that
A. nurse young with milk. B. have body hair.
C. give birth to live young. D. all of these.

12. Mammals that lay eggs are
A. placental mammals. B. marsupials.
C. monotremes. D. crazy.

**For questions 13 – 16, use the diagrams below to answer the questions.**



**A** **B** **C** **D**

13. Which skull above is from a cow that eats grass?
14. Which skull above is from an ape that eats termites and fruit?
15. Which skull above is from a rabbit that eats grass?
16. Which skull above is from a carnivorous coyote?

17. One of the ways to distinguish the skull of a mammal from the skull of a therapsid is that mammals have____.
A. a variety of teeth B. eye sockets
C. a single jaw bone D. None of these

18. Ruminants have an_____ number of toes and a _____ part stomach for eating and digesting plants.
A. odd: 3 B. odd:4 C. odd: 1 D. even: 1 E. even: 3 F. even: 4

19. The largest animal that ever lived is
A. a cetacean. B. the blue whale. C. a filter feeder. D. all of the above.

20. Which of the following is usually characteristic of reproduction in a terrestrial environment?
A. external fertilization B. internal fertilization
C. shell-less, water permeable eggs D. none of these

21. Which of the following is NOT part of the mammalian heart?
A. atrium B. conus arteriosus C. ventricle D. septum
22. Paired excretory organs that are found close to the vertebrae are called
A. livers. B. intestines. C. rumens. D. kidneys.

23. Perissodactyls have an _____ number of toes and a _____ for digesting plants.
A. odd: cecum B. odd:cloaca C. odd: cecum
D. even: cloaca E. even: cecum F. even: cloaca

**For question 24 - 26, use the following answers to fill in the blanks.**
A. young are born soon after conception B. are born well developed
C. lay eggs D. reproduce asexually

Monotremes mammals _____(24), marsupials mammals _____ (25), and placental mammals _____(26).

27. In all _____ the blastopore becomes the anus during embryonic development.
A. Protostomes B. Deuterostomes C. Monostomes D. Octastomes

28. The sounds that bats emit
A. help them navigate. B. help them capture their prey.
C. are too high pitched for humans to hear D. all of these

29. All female mammals
A. mate for life B. have one extra tooth on each side of their mouth
C. have mammary glands D. have a syrinx

30. Animals that maintain high body temperature through metabolism is said to be _____.
A. endothermic B. ectothermic C. isothermic D. exothermic

31. Primates have all of the following **except**
A. have an opposable thumb B. depth perception
C. more developed cerebellums D. a rumen

32. Amylase and lipase break down carbohydrates and fat first in the _____.
A. stomach B. small intestine C. mouth D. large intestine

33. Animals with hooves are called
A. marsupials B. chiroptera C. ungulates D. lagamorphs

34. Which of the following are adaptations of artiodactyls for digesting plant matter?
A. rumen B. cecum C. small intestine D. vestage

35. Which of the following are adaptations of Perissodactyls for digesting plant matter?
A. rumen B. cecum C. small intestine D. vestage

