Impact of Biological Sex in Homework Completion on High School Science Students' Grade and Achievement

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Abstract

The purposes of this study were to determine if there were differences in the completion of homework between male and female student participants and to ascertain if these differences influenced summative assessment scores of participants of each sex. This study is focused on two research questions: Does homework completion differ between male and female students? Do students who complete homework have higher scores on summative assessments? Sixty-one freshman and sophomore students from a Biology course participated in the study to evaluate these research questions. Fifteen homework assignments and two summative assessments were evaluated over the course of the six-week study. It was hypothesized that a higher rate of homework completion would lead to higher summative assessment scores, and that female students would show a higher rate of homework completion. Female participants did have higher homework completion and scores each week with females having 88% mean completion and males having 85% mean completion, but did not have higher summative assessment scores than the male participants. Female mean assessment scores were 72.7% and male mean assessment scores were 74%. It is imperative that educators are mindful when assigning homework and evaluating homework practices to best support student learning.

Keywords: high school, homework, gender, biological sex, assessment

Impact of Biological Sex in Homework Completion on High School Science Students' Grade and Achievement

Homework is a ubiquitous component of education across subject areas at the high school level of education. There have been rigorous arguments both for and against its use in schools at various age levels and for a myriad of reasons, with no clear consensus in place now (Davidovitch & Yavich, 2017; Núñez et al., 2015). A high school science course requires students to both think critically to solve complex problems as well as to learn a full vocabulary of terms to apply to these real-world scenarios. While the critical thinking skills can be applied universally in many different courses, the rote memorization component of learning new terms and names of important historical figures may require considerable time outside of the regular instructional setting, but how much time is sufficient is unknown. Students present with a variety of prior knowledge and skills, which can influence how much time they will need to dedicate in learning and applying newly learned information and skills for a high school science course. Some of this variety could be represented across sex lines, having an impact on the overall grades of male and female students in different ways.

While some studies have shown a correlation between the time spent on homework and a student's classroom grades, much less is known about the possible sex difference that exists in this time (Bembenutty, 2011; Carr, 2013; Cooper, 2006; Kalenkoski & Pabilonia, 2017; Keith, 1982; Merriman et al., 2016; Núñez et al., 2015). Societal expectations have shifted toward a more equitable playing field for both male and females in the working world, and a difference in time spent, with females spending a significantly longer amount of time doing homework by upwards of an hour a week, may be positively impacting their grades and standardized test scores (Gershenson & Holt, 2015; Kalenkoski & Pabilonia, 2017). This increased academic achievement may eventually lead to a swaying of the scales toward more female students and graduates at the post-secondary level of education.

It has been shown that the optimum amount of time dedicated to homework in math and science courses is between 90 and 120 minutes (Maltese et al., 2012). This amount of time would be distraction free and had a measurably positive impact on student grades and standardized test scores, such as that of the ACT or SAT. In addition, in a study by Ndum et al. (2018), a difference in the amount of time spent on homework by individuals of different sexes could be virtually eliminated with motivation to complete and submit assignments in a timely manner.

High school students have a variety of factors that vie for their time including family obligations, extracurricular activities, and working an outside job. Homework is a factor that can be a low priority item for high school students who are not motivated by grades alone. Some students may require more motivation to complete assigned work, unfinished tasks, or studying. If a sex difference does exist and is correlated to different grade achievement by male and female students, it may be useful to direct further study into the motivation and time management of lower performing students. With assistance in these very foundational skills for academics, the sex difference could be reduced or even eliminated. Finding methodologies to put into practice in this regard would not be easy, but would be commendable.

Students have a right to receive a free, public education and it is up to educators to be sure that this education is fair, balanced, and meaningful. Homework can create contention for families, teachers, and students. It is important to recognize the benefits and detriments of this traditional practice and to make an effort to optimize the impact of homework on students. Therefore, understanding where homework may be failing is just as important as understanding where it is supporting higher achievement so that best practice can be put into place.

The overall purpose of the study was to find out if there were differences in the completion of homework tasks between male and female student participants. Additionally, the study ascertained if differences in homework completion influenced summative assessment scores of participants of each sex.

The researcher hypothesized there would be a difference in homework completion between the biological sexes of students. Moreover, the researcher hypothesized that this difference in homework completion would show a marked difference in the summative assessment scores whereby participants completing less homework will achieve lower summative assessment scores on average.

The research questions of the study were as follow:

1. Does homework completion differ between male and female students?
2. Do students who complete homework have higher scores on summative assessments?

The hypotheses of the study were as follow:

1. Homework completion will be different between male and female students.
2. Students who have a higher rate of homework completion will earn higher scores on summative assessments.

Homework and Academic Achievement of High School Students

Educators have a practice of utilizing homework for a variety of purposes but both educators and community members alike frequently question its worth. Decades of studies have been done on the subject of homework to determine its effectiveness in improving academic achievement of students. Studies have shown mixed results based on various demographic factors to include age of students, relevance of assignments given, amount of time spent on task, distraction factors, parental/family support, socioeconomic status, racial identity or sex of the students. This literature review will focus on four key areas of homework at the high school level: amount of time spent, sex differences, quality of assignments, and supportive homework environment.

History of Homework Practice in the Public School Classroom

Public education has held homework as a standard practice across grade levels since the mid-twentieth century (Gill & Schlossman, 1999). Cooper (1989) defined homework in a way that has resonated through the studies on homework practice through the years as "any task assigned by school teachers intended for students to carry out during non-school hours" (p. 86). In recent years, there has been a shift in attitudes about the merits of homework at various grade levels (DeNisco, 2017). While there has been a wealth of research to show that limiting the amount of time elementary students spend on traditional homework is a worthy cause to be replaced with tasks associated with strengthening family relationships and building basic interpersonal skills, much less is known about the effectiveness of homework at the secondary level (Davidovitch & Yavich, 2017; Núñez et al., 2015a). Therefore, more study is warranted to discover both the amount and kind of homework that is most beneficial to high school students in reference to future success in a post-secondary school, trade school, military or other career paths. "This examination has focused on answering two basic questions: To what extent, if any, does homework influence learning? And, if homework does influence learning, which aspects of homework are important for learning?" (Keith et al., 2004, p. 188).

The greatest struggle with such research is to control for the variety of confounding variables that include family dynamics, socioeconomic status, mental and physical health, relationship with teachers, mentors, and parents, and a variety of other factors that can influence the motivation, attitude, and approach of students and teachers toward homework (Bembenutty, 2011). When trying to evaluate the effectiveness of homework on academic achievement things to consider include the type of course and institution, sex, race, and socioeconomic status of students and the community at large (Trautwein, 2007). In general, for middle and high school students there is data that supports a correlation between homework and improved academic performance within limits (Keith et al., 2004). Too much homework, too little homework, and the supports available during homework completion have also been shown to be relevant factors to consider when finding the sweet spot for homework practices (Keith et al., 2004). Cooper et al. (2006) states that:

> Variations in homework can be classified according to its (a) amount, (b) skill area, (c) purpose, (d) degree of choice for the student, (e) completion deadline, (f) degree of individualization, and (g) social context. Variations in the amount of homework can appear as differences in both the frequency and length of individual assignments. Assignments can range over all the skill areas taught in school. (p. 1)

It is important to acknowledge the breadth of nuance when it comes to studying homework. What counts as homework, how and where homework is completed, what type and frequency of homework is assigned, along with various demographic indicators can have a measurable impact on the effectiveness of homework on the academic achievement of students.

Time Spent Dedicated to Homework at the High School Level

High school is typically known as a time in a student's life when the amount of homework they receive can increase dramatically. Students are expected to learn six to eight subjects each day during class and then to use homework in the afternoons or evenings to reinforce the content learned throughout the school day. The question becomes how much homework is sufficient to practice the content learned and gain mastery without becoming monotonous, repetitive, and wasted time.

For high school students, a positive correlation in time spent on homework and academic achievement seems to lie between one and two hours of homework time per day, with too much homework having as low effectiveness on achievement as no time spent on homework (Cooper et al., 2006). Research of high school students has shown a positive correlation between the amount of time spent on homework and students' academic achievement as measured by classroom grades and standardized test scores such as the ACT and SAT (Bembenutty, 2011; Carr, 2013; Kalenkoski & Pabilonia, 2017; Keith, 1982; Merriman et al., 2016; Núñez et al., 2015b; Mau & Lynn, 2000). The amount of time spent on homework in math and science courses was correlated more positively than other areas in improving students' achievement on both overall grades from transcripts and standardized tests such as the SAT (Maltese et al., 2012). A positive correlation has also been seen between class participation, homework completion and increased scores on tests (Green et al., 2012). The more active a student is during class, engaging in the lessons presented and the higher a student's homework completion, the more their test scores reflected a better understanding of content presented or skills acquired (Green et al., 2012).

It is also important to note that students tend to engage in other activities while completing homework simultaneously, such as checking social media, communicating with peers, listening to music or television, etcetera and that time spent in this distracted state of homework is not as effective as time spent dedicated to homework alone (Xu & Wu, 2013). Time solely engaged in homework accounted for approximately half of the time measured as homework time, that is time spent with no other outside factors previously mentioned

(Kalenkoski & Pabilonia, 2017). Distraction factors have a distinctly negative impact on the effectiveness of any homework tasks. The more a student can focus solely on the task presented, the better the retention of content presented or skill being practiced.

It is furthermore important to acknowledge the differences between time spent on homework and time needed to complete homework tasks because not all students will need an equivalent amount of time to complete tasks due to differences in proficiency in the content (Trautwein, 2007). Some students will require a great deal more time practicing skills and content mastery due to differences in prior knowledge, learning difficulties, learning style, motivation, or interest in the subject matter. This gap in time spent versus time needed may also play a role in student persistence to complete a task as it becomes much more difficult to complete homework tasks if the task is deemed particularly difficult or uninteresting. While it seems that there is consensus in support of homework at the high school level, there is certainly not consensus on exactly how much is sufficient to produce the desired result of students gaining mastery of their studies.

Sex Differences in Time Spent on Homework at the High School Level

There are measured differences in how male and female students approach homework at the high school level when it comes to the amount of time dedicated toward the task of homework completion or study of content materials. Generally, studies have shown that female students spend markedly more time on homework and studies than their male peers (Gershenson & Holt, 2015; Kalenkoski & Pabilonia, 2017; Mau & Lynn, 2000). This increased time translates into higher average grades in high school courses even when controlled for outside influencing factors (Gershenson & Holt, 2015; Kalenkoski & Pabilonia, 2017; Mau & Lynn, 2000). On average, all students spent between six and seven hours on homework a week, with female students averaging 7.6 hours and male students averaging 5.2 hours (Kalenkoski & Pabilonia, 2017).

Speculation as to why this biological sex gap exists is slim. Some studies have noted differences in how female and male students are viewed to fit into traditional gender roles that may carry over into how each sex approaches homework tasks (Xu, 2006). Xu's (2006) study found the following:

> Specifically, compared with boys, girls reported more frequently working to manage their workspace, budget time, and monitor and control emotions. Similarly, girls reported that they spent more time doing homework and were less likely to come to class without homework. In addition, girls considered homework less boring than boys. (p. 85)

This implies that female students are generally more organized and make less distinction between school and home tasks, making the task of schoolwork done at home more acceptable to female students (Xu, 2006). "These studies relating to possible gender differences in some homework behaviours (e.g., organising homework assignments) raise the interesting question of whether there might be gender differences in other related self-regulatory behaviours while doing homework" (Xu, 2006, p. 75).

It would stand to reason that if female students are spending more time engaged in homework that their scores in class would therefore be higher than their male counterparts, which was found to be true in some studies, however this increased achievement did not translate to increased standardized test scores (Gershenson & Holt, 2015; Kalenkoski & Pabilonia, 2017). This may imply that the increase class grades were a result of a motivation or effort based grade system that did not solely take into account the accuracy of a student's work. It may also signal biases that exist in classrooms toward either female or male students. This area of homework study is worthy of further research to determine possible causation for such discrepancies in time spent completing homework and the grade or standardized test outcomes of such time differentials as it seems to impact classroom grades more than standardized testing of content information.

Quality of Homework Assignments at the High School Level

Because each classroom teacher assigns homework in response to the students of each course and even at times each class of students taking a course, homework can come in a variety of forms. In order for homework to be most effective for student achievement and engagement in a course, certain factors must be considered. Homework can effect academic achievement at the class level and/or at the student level (Trautwein, 2007). The class level appears as a homework assignment factor where classes with more homework assigned show a larger impact of homework on class grades than classes that do not assign as much homework (Trautwein, 2007). The student level appears when homework completion influences a class grade causing homework behavior to have an impact on achievement scores rather than only measures of academic aptitude (Trautwein, 2007). The quality of the homework assigned, the type and frequency of feedback students receive from teachers, and how homework impacts grades are all important factors to consider when evaluating the quality of homework as assigned.

With more access to technology, homework can now be assigned as an online task, most of which have been found to be just as effective as their printed counterparts are and in some cases are actually more effective for student understanding (Dodson, 2014). It is not only the method of how homework is completed that is important. Students must see value in the work assigned and be able to use it to reinforce their learning (Carr, 2013). Homework is not only used to reinforce content with practice, but also to develop soft skills such as time management, effective study skills, responsibility, and becoming life-long learners (Bembenutty, 2011). This variety of methodology and impact can make the study of the effectiveness of homework difficult at best.

Students sometimes feel that homework is given as a formality to build grades rather than to build skills or concepts. It is important that departments and even districts as a whole examine homework policies to ensure that these show a value for meaningful homework with distinct goals in terms of "frequency and duration of assignment" (Bembenutty, 2011, p. 346). If homework does not have purposeful goals that are communicated with stakeholders to include students and families, then the impact of homework may be less constructive. "By contrast, effort on homework was consistently associated with higher student achievement and greater achievement gains" (Trautwein, 2007, p. 374). Teachers then bear the responsibility of communicating to students the reason for the homework assigned, how their homework connects to the broader context of the course, expectations of what the student should accomplish, and how students should submit their work for assessment (Bembenutty, 2011). One study suggests that quality homework assignments not only improved students' academic achievement, but also their ability to better manage their time (Núñez et al., 2015a). Students could be more motivated to make an effort on homework if they see value in the homework assigned.