36. Herbivores grind plant matter with their
A. canines B. incisors C. hard palate D. molars

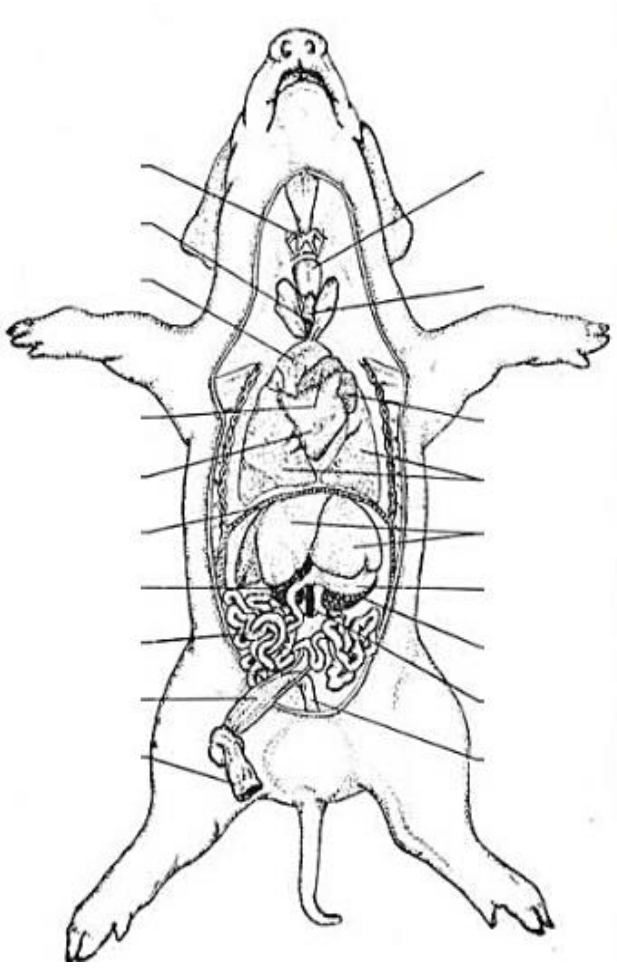
37. Endotherms can be found in the _____ while ectotherms cannot.
A. Artic B. Desert C. Oceans D. all of these

**Short Answer Questions:**
38. Explain what you learned from the Caribou Conservation Case Study? (6 points)

39. What kind of ecological symbiotic relationship exists between a cow and the microorganisms that live in its rumen? Explain your answer. (2 points)

40. Why was it an advantage for early mammals to be nocturnal? (2 points)

**41. <u>Label 10 internal structures</u> on the fetal pig diagram below by writing the name next to the line.**



# APPENDIX G

## BELL WORK AND EXIT SLIPS FOR MAMMALS UNIT

**1. Introduction to Mammals**
Where do mammals live?

There are three living orders of mammals listed below. Describe the characteristics, including reproduction, for each order:

a.

b.

c.

**2. Origin and Evolution of Mammals**
300 million years ago, mammals descended from _____.

What are synapsids?

As synapsids diversified, therapsids arose and this is the group that mammals came from. What characteristics do mammals and therapsids share?

Mammals coexisted with dinosaurs for over 150 million years. Describe how mammals lived that made this possible.

**3. Age of Mammals**
What era is considered the "Age of Mammals" and how many million years ago did this begin?

Describe the events that occurred allowing mammals to become the dominant vertebrates on Earth.

As dinosaurs became extinct, adaptive radiation occurred in mammals. What does this mean?

How does the mammal skull differ from a reptilian skull?

**4. Characteristics of Mammals**
All mammals share 6 major characteristics. Each of the following questions refers to one of these characteristics.

a. Mammals are endotherms. Explain what this means.
b. Do all mammals have hair? What are the functions of hair?
c. Describe the mammalian heart. Drawing a picture may help.
d. Describe feeding and nutrition in newly born mammals.
e. Describe the jawbone in mammals. Why is this important?
f. Describe mammalian teeth.

**5. Circulatory System**
A mammal's heart has 4 chambers. How are these chambers arranged on different sides? What divides the chambers?

When blood returns from the body, it flows into which chamber?
Blood is pumped to the lungs from which chamber?
When blood returns from the lungs to the heart which chamber does it enter?
Which chamber pumps blood to the body?

What is the difference between systemic circulation and pulmonary circulation? What is this type of circulation called?

**6. Digestive System**
Describe the function of each of the following specialized type of teeth?

a. Incisors
b. Canines
c. Premolars
d. Molars

Baleen whales do not have teeth. What is the function of baleen?

Compare and contrast the digestive systems of carnivores and herbivores.

What is the rumen?

Compare and contrast artiodactyls and perissodactyls.

**7. Mammalian Metabolism**
Mammals are endotherms. What other groups of animals are endotherms?

Compare and contrast endotherms with ectotherms. Which is the more advantageous type of metabolism?

What adaptations do mammals have to conserve body heat?

How is the mammal body cooled?

**8. Nervous System**
How does the size of a mammal brain compare to a reptile brain?

The mammal brain is composed of three main parts. What is the function of each of the following areas?

a. Cerebrum
b. Cerebellum
c. Medulla oblongata

Mammals have extremely well developed senses. In what ways has this characteristic contributed to the success of mammals?

**9. Respiration and Excretion**

What respiratory organ is used for gas exchange in all mammals?

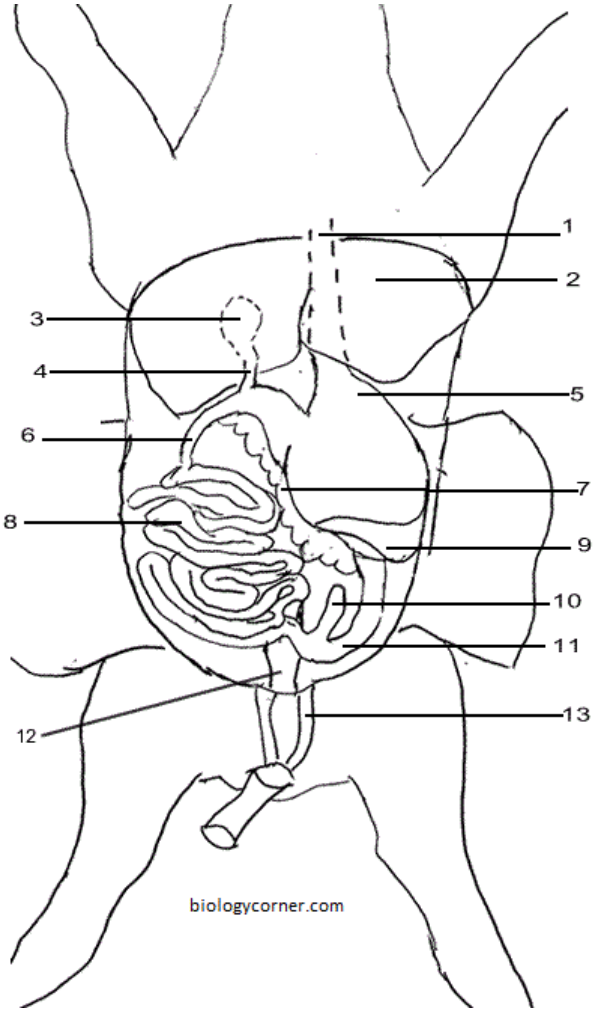
What are alveoli? Describe them and their function.

Mammals rely on two mechanisms to breathe. What are they?

The kidneys are the main excretory organ. List the function of the kidneys

**10. Pig Anatomy**

The diagram below shows the major organs found in mammals. Label the structures.




1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____

# APPENDIX H

# MAMMAL QUIZZES

Mammal Quiz 1

1. The group of mammals that lays eggs is called _____
2. The group of mammals that nourishes the fetus until fully developed inside the mother's uterus is called _____
3. The group of mammals that gives birth to a premature embryo that will complete development inside the mother's pouch is called _____
4. _____ means an animal is active at night.
5. Mammals conserve body heat in what two ways?
6. List the 6 major characteristics shared by all mammals.
    a.
    b.
    c.
    d.
    e.
    f.
7. Explain how the environmental events that occurred 65 million years ago led to the rapid evolution of mammals.