Many things can impact how effective homework is for students, but it is imperative that teachers design homework with a specific goal in mind and are able to communicate that clearly to students. Vatterott (2010) describes five essential characteristics of good homework to be purpose, efficiency, ownership, competence, and aesthetic appeal. While not all assignments can meet all five of those criteria each and every time, the more areas that are addressed the more effective the homework can become (Carr, 2013). If homework assignments are manageable in size and time commitment, meaningful in purpose, and engaging for students, then the positive impact on student academic achievement is predictable (Trautwein, 2007). Homework should not be just a time filling device as a means to facilitate grade generation, but rather a task filled with deep thinking and practice of concepts that may be difficult to learn.

Supportive Homework Environment for Students at the High School Level

Students bear the burden of completing homework to practice content and skills, but this completion of work does not always happen the same type of environments at home or with the same level of support. Students come from a variety of socioeconomic backgrounds with various levels of parental support (Carr, 2013). Homework is more effective when students are encouraged, supported, and have a conducive learning environment either at home or in a study center environment (Merriman, 2016). While high school students do have a higher level of homework independence than younger students, they still benefit significantly with positive parent involvement in homework, particularly when the homework is in an area of the parent's expertise (Patall et al., 2008). In order to address inequities in home environments, supplemental programs such as mentorship or after school study centers are associated with a significant increase in homework completion, grade improvement, and increased standardized test scores (Clark et al., 2016).

While parent involvement is usually a positive impact on homework completion, at times parents can push the student to achieve more than they are capable of at the time and to set unrealistic standards for the student to achieve (Bembenutty, 2011). Research by Bembenutty (2011) describes five roles that parents should have in homework: stage manager, motivator, role model, monitor, and mentor. It is important that parents, guardians, mentors, or homework coaches be given guidance on how best to support students in completing their homework.

Without this guidance, those tasked with helping students to complete homework tend to adopt various attitudes that can negatively influence student homework completion. These can include a vocal negativity toward school or homework in general, an overbearing micromanager style with unrealistic expectations, a completely hands-off style with little to no accountability, or even a parent who takes on the task on completing the homework themselves rather than have the student do the work.

A preferred model homework guide is one who helps students to persist in the face of challenge and to manage time for tasks efficiently (Xu & Wu, 2013). Time spent practicing concepts and skills outside of school can positively impact students academically as well as with soft skills such as time management and persistence (Keith et al., 2004). Each student is unique and may flourish in a different setting. It is important to find what works for each individual and to provide assistance in determining what will provide the best outcome for the student in terms of not only homework completion, but also understanding of the concepts being reinforced or the skills learned.

Summary

Homework can be a valuable asset to student learning in a high school environment. Designing meaningful homework assignments to meet the needs of each individual student is challenging to accomplish, but significantly positive in the outcome. Homework is also not a one size fits all model of education. Some students may need more or less practice with each individual concept or skill learned at any given time. Some students may not have the same environment at home to support effective completion of homework tasks with a dedicated quiet space, void of distractions, with a supportive adult coaching them through the process and encouraging their efforts. Some students may spend more time worried about their next meal or if they are safe, than what homework they have to be completed that night.

This dynamic system of how much homework is done each week, what kind of homework is assigned by teachers, and in what environment homework is completed, makes this area of study both challenging and intriguing. While there may never be a perfect set of guidelines for homework at the high school level that can account for the various outside factors of a student's life, there can be research used to understand what is working well and what is not so as to build a model for what high school teachers should strive to accomplish when creating and assigning homework to students.

Methods

This study used a quantitative approach utilizing quasi-experimental design. Data was collected from participant homework and formal assessment scores. The study was conducted over a period of six weeks to include two units of study for the Biology course. Data was collected from all 9th and 10th grade student participants enrolled in the researcher's Biology classes during the spring semester of the 2020-2021 school year.

Participants and Setting

The sample was a total of 61 student participants (29 male and 32 female), enrolled in Biology, a sophomore level course. Freshmen students identified as academically gifted were enrolled in biology on a recommendation from their middle school math and science teachers. This allows most students to be in similar academic standing entering the course. Students were between the ages of 14 and 16 years during the study. Students ranged in socioeconomic status and included six students with IEPs for a variety of learning disabilities or other medical impairment (four male, two female).

The location of this inquiry was the Biology course in a small, rural high school just outside of Peoria, Illinois. This school is a consolidated district that also serves the surrounding communities, with a combined population of just under 6,000 (U.S. Census Bureau, 2019). According to the 2019 Illinois Report Card, the school's student population of 252 students is 93% White, 1% Black, 0% Asian, 3% Hispanic, 1% American Indian, and 2% Two or More Races (Illinois State Board of Education, 2019). 26% of students are low-income and 10% of students have an IEP (Illinois State Board of Education, 2019).

Data Source and Research Materials

The study was conducted over the course of six weeks and include two units of content: Population & Community Ecology and Ecosystem & Biome Ecology. The study utilized 15 homework assignments (see Appendices B-E, G-I, M-P, R-U), six teacher interventions (see Appendices A, F, J, L, Q, & V), and two summative assessments (see Appendices K & W). Because of the changes due to COVID precautions, all assignments and assessments were administered digitally using Google Classroom to post and collect homework assignments and Google Forms for summative assessments.

Procedures and Data Collection

The period for this study was six weeks to cover two units of study. For the purpose of this study, homework was defined as any assigned Biology coursework completed independently.

- Week 1: The teacher researcher presented the introduction for the Population & Community Ecology Unit using the Khan Academy Introduction to Ecology and Population Size activity (see Appendix A). Students completed four homework assignments including two EdPuzzle

Videos (see Appendix B and Appendix C) and two guided inquiry activities (see Appendix D and Appendix E).

- Week 2: The teacher researcher presented the introduction for the next unit using the Khan Academy Population Growth and Interactions activity (see Appendix F). Students completed three homework assignments including two EdPuzzle Videos (see Appendix G and Appendix H) and a lab simulation (see Appendix I).
- Week 3: Students reviewed the unit material with the teacher researcher utilizing a Quizlet Review (see Appendix J) in preparation for the unit exam and ended the week with the summative assessment for the Population and Community Ecology Unit (see Appendix K).
- Week 4: The teacher researcher presented the introduction for the Ecosystem & Biome Ecology Unit using the Khan Academy Trophic Levels and Biogeochemical Cycles activities (see Appendix L). Students completed four homework assignments including two EdPuzzle Videos (see Appendix M and Appendix N) and two guided inquiry activities (see Appendix O and Appendix P).
- Week 5: The teacher researcher lead group work on a guided inquiry activity (see Appendix Q). Students completed four homework assignments including two EdPuzzle Videos (see Appendix R and Appendix S) and two guided inquiry activities (see Appendix T and Appendix U).
- Week 6: The teacher researcher lead group work on a guided inquiry activity (see Appendix V). Students reviewed the unit material with the teacher researcher utilizing a Quizlet Review (see Appendix W) in preparation for the unit exam and ended the week with the summative assessment for the Ecosystem and Biome Ecology Unit (see Appendix X).

Data Analysis and Results

Data was analyzed quantitatively using descriptive analysis. The researcher collected data from homework completion and assessments for six weeks for 61 participants. Data was separated by sex to compare female and male participants' homework completion and summative assessments. Data from weeks one, two, four, and five show completing unit homework for two different units of Biology curriculum focused on Ecology. Week two was shortened by a holiday weekend, and therefore had one fewer homework assignment than weeks one, four, and five. There were 15 homework assignments in total over the six week study. Weeks three and six were spent reviewing and completing the summative assessments for the units of study.

The school follows an A/B block schedule where classes meet every other day for a total of two or three days in each five day week. Weekly data collection experienced no major issues aside from remote learning district-wide during week one and remote teaching for the researcher during weeks four and five due to a quarantine period (see Appendix Y). No assignments or assessments required modification due to the changes in teaching and learning location shifts.

Data Analysis

Data was analyzed quantitatively for completion of homework, achievement of academic success as measured by summative assessment, and by sex differential. Each week the researcher collected data on homework (weeks one, two, four, and five) or summative assessment scores (weeks three and six). All data collected was organized and reported as both raw scores to analyze academic achievement as well as using homework completion scores to analyze homework completion differences between sexes. Mean values of weekly raw homework scores and homework completion scores were used to present results.

Homework was classified as complete when a score of 65% or higher was earned and given a score of one. Homework was classified as attempted when a score of greater than 0% but less than 65% was earned and given a score of 0.5. A score of 65% is the lowest passing score that a participant can earn. Any student who completes an assignment can achieve no lower than a score of 65%. Homework was classified as not attempted when a score of 0% was earned. Average weekly homework completion scores were compared for work completed during weeks one, two, four, and five. See Table 1 for details.

Table 1

Classification of Homework

Classification	Percentage of Score	Level of Score
High	65 and above	1
Attempted	less than 65	0.5
Not Attempted	0	0

Results

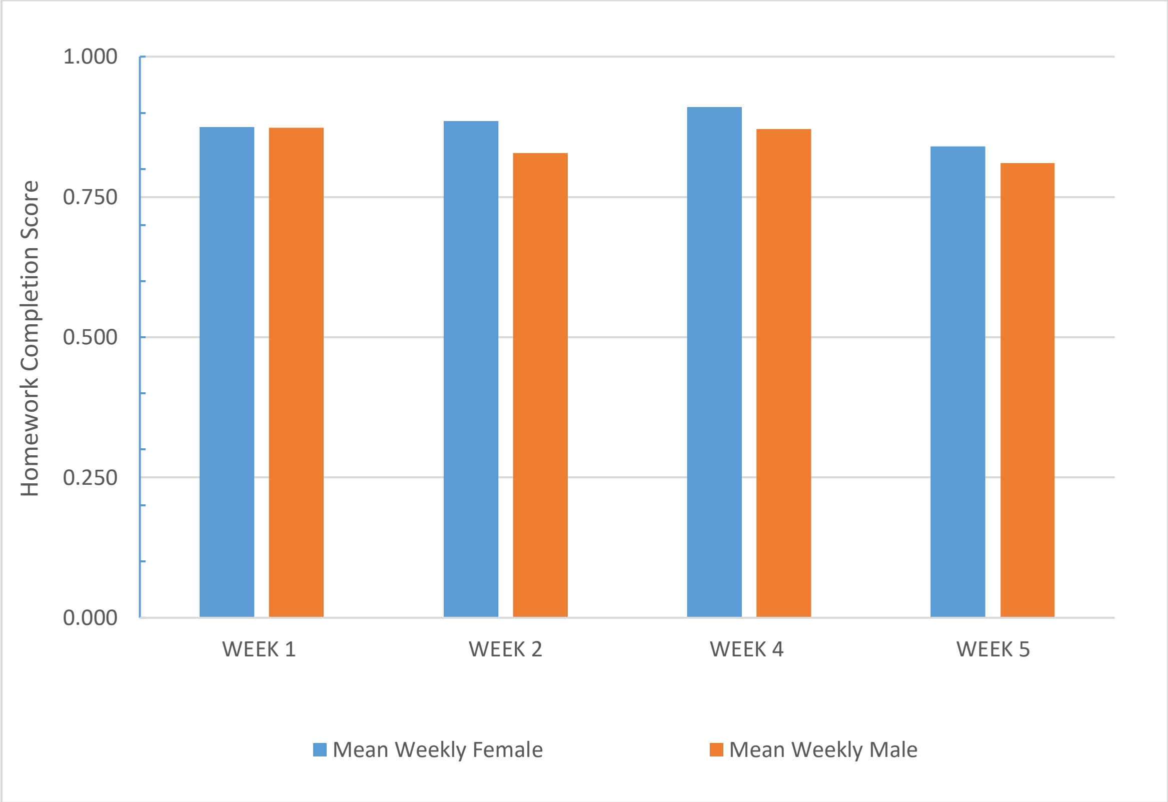
Participant scores were used in four main applications: mean homework completion by sex, mean homework raw scores by sex, mean homework raw scores for all participants, and summative assessments scores by sex. The graphs and tables that follow report the results of the data collected during the six-week study. Following will be results of each research question considered in the study.

Research Question 1: Does Homework Completion Differ Between Male and Female Students?

All 61 participants completed all 15 homework assignments and both summative assessments as assigned over the six-week study. Weeks 1, 2, 4, and 5 included homework assignments while weeks 3 and 6 included review and completion of a summative assessment for the unit of study without homework assignments. Week two had three homework assignments due to a shorted week because of a holiday weekend while weeks one, four, and five had four homework assignments each. Both units focused on an aspect of biological ecology.

Figure 1

Mean Homework Completion Score by Sex



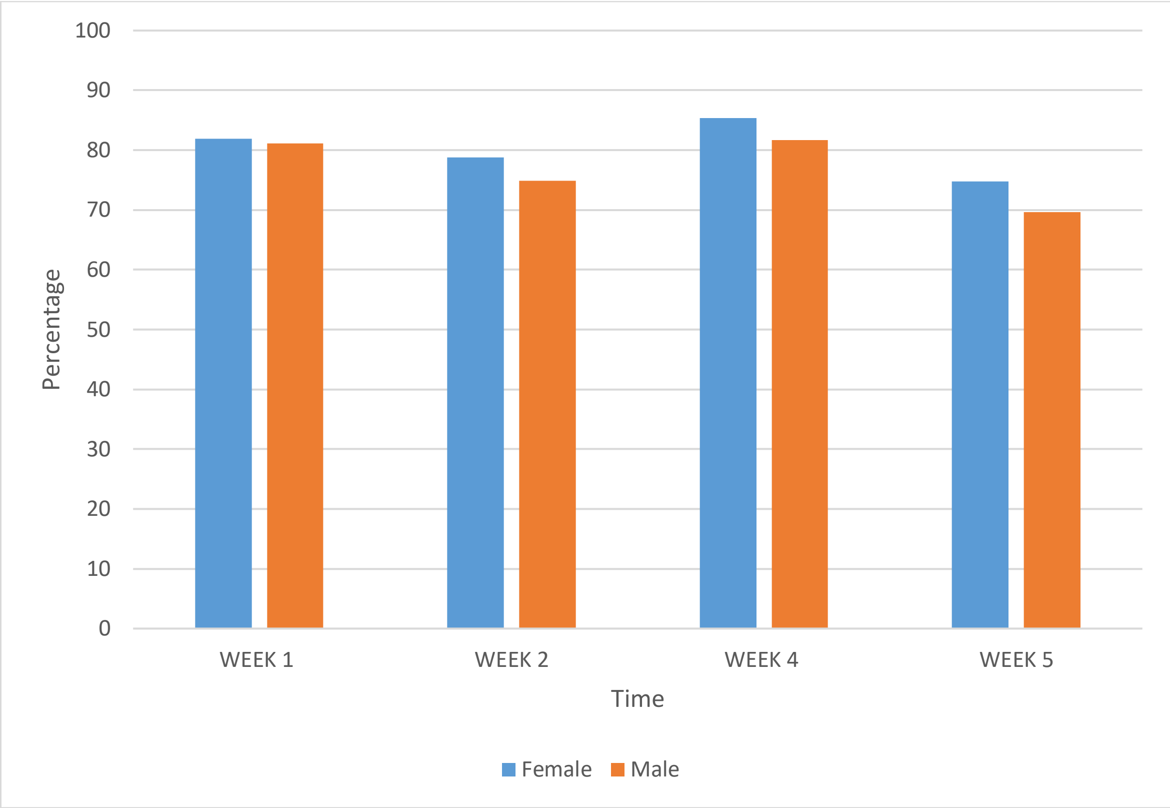
Note. Weeks 3 and 6 had no homework scores collected as they were used for summative assessments.