8. Why do scientists believe that the monotremes were the first mammals to evolve from the reptiles?

Mammal Quiz 2

1. List the path blood takes through the mammalian heart and lungs.
2. The wall of tissue that separates the two sides of the heart is called the _____.
3. The part of the brain responsible for complex behaviors such as learning and thinking is the _____.
4. The _____ of the brain regulates involuntary body functions such as heart rate and breathing rate.
5. The part of the brain that controls muscle coordination is called the _____.
6. What are the advantages of endothermy?
7. What type of ecological relationship exists between and cow and the microbes in the cow's rumen? Explain this relationship.
8. How do the brains of mammals compare with the brains of other vertebrates?
9. What are the two mammalian adaptations for digesting plants?
10. Compare and contrast artiodactyls and perissodactyls. Give an example of an animal for each.

Mammal Anatomy Google Quiz 3

1. The two parts of the small intestine where nutrients are absorbed are the
    a. Jejunum and ileum
    b. Jejunum and duodenum
    c. Ileum and duodenum
    d. Ileum and cecum

2. The gallbladder empty into _____
    a. Jejunum
    b. Ileum
    c. Duodenum
    d. Colon

3. Vibrissae are
    a. hooves
    b. eye lashes
    c. whiskers
    d. outside skin on the ear

4. Fat stored in the body is for
    a. insulation and evaporation
    b. insulation and protection
    c. protection and evaporation
    d. insulation and energy

5. These structures increase the surface area in the lungs making gas exchange more efficient are called
    a. Alveoli
    b. Diaphragm
    c. Trachea
    d. Esophagus

6. Digestion of starches starts in the _____ with the addition of _____ .
    a. mouth; trypsin
    b. mouth; amylase
    c. stomach; lipase
    d. stomach; protease

7. This organ controls cell growth and differentiation and regulates metabolism
    a. Gallbladder
    b. Pancreas
    c. Jejunum
    d. Thyroid

8. This organ makes insulin and trypsin
    a. Gallbladder
    b. Pancreas
    c. Jejunum
    d. Thyroid

9. The tympanic membrane is found inside the
    a. Ear
    b. Nose
    c. Thyroid
    d. Mouth

10. Red blood cells are missing what organelle?
    a. Mitochondria
    b. Golgi apparatus
    c. Ribosome
    d. Nucleus

11. The appendix is a
    a. vestigial ruminant
    b. vestigial cloaca
    c. vestigial cecum
    d. vestigial tympanium

12. This structure makes respiration more efficient by helping pull air into the lungs
    a. Alveoli
    b. Diaphragm
    c. Trachea
    d. Esophagus

13. The heart of a mammal has___ chambers and is found ____ in the body.
    a. 4; ventral
    b. 4; dorsal
    c. 3; ventral
    d. 3; dorsal

14. The medulla oblongata functions in
    a. balance and coordination
    b. higher order thinking
    c. visual cues
    d. involuntary body systems

15. The cerebellum functions in
    a. balance and coordination
    b. higher order thinking
    c. visual cues
    d. involuntary body systems

16. The cerebrum functions in
    a. balance and coordination
    b. higher order thinking
    c. visual cues
    d. involuntary body systems

17. Which organ processes and collects red blood cells?
    a. Pancreas
    b. Spleen
    c. Liver
    d. Gallbladder

18. What percentage of mammals are placentals?
    a. 75%
    b. 85%
    c. 90%
    d. 95%

19. These structures increase the surface area of the intestines making absorption of nutrients faster.
    a. alveoli
    b. Cecum
    c. Villi
    d. Ileum

20. What organ removes Urea from the blood while maintaining ion and water balance in the body?
    a. Spleen
    b. Liver
    c. Kidneys
    d. Pancreas

# APPENDIX I

## INTERVIEW QUESTIONS

Interview Questions - First Interview

1. How do you feel you are doing in class right now on a scale of 1 to 5 with 5 being exceptional and 1 being struggling with everything? Why?

2. How much time do you usually spend working on zoology assignments each week?

3. What motivates you to do your zoology assignments?

4. How do you prefer to learn the information you need? Videos? Slides with voice over? Or Reading?

5. How much time do you spend studying for a zoology test?

6. For Blended Students Only: What skills or characteristics help a student be successful in Blended zoology?

7. What part of zoology is the most difficult for you?

8. How confident are you in explaining what you learned about zoology to others?

9. What is your favorite type of assignment in zoology?

10. What is your least favorite type of assignment in zoology?

11. What can I (the teacher) do to help you with your zoology struggles?

12. Is there anything else you would like to tell me about your zoology class?

Interview Questions - End of Study Interview

1. How do you feel you are doing in class now on a scale of 1 to 5 with 5 being exceptional and 1 being struggling with everything? Why?

2. How much time do you usually spend working on zoology assignments each week?

3. For Blended Students Only: Do you typically do the work during the same time period that the class would meet or another time? Why?

4. Has the amount of time do you spend studying for a zoology test changed this quarter?

5. Do you feel you are more or less prepared for zoology tests this quarter? Why?

6. What is the most difficult part of zoology for you?

7. How confident are you in explaining what you learned about zoology to others?

8. What is your favorite type of assignment in zoology this quarter?

9. What is your least favorite type of assignment in zoology this quarter?

10. What is your favorite in class activity in zoology this quarter?

11. What is your least favorite in class activity in zoology quarter?

12. What other activities you do in other classes that you would like to see used in zoology?

13. What can the teacher do to help you with your zoology struggles?

14. What skills do you think are important to have in being successful in zoology?

15. Is there anything else you would like to tell me about zoology class?

# APPENDIX J

# LIKERT-TYPE SURVEY

**Likert-type Survey**

Please rate the following on a scale of 1 to 10 with 1 being the lowest and 10 being the highest.

1. How motivated are you to complete your zoology assignments?

2. How motivated are you to study for zoology tests?

3. Rate the next four ways on how do you like to obtain the information you need to learn?

Reading
Slides with voice over
Watching a video

4. How helpful were the assignments in being able to answer questions on the quizzes and test?

Rate the following on a scale of 1 to 10 with 1 being the easiest and 10 being the hardest.

5. How difficult is it for you to learn the evolution of animals?
6. How difficult is it for you to learn the characteristics of animals?
7. How difficult is it for you to learn zoology vocabulary?
8. How difficult is it for you to learn zoology anatomy?
9. How difficult are the assignments in zoology?
10. How difficult are the in class activities in zoology?

Rate the following question on a scale of 1 to 10 with 1 being no confidence and 10 being very confident.

11. How confident are you in explaining what you learn in zoology to others?

12. What were your three favorite types of in class activities in zoology?
    a. Animal Characteristic sorting activities
    b. Graphic organizers
    c. Anatomy sorting puzzle and labeling
    d. Dissection
    e. Review games
    f. Labs
    g. Taking notes
    h. Case studies
    i. Partner Projects
    j. Compare and Contrast activities
    k. Animals in the news

l. Individual Project
m. Reading articles
n. Questioning from your teacher
o. Vocabulary games
p. Discussion
q. Visual notes
r. Creative activities

13. What were your three least favorite in class activities in zoology?
    a. Animal Characteristic sorting activities
    b. Graphic organizers
    c. Anatomy sorting puzzle and labeling
    d. Dissection
    e. Review games
    f. Labs
    g. Taking notes
    h. Case studies
    i. Partner Projects
    j. Compare and Contrast activities
    k. Animals in the news
    l. Individual Project
    m. Reading articles
    n. Questioning from your teacher
    o. Vocabulary games
    p. Discussion
    q. Visual notes
    r. Creative activities

Please answer the following free response questions with as much detail as you can.

14. Are there any activities from other classes that you liked think would be a good addition to zoology?
15. How can students be held responsible for their own learning?
16. What skills are needed to be successful in zoology?
17. How can your teacher help you with zoology struggles?
18. What is one thing you learned in zoology class that you will remember for the rest of your life?