Figure 1 shows the mean weekly homework completion scores for female and male participants. A score of one was achieved if all assignments were complete to a score of 65% or higher. Female students had an overall mean completion score of 0.88 while male students had an overall mean completion score of 0.85. Each week, female participants had higher rates of homework completion than their male peers (Figure 1). This difference in homework completion may reflect a difference in the way that female and male students approach their assigned homework tasks and the level of importance completing homework has for different sexes.

Figure 2 illustrates the mean weekly homework scores for female participants and male participants. These scores were based on the earned accuracy score for homework assignments given during weeks 1, 2, 4, and 5 in preparation for summative exams during weeks 3 and 6. Raw score data was utilized to find the mean percentage of academic achievement on weekly homework scores for both male and female participants

Figure 2

Mean Percentage of Weekly Academic Achievement by Sex



Note. Weeks 3 and 6 had no homework scores collected as they were used for summative assessments.

Figure 2 shows that female participants had higher weekly academic achievement as measured by accuracy of homework assignments during all four weeks during which homework was assigned and completed. Female participants had an overall mean homework accuracy score of 80.2% while male participants had an overall mean homework accuracy score of 76.8%. This difference in homework accuracy scores toward academic achievement may reflect a difference in the way that female and male students manage their assigned homework tasks.

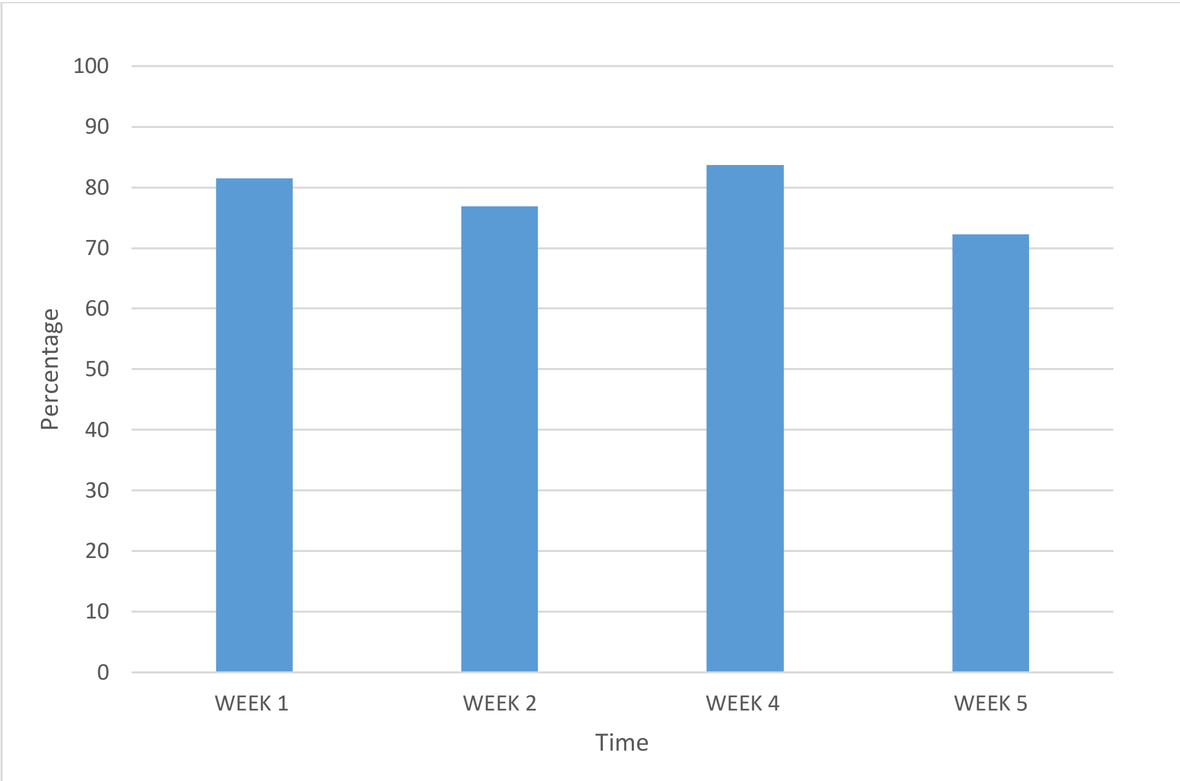
Overall, female participants had higher rates of both homework completion and weekly academic achievement as measured by homework accuracy scores during all four weeks for which homework was assigned and collected (Figures 1 & 2). Female participants more regularly completed homework tasks and earned academic scores of a higher level than their male peers during this study. The reasons why female students reach these higher scores is speculative, but worth note for further study into the motives of students to complete homework and earn high marks on this work. The next section will explain how these homework completion and accuracy scores impact summative assessment scores for female and male participants.

Research Question 2: Do Students Who Complete Homework Have Higher Scores on Summative Assessments?

The overall mean weekly academic achievement scores as measured by homework accuracy scores closely reflect the summative assessment score data. Figure 3 shows that weekly academic achievement for participants on the whole were better during the first week of each unit studied (81.5% for week 1 versus 76.9% for week 2; 83.7% for week 4 versus 72.3% for week 5). The drop in scores may be related to the content becoming for difficult as each unit of study progresses toward a summative exam.

Figure 3

Overall Mean Percentage of Weekly Academic Achievement



Note. Weeks 3 and 6 had no homework scores collected as they were used for summative assessments.

The next section discusses the results of the study based on the summative assessment scores between sexes.

Summative Assessment Results Based on Sexes

Table 1 reports details of summative assessment scores for all participants on both assessments given during the study period during weeks 3 and 6. Overall, the mean summative assessment score of female participants was 76.4% and male participants was 77.3% inclusive of both assessments given during the study.

During week 3, the mean summative assessment score for female participants was 80.1% and for male participants was 80.6%. These values are extremely close, with male participants holding the slight advantage. Given that female students during weeks 1 and 2 in preparation for the summative assessment of week 3 had consistently higher homework completion and accuracy scores (Figures 1 & 2), the researcher expected that female participants would have higher assessment scores than male participants, but this was not the case. The three highest scores for female participants were 101%, 100%, and 100% while the three highest scores for male participants were all 100% for the week 3 summative assessment. The three lowest scores for female participants were 46%, 47%, and 49% while the three lowest scores for male participants were 30%, 48%, and 54% for the week 3 summative assessment.

During week 6, the mean summative assessment score for female participants was 72.7% and for male participants was 74.0%. These values are close, with male participants holding the lead. Given that female students during weeks 4 and 5 in preparation for the summative assessment of week 6 had consistently higher homework completion and accuracy scores (Figures 1 & 2), the researcher expected that female participants would have higher assessment scores than male participants, but this was not the case for the second assessment either. The three highest scores for female participants were 95.5%, 96%, and 97.5% while the three highest scores for male participants were 96%, 97%, and 99% for the week 6 summative assessment. The three lowest scores for female participants were 42%, 43%, and 53% while the three lowest scores for male participants were 22%, 30%, and 36% for the week 6 summative assessment.

Table 1

Summative Assessment Scores of Participants by Sex

Participant	Sex	Week 3	Week 6	Difference
1	F	97	87	10
2	F	96	91	5
3	F	82	73	9
4	F	70.5	57	13.5
5	F	77.5	75	2.5
6	F	96	87	9
7	F	68	22	46
8	F	100	91	9
9	F	74	68	6
10	F	49	67	18
11	F	58.5	66	7.5
12	F	95	86.5	8.5
13	F	73.5	61	12.5
14	F	82	82.5	0.5
15	F	100	95.5	4.5
16	F	79	85	6
17	F	67	42	25
18	F	84	61	23
19	F	74	73	1
20	F	72	53	19
21	F	95.5	95	0.5
22	F	89	90	1
23	F	98	96	2
24	F	93	87	6
25	F	47	26	21
26	F	68	80	12
27	F	66	67	1
28	F	101	84	17
29	F	99	84	15
30	F	97	97.5	0.5
31	F	46	43	3
32	F	68	53	15
Mean Female		80.1	72.7	10.3
33	M	77	74	3
34	M	76	82	6
35	M	92	78	14
36	M	72	77	5
37	M	82	79	3
38	M	94	97	3
39	M	54	69	15
40	M	84	83.5	0.5
41	M	100	96	4
42	M	95	92	3
43	M	85	30	55
44	M	88	81	7

Participant	Sex	Week 3	Week 6	Difference
45	M	94	93	1
46	M	72	60	12
47	M	100	88	12
48	M	63	37	26
49	M	63	64	1
50	M	96	77	19
51	M	100	94	6
52	M	100	95	5
53	M	95	99	4
54	M	72.5	64	8.5
55	M	80	74	6
56	M	48	36	12
57	M	83	72	11
58	M	98	95	3
59	M	63	67	4
60	M	30	22	8
61	M	80	71	9
Mean Male		80.6	74.0	9.2

Note. Sex is abbreviated as "F" for female and "M" for male. Summative assessments were given during weeks three and six to be completed without outside resources within the class period time limit of 70 minutes (unless otherwise dictated by an individualized education plan requirement).

Male participants had higher mean summative assessment scores than their female peers despite having lower homework completion and accuracy scores during the weeks leading up to the summative assessments. This may reflect a difference in how male and female students approach learning, studying, and taking assessments. If these differences are acknowledged and used to build an educational approach to maximize the learning of each sex, the resulting changes could lead to improvements in learning and assessment scores for all students.

Findings, Discussion, Conclusion, Implications, and Limitations

Findings

The general purpose of the study was to discover any differences in the completion of homework tasks between male and female participants. Additionally, the study was established to look at how differences in homework completion influenced summative assessment scores of participants of each sex and overall for all participants. Generally, trends in the data suggest that female participants were more likely to complete their homework and to earn higher raw scores on their homework as compared to their male peers. However, the summative assessment scores were not drastically different for females as compared to males.

Over all four weeks (weeks one, two, four, and five) for which homework scores and completion were rated, female participants had higher scores than male participants (Figures 1 & 2). Summative assessment scores, however, did not differ greatly between male and female participants (Table 1). Mean summative assessment scores for each sex were less than two percentage points apart for the second summative assessment and only half a percentage point apart for the first summative assessment (Table 1). Overall, the mean student homework raw scores were well within the average grade range (72%-83%) and reflected similar scores to the mean summative assessment scores that resulted (Figure 3).

Discussion

The researcher expected to find a sex differential for both homework completion and summative assessment scores for participants in the six-week study. It was hypothesized that a higher rate of completion would be found in female participants, and overall higher homework scores would lead to higher summative assessment scores. While there was a noticeable difference for homework completion between female and male participants, with female participants having a higher rate of homework completion as well as higher raw scores of homework tasks, the summative assessment scores for female and male participants were not remarkably different overall.

The research questions explored could be answered with the data collected. There was a difference in homework completion for male and female participants, with female participants having consistently higher homework completion and higher homework raw scores (Figures 1 & 2). There was not consistent evidence to conclude that participants with higher homework completion or homework raw scores had higher summative assessment scores. Summative assessment scores were not remarkably different for male or female participants even though there was a difference in homework completion and raw homework scores for participants along biological sex lines (Table 1, Figures 1 & 2). Summative assessment scores more closely reflected the raw score data from homework assignments for both female and male participants (Figure 3).

Conclusion

This study sheds light on the different approaches of male and female students to their academic pursuits in high school. The data from this study suggests that while female students tend to complete homework tasks at a higher level both for completion of tasks and accuracy of information than their male peers, it does not serve to give female students an advantage when it comes to summative assessment scores (Table 1).

Homework as measured by this study was defined as any work to be completed independently. Independent work is practice for the summative assessment where participant knowledge and skills are assessed. Male and female participants show a difference in their homework completion and scores, but less of a difference if any at all in their summative assessment scores. This could be important for educators to consider when designing grading practices for courses at the high school level.

It would seem logical that if female students spend more time on homework, they would earn higher grades in class than their male peers. However, this increased achievement did not lead to higher standardized test scores in previous studies or in the summative assessment scores of female students in this study (Gershenson & Holt, 2015; Kalenkoski & Pabilonia, 2017). This may indicate that higher class grades for female students may be due to a motivational or effort-based grading system that relies on compliance rather than competence in the unit of study. It may also indicate inequalities in the classroom between female or male students based on societal norms of compliance that differ for males and females (Xu & Wu, 2013).

Implications

The use of homework for high school courses has long been debated for its effectiveness in helping students to achieve higher academic success. If we use summative assessments to determine what a student has learned through a unit of study for both knowledge and skills, it is important to consider how much, what kind, and how to score the homework assignments or independent work assigned to students throughout the unit of study. Male and female students may take different approaches to homework completion for a variety of reasons, but it is important to acknowledge those differences and use that knowledge to more effectively formatively and summatively assess students, especially when it comes time to assign a grade for this work to a student.

While male participants in general had a lower rate of homework completion and raw scores (Figures 1 & 2), this did not cause a lower mean summative assessment score for male participants. Female students may have a higher rate of homework completion for social and societal reasons rather than academic need, which is driving their higher completion and raw scores on homework. According to Xu & Wu (2013), female students may be held to a higher standard of obedience and servitude to those in positions of power, such as a parent or a teacher. Therefore, it is possible that female students complete tasks to a higher level simply because of this pressure to please and follow expectations rather than to attain further knowledge or skills.

When teachers are assigning tasks, it is important to acknowledge that students are not all starting from the same foundation and therefore may have different needs to reach the final goal of a course or unit of study. While some students may need more homework tasks to practice a particular skill or learn a certain topic, not all students will need these tasks to accomplish the goal of successful learning of the knowledge and skills presented for each unit of study. Therefore, it is imperative for teachers to be mindful of grading practices as students engage in these practice exercises to more effectively and accurately score the student's proficiency for a given unit of study.

Limitations

This study was most limited by the period of time and the units of study covered during the study period. A six-week timeline makes it difficult to make assumptions that the trends seen in this study could be applied to other similar scenarios in the future. If the study could be expanded to cover a larger volume of time and course material, trends in data may be more reliable. Also, different areas of study in biological course material present different kinds of challenges to students. The units of content covered during this study were large-scale, ecological topics. For small-scale, cellular and molecular biology topics, different trends might be identified.

Reflection and Action Plan

Reflection

While there was a difference for homework between different sexes of students, that difference did not translate to a marked difference in summative assessment scores. When choosing homework assignments and scoring homework assignments, it is important to acknowledge that this practice of homework is just that, practice. Some students may need more or less practice than others, or may prefer a different style of practice to learn the content material and skills efficiently.

It is important for educators to understand that homework can lead to inequities due to differences found in homes or resources allocated to different schools. Homework can also lead to a grade that does not truly reflect the abilities of the student because of the compliance of some students to complete work simply to earn the points or get the grade rather than to learn the content presented. This also poses a challenge to students and parents or guardians to engage in learning to truly learn the material rather than just earn the score and move forward. A shift in this homework paradigm would not be easy. Students count on homework scores to bolster lower assessment scores. To remove the compliance component of homework in a student's grade would give a more accurate reflection on student competence, but would also lead to new challenges.

With a removal of homework for a grade in order to decrease scores that reflect compliance more than competence, new challenges arise. Students would need to understand how to utilize homework and classwork tasks in order to master content so that they could be successful on end of unit assessments rather than relying on the homework scores to cushion their grades. Students and families would also need to shift their focus away from "getting the grade" and toward learning for competence in the subject. This shift would also require proper supports within the school to help students adjust to a new structure for assessment. This may include things like improved study skills education, remediation assignments or re-testing if a concept is not mastered, and different styles of assessments to include research projects, verbal assessments, written reflections, or similar differentiated approaches for students to demonstrate competency in their content knowledge and skills.

Action Plan

The researcher plans to share the findings of this study with district administration and other math and science teachers in the district. This district has been working on changing homework expectations and policies over the past few years and this data will help to shed light on some of the advantages and disadvantages of our current practices. In the researcher's courses, homework is a small percentage of the students' overall course grade and this study may reduce that impact even further to avoid perpetuating grading for compliance over competency.

While some new practices of homework may require more work upfront for both educators and students, the result could be an improved overall education experience with better content proficiency. Especially because there is a sex differential in homework compliance that may be the result of different societal standards for male and female students, it is important to be aware of this inequity and to address the need to refocus on the actual learning that occurs for students. Education is a field that is constantly in a state of flux, especially this year in particular with the extra challenges of a pandemic, and this time is prime to reevaluate traditional practices for their effectiveness and make changes where deficiencies are found to exist.

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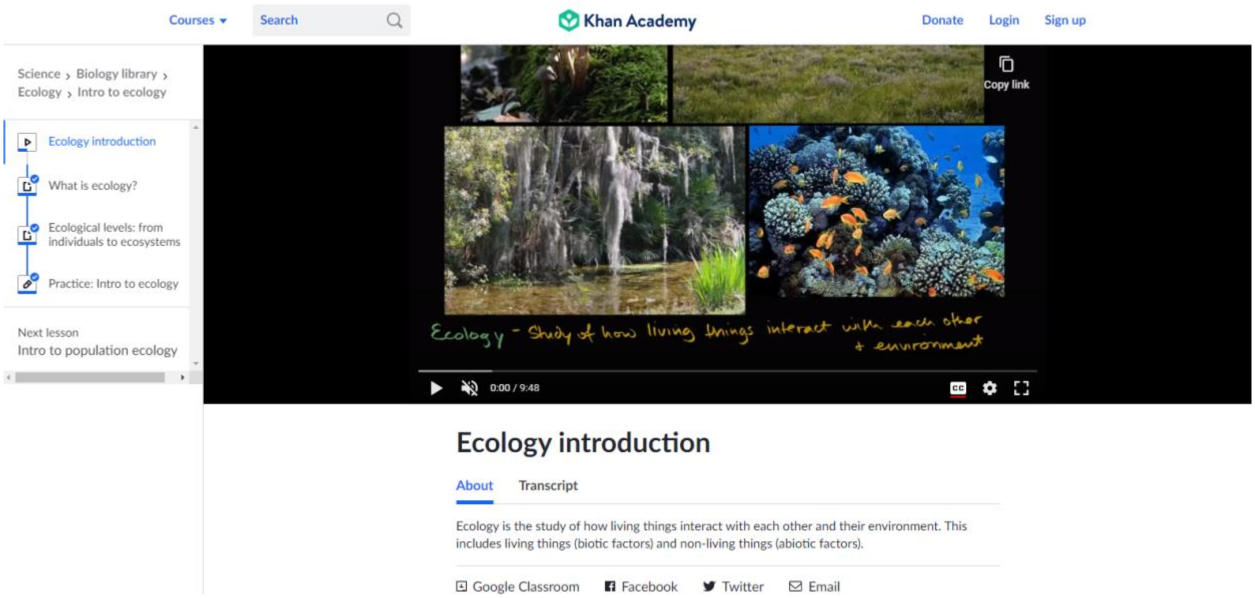
Appendix A



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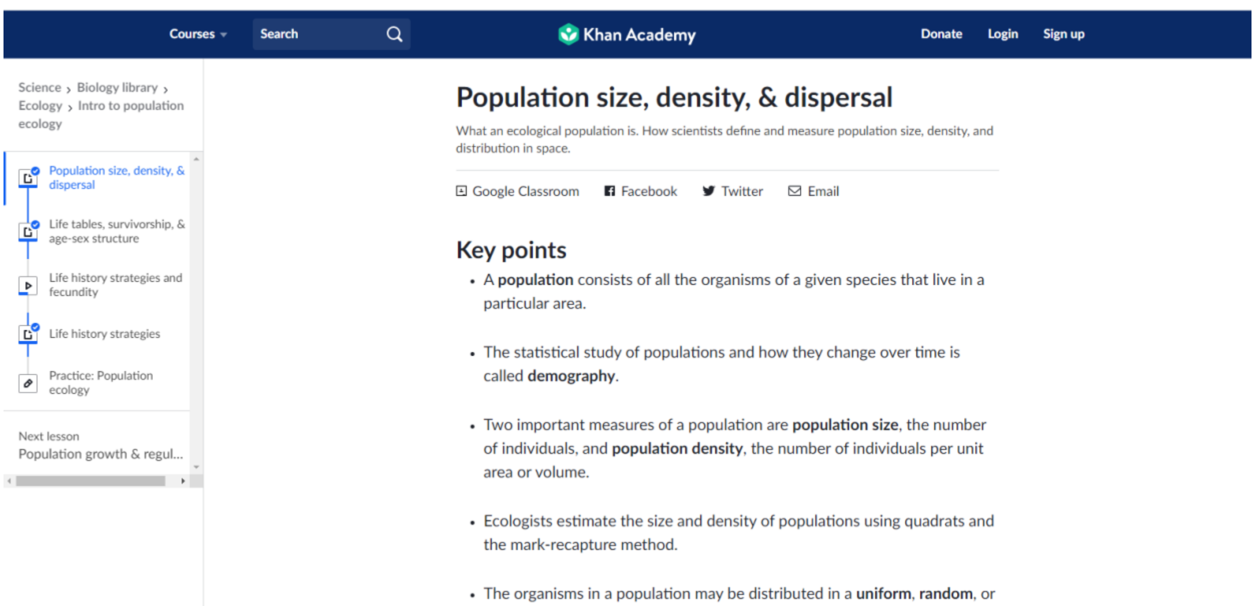

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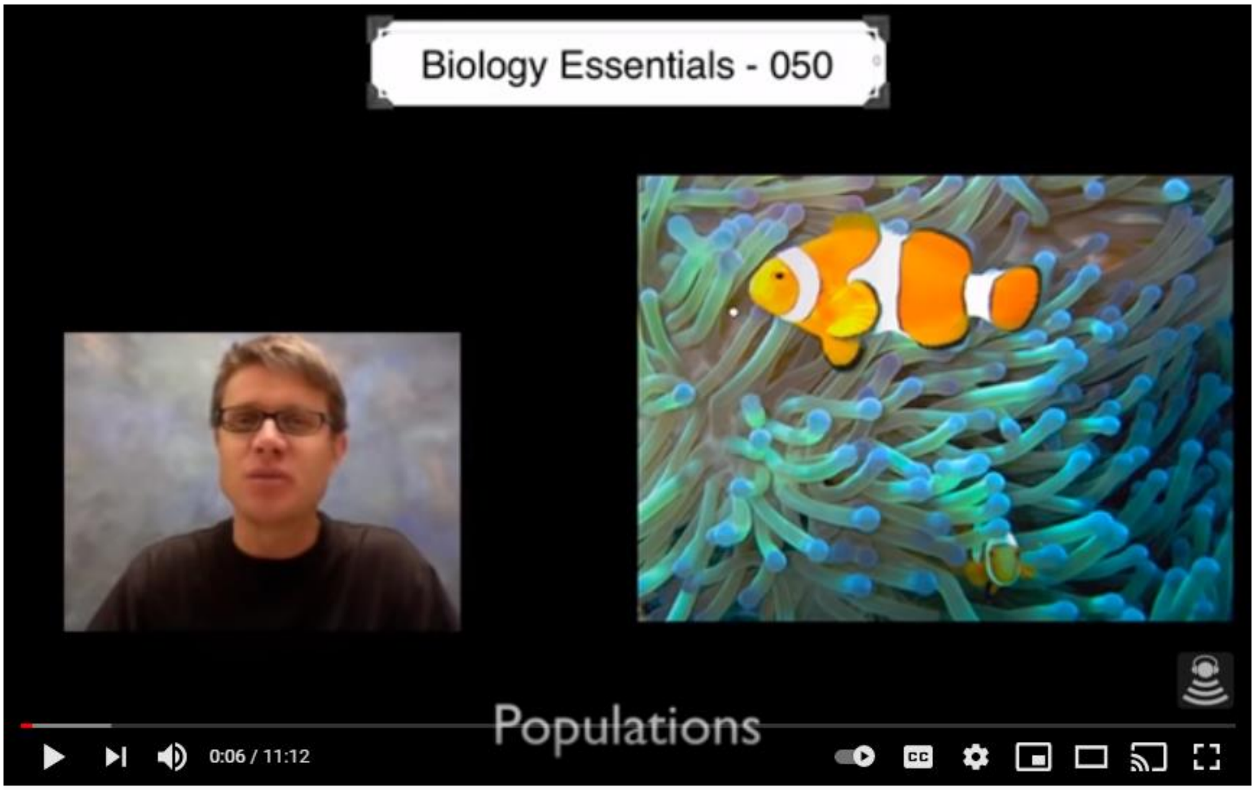
Appendix B


Biology Essentials - 050
Populations
0:06 / 11:12


youtube.com/watch?v=KFViSog6ZJw

Appendix C

youtube.com/watch?v=c6pcRR5Uy6w

Appendix D

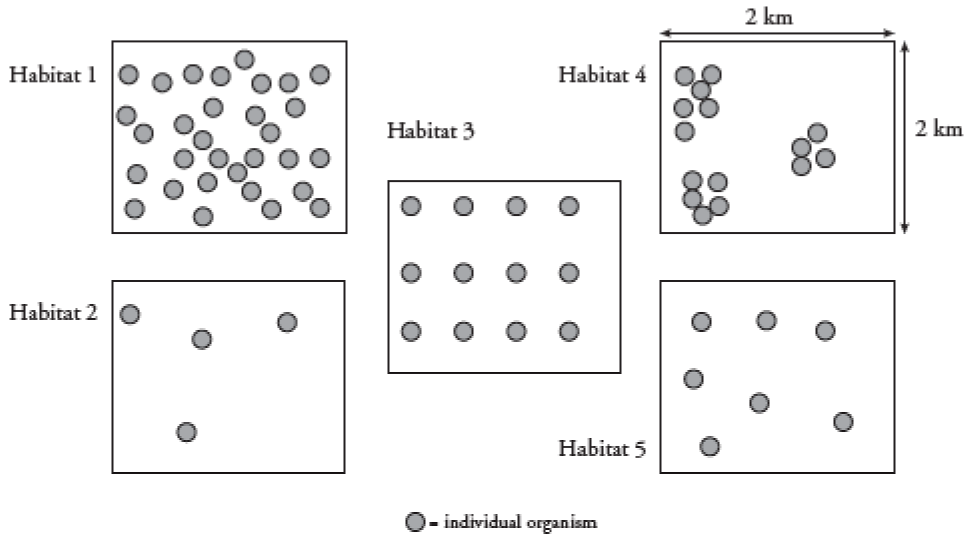
Population Distribution

How does population distribution affect the environment?

Why?

Alaska contains over 127 million acres of untouched forest land. It is the largest state in the United States, yet with a population of nearly 700,000 people it has the same total population as Austin, Texas. New Jersey is one of the smallest states and home to a population of nearly 9 million, but almost 1.8 million of its 4.4 million total land acres are untouched natural woodland. What are the reasons for the ways populations organize themselves, and what effect does this organization have on the environment?

Model 1 – Population Density and Distribution



1. Refer to Model 1.
   a. What do the dots in the diagrams represent?

   b. What do the boxes in the diagrams represent?

2. Calculate the area of a single habitat.

3. Consider the arrangements of the dots in Model 1.
   a. Describe the arrangements of the dots in habitat 3.

b. Describe the arrangement of the dots in habitat 4.

4. Fill in the table below by counting the number of individuals in each habitat in Model 1 and then calculate the area available per individual.

Habitat No.	**Area (km^2)**	**No. of Individuals**	**No. of Individuals/Unit area (Density)**
1			
2			
3			
4			
5			

5. Refer to the completed table above.

   a. Which habitat shows a high **population density**?

   b. Which habitat shows the lowest population density?

6. Draw a vertical line through the middle of each of the boxes in model 1. Label the left side "a" and the right side "b" on each box. Complete the table below for each half of each habitat.

Habitat No.		**Area (km^2)**	**No. of Individuals**	**No. of Individuals/Unit area (Density)**
1	a			
	b			
2	a			
	b			
3	a			
	b			
4	a			
	b			
5	a			
	b			

7. For which of the habitats in Model 1 is population density very similar between sides a and b?

8. For which of the habitats in Model 1 is the population density quite different between sides a and b?

9. Label each of the diagrams on Model 1 using the terms clumped (clustered), random, and uniform (even) to describe the **population distribution** within the boxes.

10. Compare and contrast the terms population density and population distribution.

11. Assuming the population size stays constant, propose at least two factors that might cause a population to shift from a low density habitat to a high density habitat?

12. Animals such as lions or wolves often show clumped distribution. Give a reason why this would be advantageous for these animals.

13. Other than social reasons, list any other factors that may lead to clumped distribution patterns in populations.

14. For each of the organisms listed below state the type of population distribution and population density of their habitat. Give a reason for each answer.

Organism	Distribution	Density	Reason
Tigers			
Bison			
Ants			
Dandelions			
Apple trees in an orchard			

Model 2 – Factors Affecting Density

Factor	Density Dependent	Density Independent
Food supply	X	
Rainfall		X
Flood		X
Parasites	X	
Acidity		X
Disease	X	
Drought		X
Competition	X	
Predation	X	

15. Refer to Model 2.
    a. Which factors are dependent on the population density?

    b. Describe how the food supply would be affected by the population density.

    c. Describe how the levels or spread of disease would be affected by population density.

16. What do all the density-independent factors have in common?

17. In your own words, define **density dependent** and **density independent** by completing the sentences below.

    Density-dependent factors are

    Density-independent factors are

18. Density-independent factors and density-dependent factors may be interrelated. For example, a lack of rainfall that causes a drought will impact the food supply in a habitat. Propose another pairing of a density-independent factor and density-dependent factor that might occur.

STOP

Appendix E

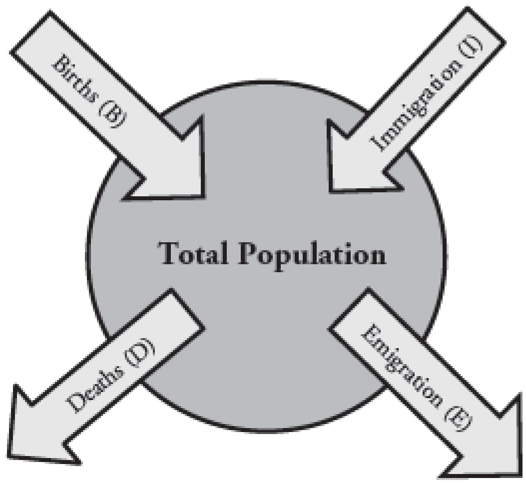
Population Growth

How is population growth naturally regulated?

Why?

The current world population is estimated to be over 7 billion. At present the number of births annually exceeds the number of deaths, which means that the population is increasing, and is estimated to reach 9 billion by 2040. In 1750 the world population was estimated at less than 800 million. How are growing populations such as ours controlled and supported, and can they continue to grow indefinitely?

Model 1 – Population Growth



1. Refer to Model 1.
   a. What is the term used for populations moving into an area?

   b. What is the term used for populations leaving an area?

   c. Name two factors that cause an increase in the population size.

   d. Name two factors that cause a decrease in population size.

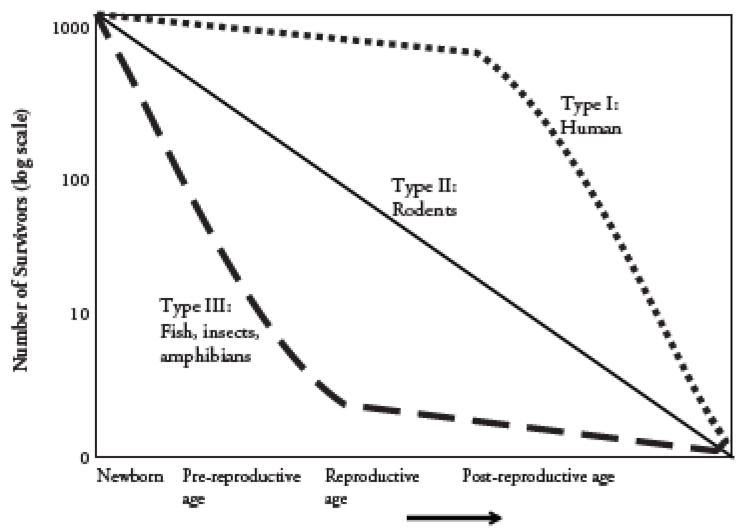
2. Using Model 1 and the letters B, D, E, and I, write mathematical expressions to show the types of population described below. *Note:* The use of > and < may be needed.

   a. A stable population (total number of organisms is not changing).

   b. A declining population (total number of organisms is decreasing).

   c. A growing population (total number of organisms is increasing).

Model 2 – Survivorship Curves



3. Refer to Model 2.

   a. What does the x-axis on the graph in Model 2 represent?

   b. Which type of organism shows a steady decline in its population at all life stages?

   c. Which type of organism loses most of the individuals in its population at an early life stage?

   d. What survivor type are humans?

4. At what life stage is each survivor type when the number of survivors is 100?
   a. Type I —
   b. Type II —
   c. Type III —
5. Which of the three types have the highest number of individuals that reach reproductive age?

Read This!

Through the process of evolution, all species have developed strategies to compensate for their survivorship type. Insects lay eggs by the hundreds. Mammals keep their young close by and protected until they reach adulthood. Factors such as these allow populations of species to survive and thrive despite their survivorship curve.

6. How do you think populations with Type II or III survivorship compensate for high pre-reproductive mortality?
7. Consider the evolutionary strategies that each survivorship type has developed for producing and rearing their young. Propose an explanation for why type I survivors have the highest relative number of individuals/1000 births that survive until they reach post-reproductive age?
8. Under what circumstances might human populations not show Type I survivorship?

STOP

Model 3 – Growth Curves

Diagram A—Exponential Growth Curve

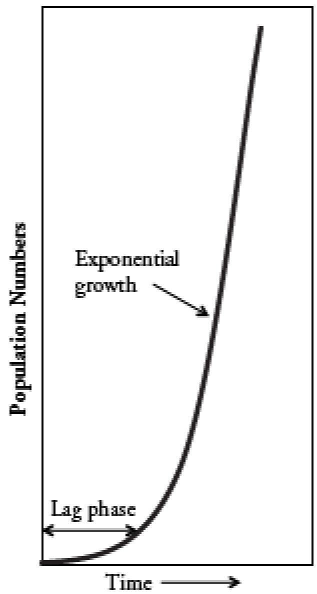
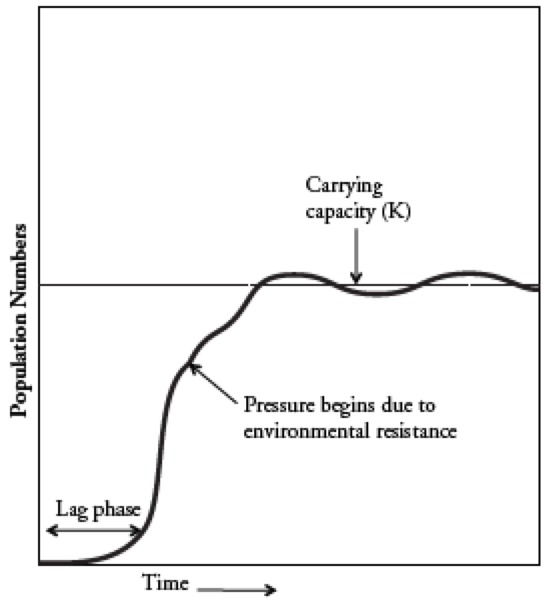


Diagram B—Logistic Growth Curve



9. Refer to Model 3.

   a. During what phase of the growth curves in each diagram is the population just beginning to colonize an area?

   b. Which type of population growth appears to continue unchecked?

10. The growth curves in Model 3 are often referred to using the letters of the alphabet they resemble. The logistic growth curve is sometimes referred to as an S-curve. What letter would you use to describe the exponential growth curve?

11. What causes the population to slow down during logistic growth?

12. The maximum population an environment can sustain is affected by environmental factors that cause the population to level out or become stable. What term is used to describe this level of logistic growth?

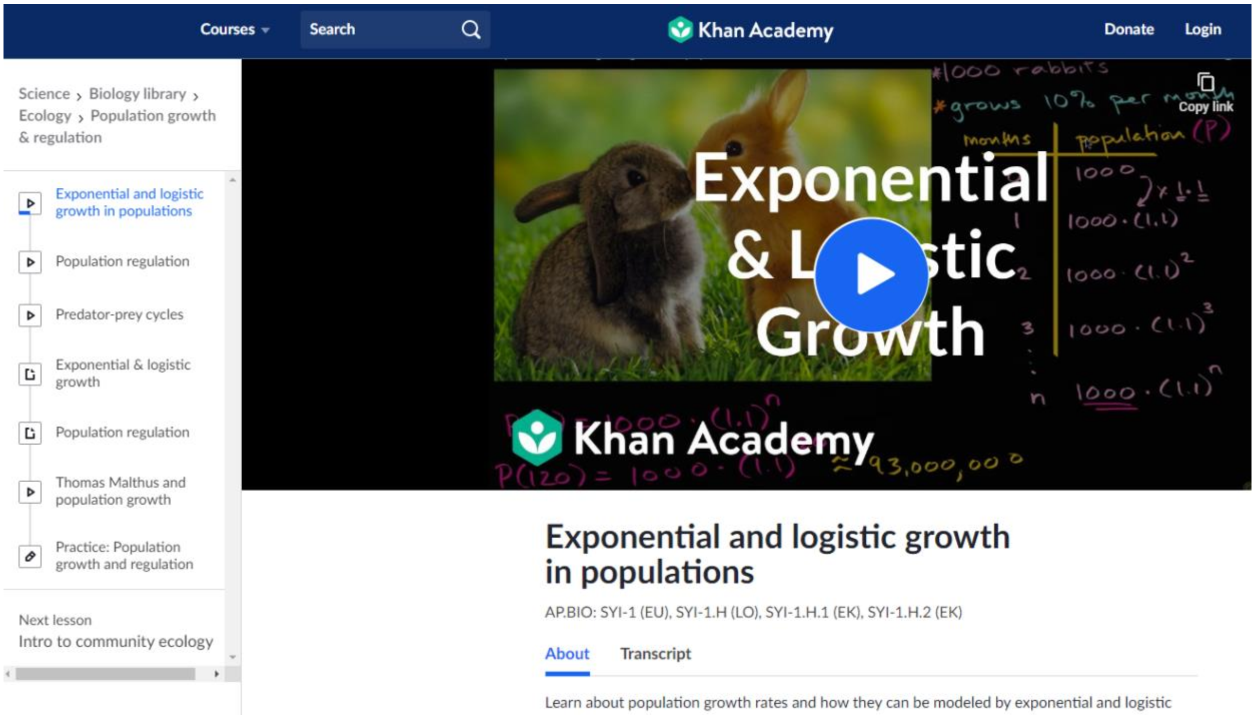
13. Propose some reasons why population growth is so rapid immediately after the lag phase in both diagrams of Model 3?

14. Exponential growth (diagram A) refers to the phenomena of populations that double in size every generation. If you start with a single bacterium capable of dividing every 20 minutes, how many bacteria would you have after just four hours?

15. In most natural populations rapid exponential growth is unsustainable. As populations increase, **environmental resistance** causes the growth rate to slow down, until carrying capacity is reached. With your group, brainstorm several factors that could be considered as environmental resistance.

16. Diagram B shows that the population size fluctuates around the carrying capacity. Considering what you know about interactions in the environment, discuss with your group some of the factors that could cause these fluctuations. In your answer you should relate these factors to the information from Model 1.

Appendix F



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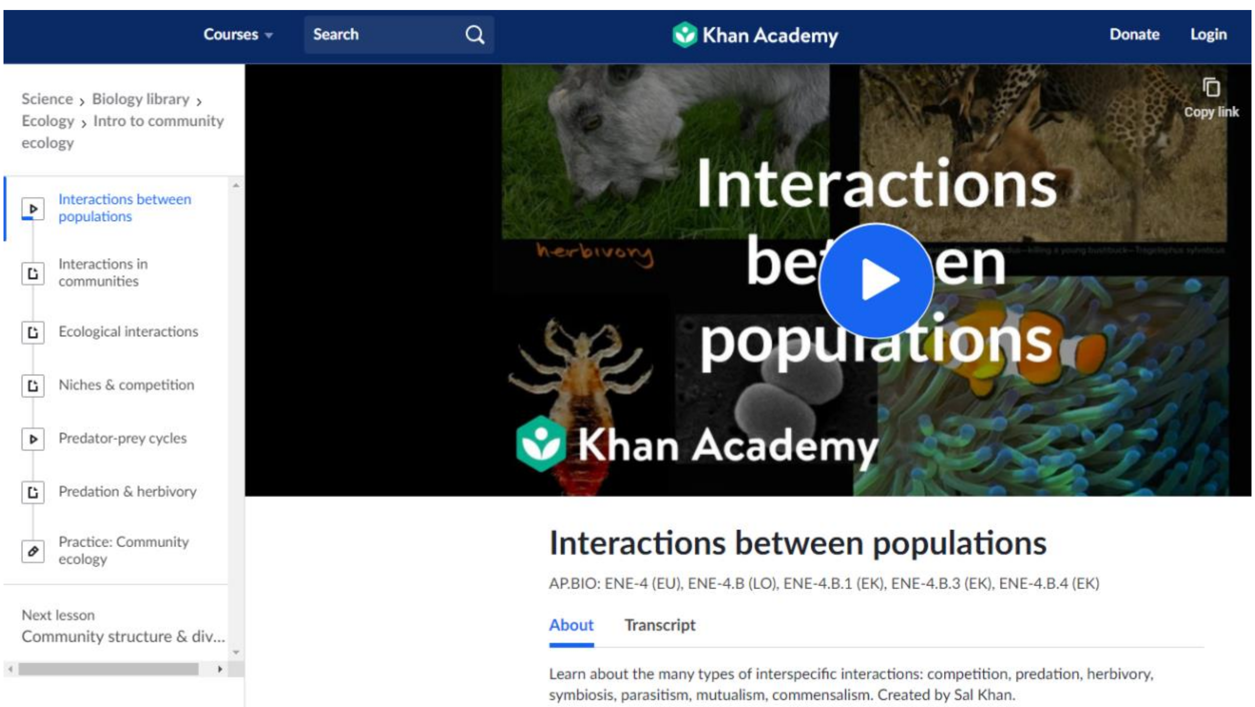

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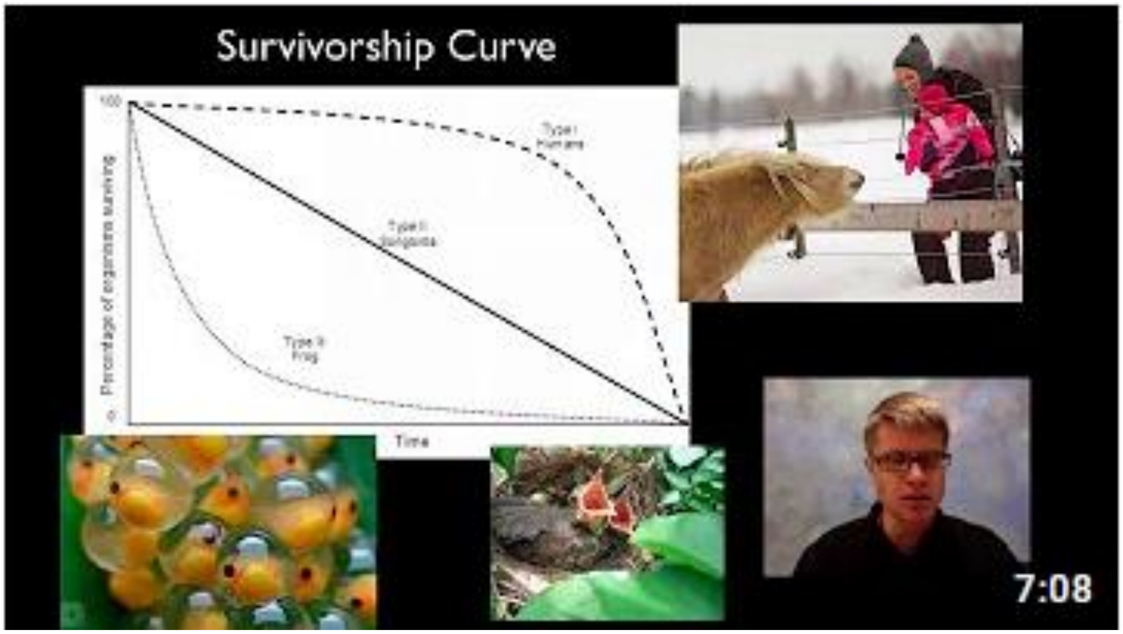
Appendix G

youtube.com/watch?v=rXlyYFXyflM

Appendix H



youtube.com/watch?v=Bu6ouKt9zhs

Appendix I

Gizmos

Name: Date:

Student Exploration: Rabbit Population by Season

Directions: Follow the instructions to go through the simulation. Respond to the questions and prompts in the orange boxes.

Vocabulary: carrying capacity, density-dependent limiting factor, density-independent limiting factor, limiting factor, population, population density

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

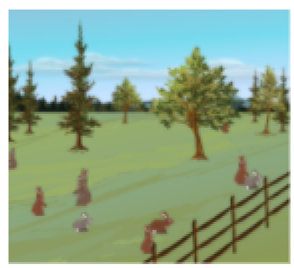
1. Suppose you had a pet rabbit. What would the rabbit need to stay alive and healthy?

2. A female rabbit can give birth to over 40 baby rabbits a year. Suppose all of her offspring survived and reproduced, all of their offspring survived and reproduced, and so on. If that happened, in only eight years the mass of rabbits would exceed the mass of Earth!

   So, why aren't we overrun with rabbits? What keeps the rabbit population in check?

Gizmo Warm-up

A **population** is a group of individuals of the same species that live in the same area. The size of a population is determined by many factors. In the *Rabbit Population by Season* Gizmo, you will see how different factors influence how a rabbit population grows and changes.



1. Select the BAR CHART tab. What is the size of the initial rabbit population?

2. Select the TABLE tab. Click **Play** (▶), and allow the simulation to run for one year.

   A. In which season did the rabbit population increase the most?

   B. In which season did the rabbit population increase the least?

Activity A: Carrying capacity	Get the Gizmo ready: • Click **Reset** ( ).	

Question: What determines how large a population can grow?

1. Think about it: A **limiting factor** is any factor that controls the growth of a population. What do you think are some of the limiting factors for the rabbit population?

2. Run Gizmo: Select the DESCRIPTION tab. Set the **Simulation speed** to **Fast**. Select the GRAPH tab. Click **Play**, and allow the simulation to run for at least 10 years. (Note: You can use the zoom controls on the right to see the whole graph.)

   A. Describe how the rabbit population changed over the course of 10 years.

   B. What pattern did you see repeated every year?

   C. How could you explain this pattern?

3. Analyze: The **carrying capacity** is the maximum number of individuals of a particular species that an environment can support. All environments have carrying capacities.

   A. What is this environment's approximate carrying capacity for rabbits? (Note: Average the summer and winter carrying capacities.)

   B. When did the rabbit population reach carrying capacity? Explain how you know.

Activity B: Density-dependent limiting factors	Get the Gizmo ready: • Click **Reset**. • On the SIMULATION pane, make sure **Ample** is selected for the amount of **LAND** available.	

Introduction: Population density is the number of individuals in a population per unit of area. Some limiting factors only affect a population when its density reaches a certain level. These limiting factors are known as **density-dependent limiting factors**.

Question: How does a density-dependent limiting factor affect carrying capacity?

1. Think about it: What do you think some density-dependent limiting factors might be?

2. Predict: Suppose a shopping mall is built near a rabbit warren, leaving less land available for rabbits. How will this affect the environment's carrying capacity?

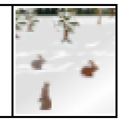
3. Experiment: Use the Gizmo to find the carrying capacity with **Ample**, **Moderate**, and **Little** land. List the carrying capacities below.

   Ample: Moderate: Little:

4. Analyze: How did the amount of space available to the rabbits affect how many individuals the environment could support?

5. Infer: Why do you think limiting a population's space decreases the carrying capacity?

6. Challenge yourself: Other than space, what might be another density-dependent limiting factor? Explain.

Activity C: **Density-independent limiting factors**	Get the Gizmo ready: • Click **Reset**. • On the SIMULATION pane, select **Ample** for the amount of **LAND** available.	

Introduction: Not all limiting factors are related to a population's density. **Density-independent limiting factors** affect a population regardless of its size and density.

Question: How do density-independent limiting factors affect how a population grows?

1. Think about it: What do you think some density-independent limiting factors might be?

2. Gather data: Click **Play**. Allow the population to reach carrying capacity. Click **Pause** ( ). Select the GRAPH tab and click the camera ( ) to take a snapshot of the graph. Right click the image and paste the snapshot into the box below. Label the graph "Normal Weather."

3. Predict: How do you think a period of harsh winters will affect the rabbit population?

4. Investigate: Click **Reset**. Select **Harsh winter** from the **CONDITIONS** listed on the SIMULATION pane. Click **Play**, and observe how the population changes over five years. Paste a snapshot of the graph in the box below. Label the graph "Harsh Winter."

   A. How does the Harsh Winter graph differ from the Normal Weather graph?

   B. What do you think most likely caused the differences seen in the two graphs?

5. Predict: Rabbits reproduce in the spring. How do you think a period of cold springs will affect the rabbit population?

6. Investigate: Deselect **Harsh winter**. Select **Cold spring**. Click **Play**, and observe how the population changes over a period of five years. Paste a snapshot of the graph in the box below and label the graph "Cold Spring."

   A. How does the Cold Spring graph differ from the Normal Weather graph?

   B. What do you think most likely caused the differences seen in the two graphs?

7. Predict: How do you think a period of hot summers will affect the rabbit population?

8. Investigate: Deselect **Cold spring**. Select **Hot summer**. Click **Play**, and observe the how the population changes over a period of five years. Paste a snapshot of the graph in the box below. Label the graph "Hot Summer."

   A. How does the Hot Summer graph differ from the Normal Weather graph?

   B. What do you think most likely caused the differences seen in the two graphs?

9. Think and discuss: Other than unusual weather, what might be another density-independent limiting factor that could affect the rabbit population? If possible, discuss your answer with your classmates and teacher.

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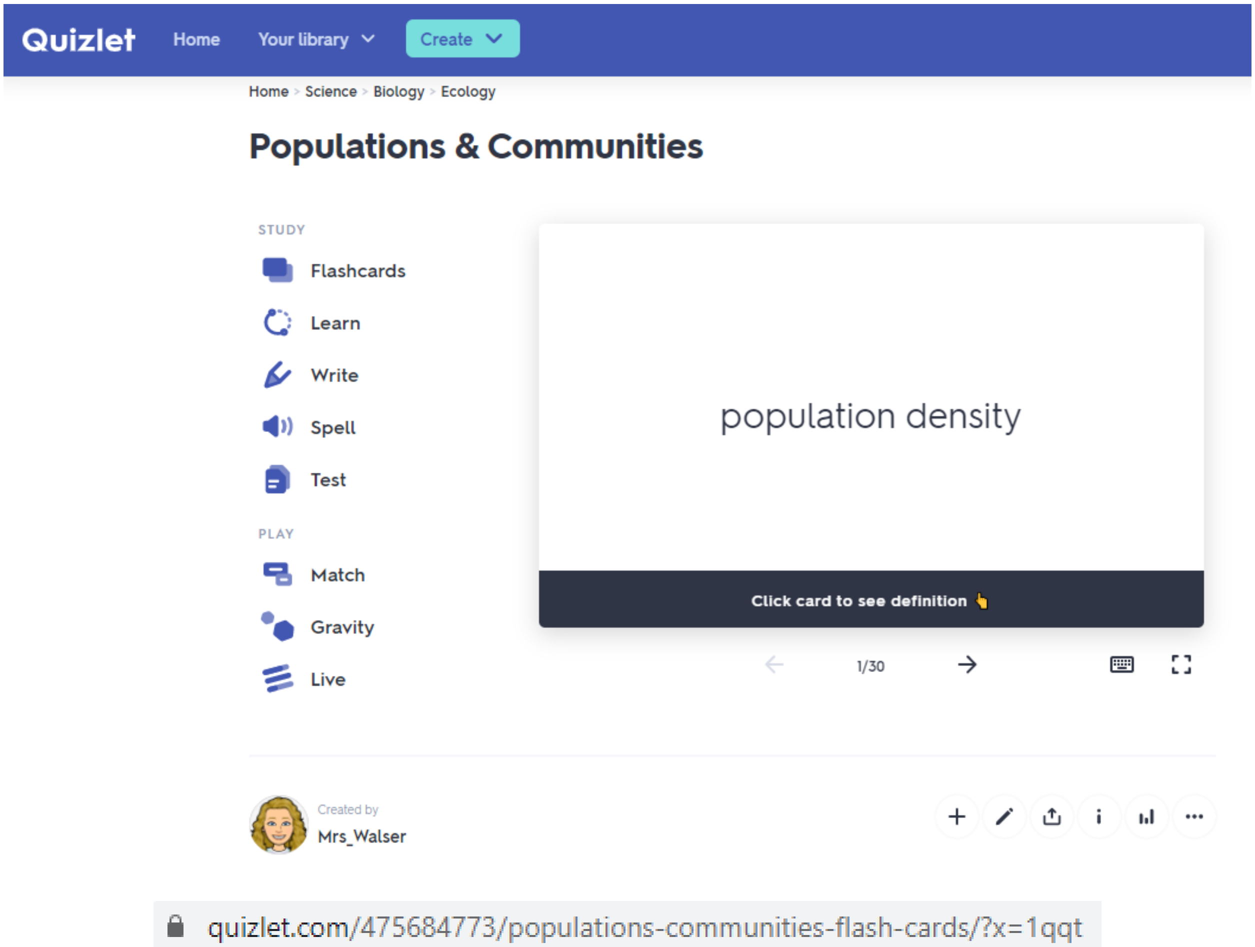
Appendix J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Appendix K

Populations and Communities Exam

Biology I

Name: ______________________________

Date: ______________________________

Class: ______________________________

1) Mark each Factor as either density dependent or density independent by placing an "x" in the box.

Factor	*Density Dependent*	*Density Independent*
Food supply		
Rainfall		
Flood		
Parasites		
Acidity		
Disease		
Drought		
Competition		
Predation		

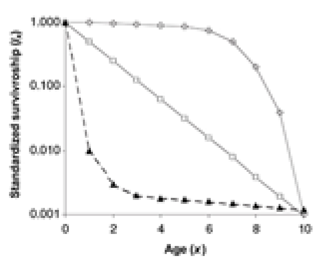
2) Describe what the following variables stand for in population biology:

A. K: ____________ **B. N:** ____________ **3) r:** ____________

4) Briefly describe each of the following types of symbiosis by completing the chart (X and Y represent organisms involved in the interaction):

Type of interaction	*Effect on X*	*Effect on Y*	*Example interaction*
Amensalism			
Neutralism			
Commensalism			
Competition			
Mutualism			
Predation/parasitism			

5) ***Label the graph below*** with the three different survivorship curves ***(I, II, and III)*** and then give an example organism for each type below the graph.



I. Example organism: ___________________

II. Example organism: ___________________

III. Example organism: ___________________

6) **Compare and contrast r and K selected species: Write "r" or "K" next to each factor below.**

A. ______ Base life on carrying capacity

B. ______ Base life on growth rate

C. ______ Dispersed offspring

D. ______ Early maturity

E. ______ Few, expensive offspring

F. ______ High fecundity (death before reproduc

G. ______ High level of parental care

H. ______ Humans, elephants, primates

I. ______ Insects, Fogs, Rodents

J. ______ Large body size

K. ______ Longer life expectancy

L. ______ Many, cheap offspring

M. ______ Short generation time

N. ______ Smaller body size

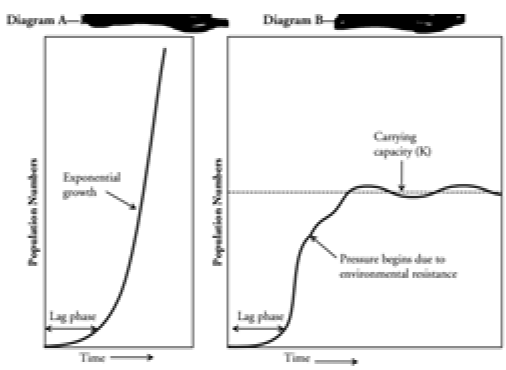
O. ______ Stable environment

P. ______ Type I survivorship

Q. ______ Type II/III survivorship

R. ______ Unstable environment

Use the following graphs to answer the questions that follow:



7) Name each growth curve:

A. ________________________

B. ________________________

8) During what phase of the growth curves is the population just beginning to colonize an area?

____

9) Why does population size fluctuate around the carrying capacity, rather than just stay at one set value? __________

____

Matching: **Write the correct letter on the line next to its definition. Use each term**

10) _____number of individuals in an area of a specific size

11) _____how population is spread out in an area

12) _____individuals are found in groups or patches within the habitat

13) _____organisms arranged in no particular pattern within the habitat

14) _____organisms are found at a regular distance from one another within the habitat

15) _____limiting factor of a population wherein large, dense populations are more strongly affected than small, less crowded ones

16) _____limiting factor that affects all populations in similar ways, regardless of population size

17) _____growth pattern in which a population's growth rate slows or stops following a period of exponential growth

18) _____ growth whose rate becomes ever more rapid in proportion to the growing total number or size

A. clumped distribution

B. density dependent factors

C. density independent factors

D. exponential growth

E. logistic growth

F. population density

G. population distribution

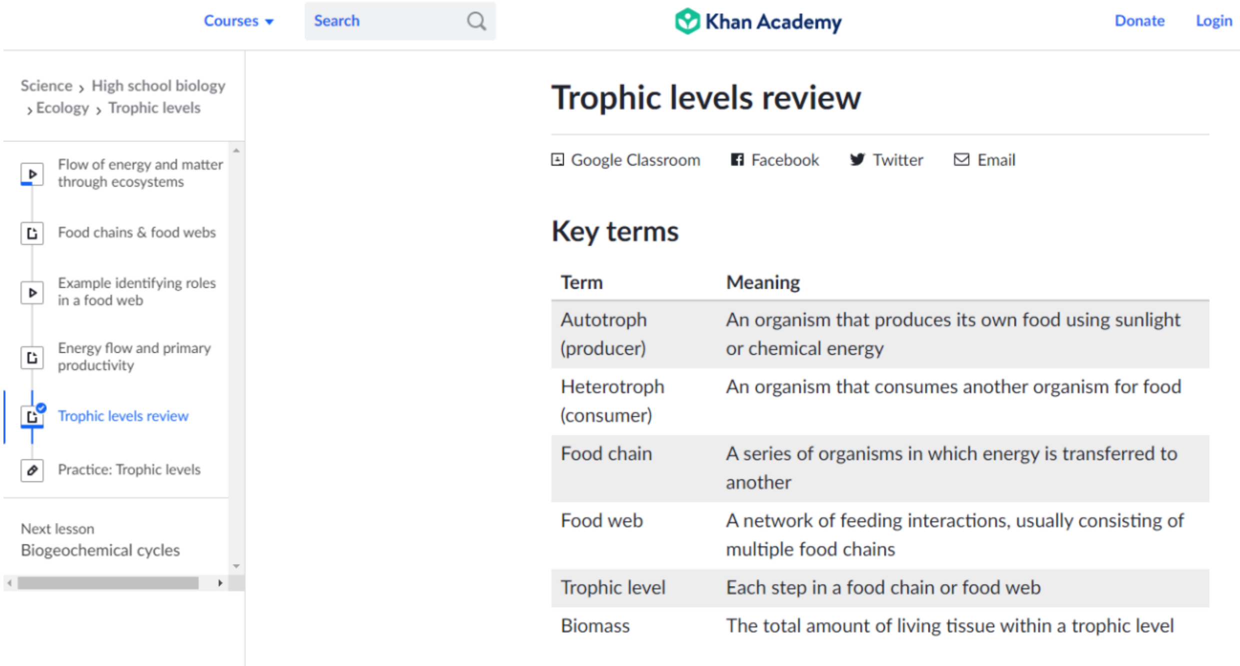
H. random distribution

I. uniform distribution

Essays:

19) **Describe factors that affect carrying capacity of ecosystems at different scales (or sizes). Be sure to describe any density-dependent and –independent factors and if it applies differently to different types of organisms (Type I, II, and III).**

Appendix L



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- Energy flow and primary productivity
- Trophic levels review
- Practice: Trophic levels

Next lesson
Biogeochemical cycles

Trophic levels review

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Key terms

Term	Meaning
Autotroph (producer)	An organism that produces its own food using sunlight or chemical energy
Heterotroph (consumer)	An organism that consumes another organism for food
Food chain	A series of organisms in which energy is transferred to another
Food web	A network of feeding interactions, usually consisting of multiple food chains
Trophic level	Each step in a food chain or food web
Biomass	The total amount of living tissue within a trophic level

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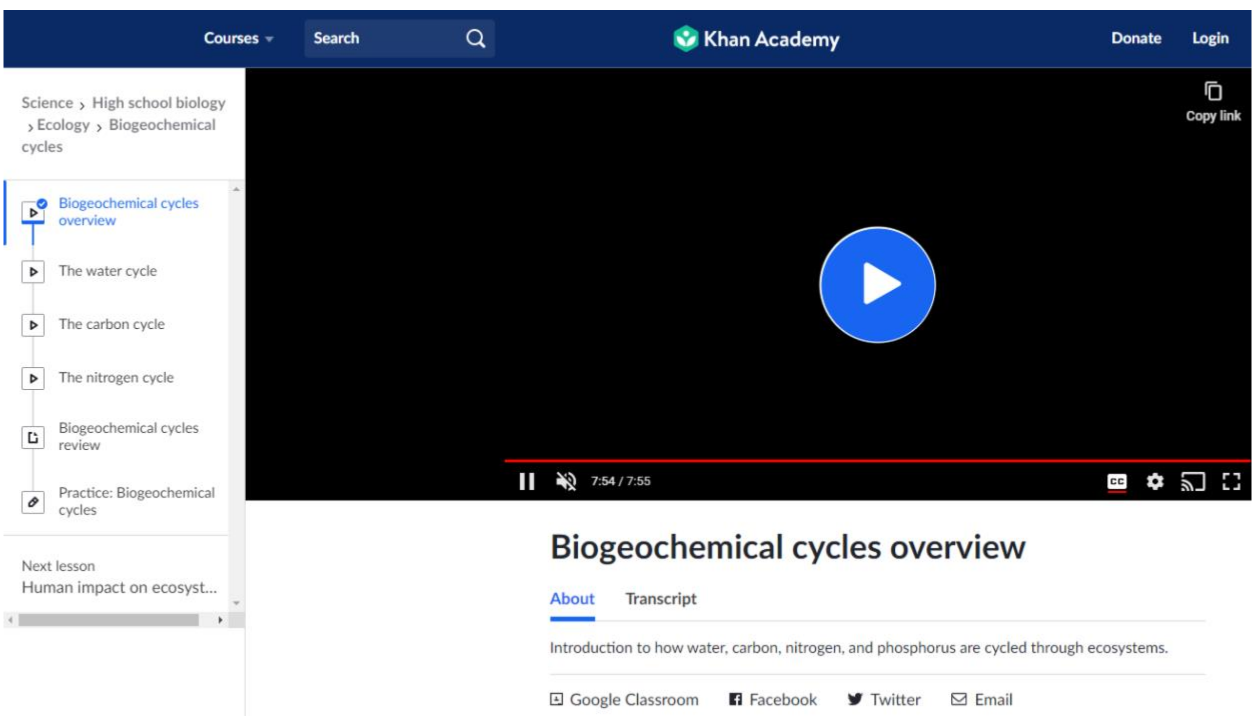

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- The carbon cycle
- The nitrogen cycle
- Biogeochemical cycles review
- Practice: Biogeochemical cycles

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About Transcript

Introduction to how water, carbon, nitrogen, and phosphorus are cycled through ecosystems.

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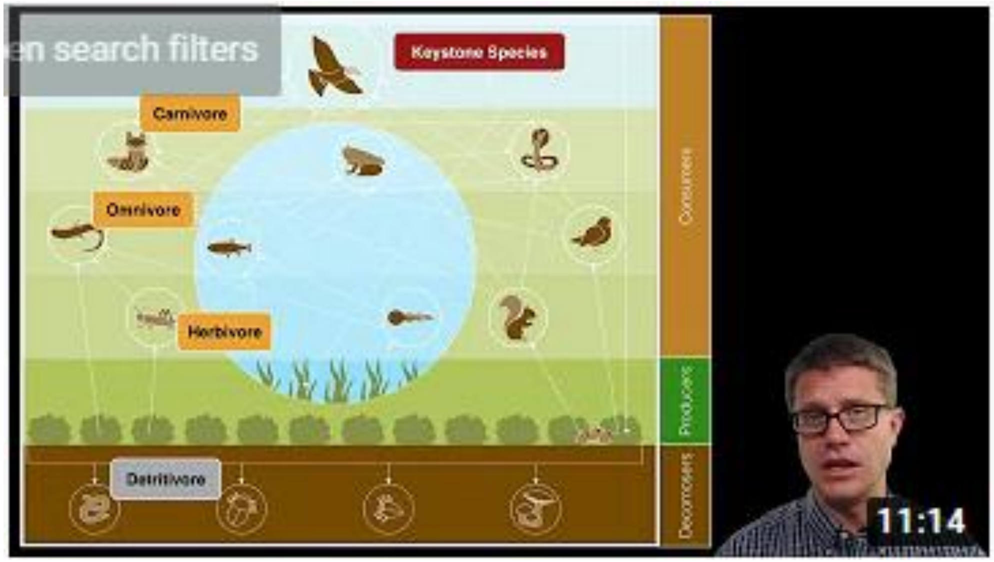
Appendix M



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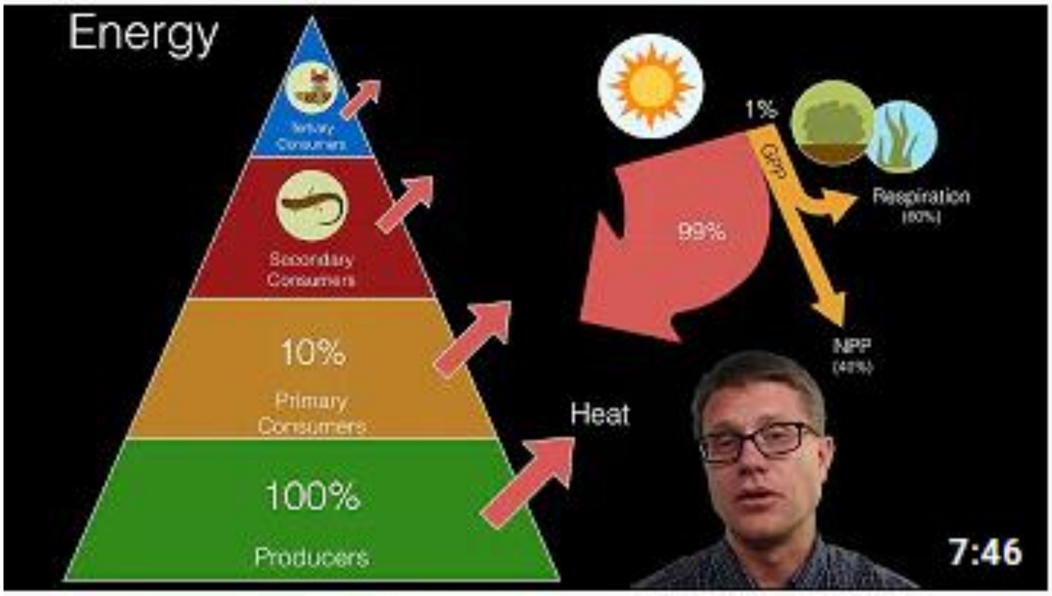
Appendix N



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Appendix O

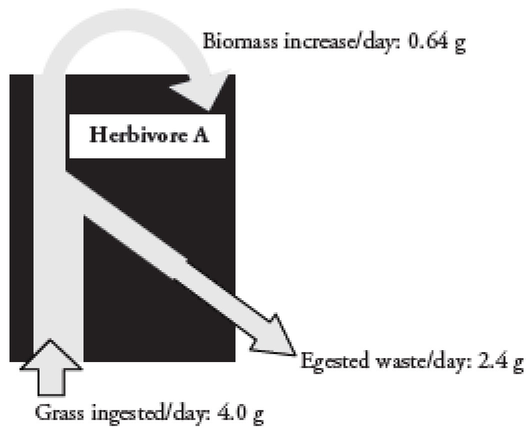
Energy Transfer in Living Organisms

How does energy move through an organism?

Why?

The **law of conservation of energy** states that energy can be neither created nor destroyed; it can only be transferred to another form. In living things energy is transferred as organic matter (molecules of carbohydrate, fats, starch, etc.). But does an organism use all of the energy that is provided by the organic matter available? How is the law of conservation of energy applied to living organisms?

Model 1 – Food Conversion in a Herbivore



1. According to Model 1, how many grams of grass does herbivore A eat each day?

2. Refer to Model 1.
   a. How much did herbivore A grow from eating this grass?

   b. What term is used to represent growth in Model 1?

3. What is meant by "egested waste" as it is used in Model 1?

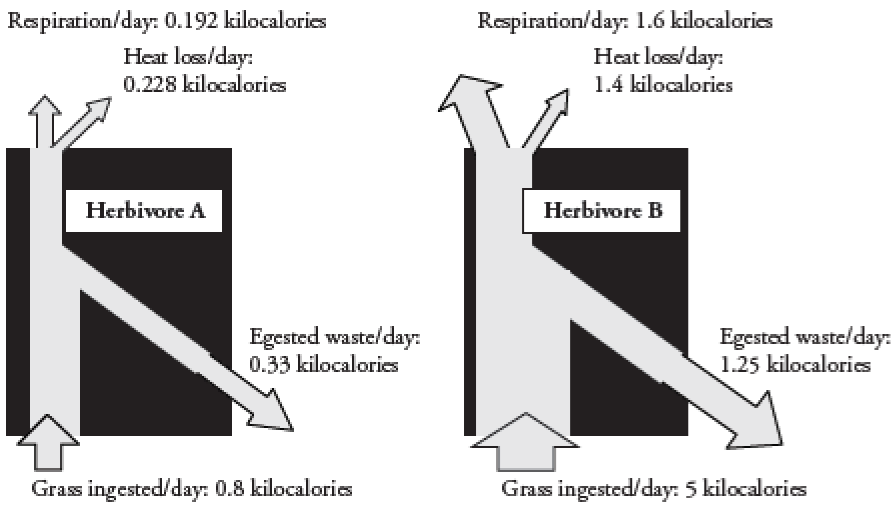
4. Is all of the mass of the ingested grass accounted for in the growth and waste of herbivore A? If not, how much is "missing"? Show a mathematical calculation to support your answer.

5. In addition to growth and waste production, what else does herbivore A's body do with the food it ingests?

6. As cells undergo cellular respiration, what products are produced, and how are they released from the body?

7. Draw an arrow in Model 1 to represent respiration and label it with the appropriate title and mass.

Model 2 – Energy Efficiency in Two Organisms



8. What unit of energy is used in Model 2?

9. Refer to the energy value of the ingested grass in Model 2.
   a. What is the energy value of the grass eaten by herbivore A each day?

   b. What is the energy value of the grass eaten by herbivore B each day?

   c. Which herbivore would you predict to be the larger animal? Explain.

10. In Model 2, what are the three ways that the energy taken in by the herbivores is used?

11. For each herbivore calculate the total energy output.

    a. Herbivore A =

    b. Herbivore B =

12. Does the total amount of energy output for each herbivore add up to the total amount of energy eaten by each herbivore?

13. Use the information given in Model 1.

    a. What accounts for the differences noted in Question 12?

    b. Add labels to Model 2 to show this energy.

Read This!

Biologists often refer to organic matter by the potential energy that is released when the substance undergoes a chemical change to make carbon dioxide and water. This could occur by burning the organic matter or by an organism using the organic matter in cellular respiration.

14. According to Model 1, herbivore A eats 4 g of grass per day. Using Model 2, how much potential energy does this represent?

15. According to Model 2, how much energy does herbivore A require for cellular respiration each day?

16. Energy lost as either heat to the environment or egested as waste is not considered to be an efficient use by the organism. What percentage of the potential energy of the grass is not efficiently used by herbivore A?

17. What percentage of the potential energy of the grass is not efficiently used by herbivore B?

18. Do the herbivores have the same efficiency in using the grass toward useful purposes? Explain in two or more complete sentences.

STOP

19. Herbivores A and B are eaten by carnivores.

    a. Which category of energy related to the organisms in Model 2 is directly available to the carnivore who eats the herbivores: grass, respiration, biomass or waste?

    b. What percentage of the original "grass energy" is available to the carnivore if it eats herbivore A?

    c. What percentage of the original "grass energy" is available to the carnivore if it eats herbivore B?

20. Which herbivore is the more efficient food choice for the carnivore? Why?

Appendix P

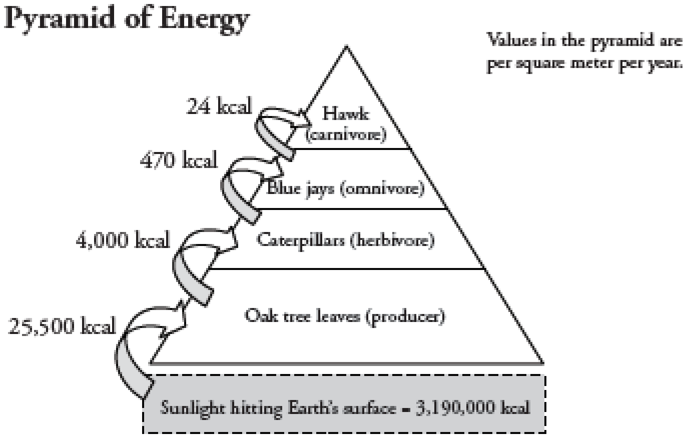
Ecological Pyramids

How does energy flow through an ecosystem?

Why?

Every organism in an ecosystem is either eating or being eaten. When cows eat grass, they obtain some of the energy that the grass transferred from the sunlight it absorbed. If cows could carry out photosynthesis, would they have access to more energy than they get as herbivores? Which organisms in an ecosystem require the most energy to sustain life?

Model 1 – Pyramid of Energy



1. A unit used to measure energy is the **kcal**.
   a. What is the source of all energy in the pyramid in Model 1?

   b. How much energy does this source provide to a square meter of the Earth per year? (Be sure your answer includes units.)

2. Label the pyramid levels in Model 1 with the following: primary producers, primary consumers, secondary consumers, and tertiary consumers.
3. The arrows in Model 1 represent the energy available to the next level of the pyramid.
   a. What percentage of the source energy from Question 1*a* is absorbed by the oak leaves in Model 1?

   b. By what process do the oak leaves harness this energy?

4. Describe how the consumers in one level of the pyramid obtain energy from the organisms at the previous level of the pyramid.

5. Refer to Model 1.

   a. How much energy per year do the caterpillars in Model 1 obtain from eating the leaves in a square meter of the oak tree?

   b. What percentage of the energy that was originally absorbed by the oak leaves is passed on to the caterpillars?

   c. What percentage of the energy absorbed by the oak leaves is not passed on to the caterpillars?

   d. With your group, list at least three possible uses and/or products of the energy absorbed by the oak leaves that did not contribute to the production of biomass.

6. Calculate the percentage of energy that is transferred from one level of the pyramid in Model 1 to another for all of the levels.

   a. Oak leaves to caterpillars (see Question 5*b*).

   b. Caterpillars to blue jays.

   c. Blue jays to hawk.

7. Calculate the average percentage of energy that is transferred from one level to another using your answers in Question 6. Note that this average percentage transfer is similar for many different types of energy pyramids in nature.

8. As a group, write a statement that describes the pattern of energy transfer among consumers within a pyramid of energy.

9. What percentage of the caterpillars' original energy is available to the hawk?

10. What percentage of the oak leaves' original energy is available to the hawk?

11. Explain why an energy pyramid in any ecosystem typically is limited to four or five levels only.

12. Propose an explanation for why populations of top carnivores, such as hawks, are always smaller than the populations of herbivores, such as caterpillars.

STOP

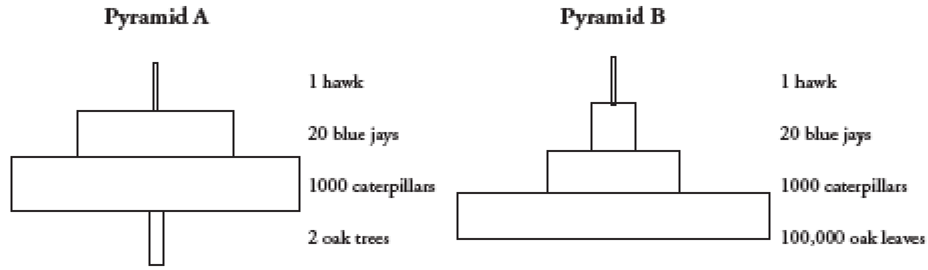
Read This!

Each level in the pyramid in Model 1 is a **trophic level**. The word "trophic" refers to feeding or nutrition. Model 1 shows one example of one organism that would be included in each level, but each level in an ecosystem includes many species of organisms.

13. List at least three other species that might be found in the trophic level with the oak trees.

14. List at least three other species that might be found in the trophic level with the blue jays.

Model 2 – Pyramid of Numbers



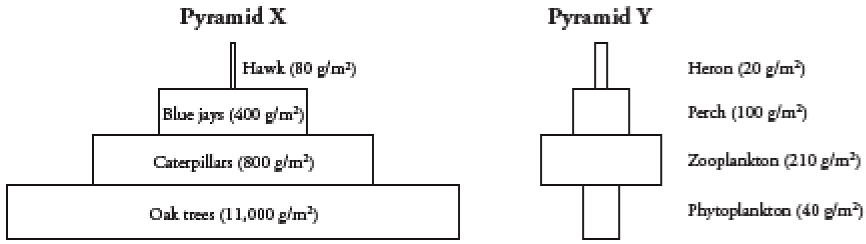
15. Compare and contrast the two pyramids in Model 2. List at least two similarities and two differences.

16. How does the number of organisms change as you move up the levels in Pyramid A compared to Pyramid B?

17. Are the "producers" levels in the two pyramids in Model 2 referring to the same organisms or different organisms? Explain.

18. Which of the two pyramids in Model 2 gives a more accurate account of what occurs in this ecosystem? Use complete sentences to explain your reasoning.

Model 3 – Pyramid of Biomass



19. Biomass is measured as grams of dry mass within an area. What is the mass of the oak trees in Pyramid X of Model 3?

20. What is the mass of the phytoplankton in Pyramid Y of Model 3?

21. Refer to Model 3.

    a. Identify the trend in biomass as you move up the trophic levels in Pyramid X.

    b. Is the trend in biomass in Pyramid X the same as seen in Pyramid Y? Explain your answer.

Read This!

Phytoplankton are microscopic aquatic organisms that are quickly consumed by microscopic animals (zooplankton). Because they are eaten so quickly there is a need for the phytoplankton to reproduce rapidly for survival.

22. Explain why the Pyramid Y ecosystem can exist with a smaller biomass at the producer level.

23. Use examples from the previous models to explain the advantage of using a pyramid of energy or biomass rather than a pyramid of numbers to explain the relationship between different trophic levels.

Appendix Q

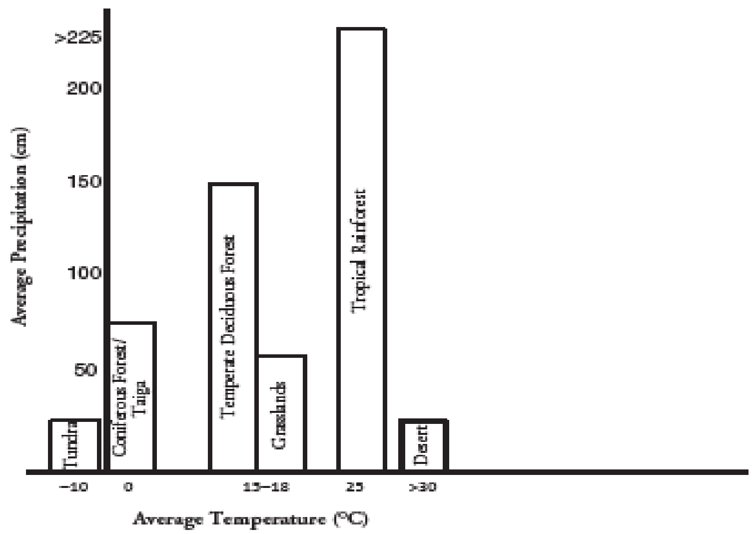
Biomes of North America

How do temperature and precipitation affect the distribution of plants and animals?

Why?

Have you ever wondered why no polar bears are in California, or cacti in Alaska? The amount of precipitation and the temperature varies tremendously across North America, resulting in well-defined community boundaries or **biomes** that are suitable for some populations but not for others.

Model 1 – Biomes of North America
Average Precipitation and Temperature



1. According to Model 1, which two biomes have the same amount of rainfall?

2. Which biome in Model 1 has the most rainfall?

3. Which biome has the highest average temperature?

4. Which two biomes have nearly the same average temperature?

5. Refer to Model 1.
   a. Name the three different types of forests shown in Model 1.

   b. What is another name for the coniferous forest?

6. Refer to Model 1.
   a. What characteristic differentiates the tundra and the desert?

   b. Why might the tundra also be known as the "frozen desert"?

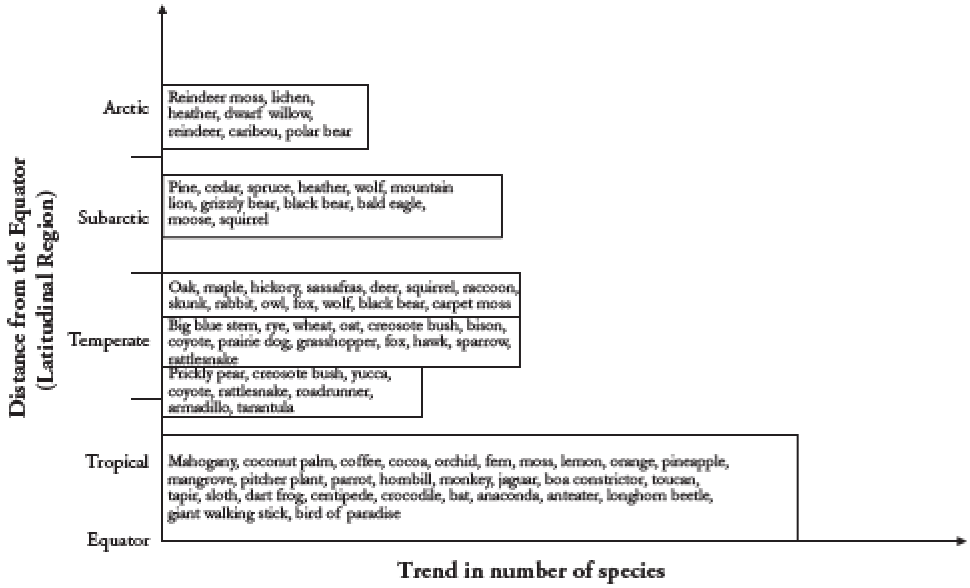
7. Consider the biomes in Model 1 with moderate temperatures.
   a. What characteristic differentiates the grasslands and temperate deciduous forests?

   b. What would be the most likely reason for the grasslands having grasses rather than trees as their dominant plant species?

8. Describe the relationship between temperature, rainfall, and the type of forest.

STOP

Model 2 – Plant and Animal Species in North American Biomes



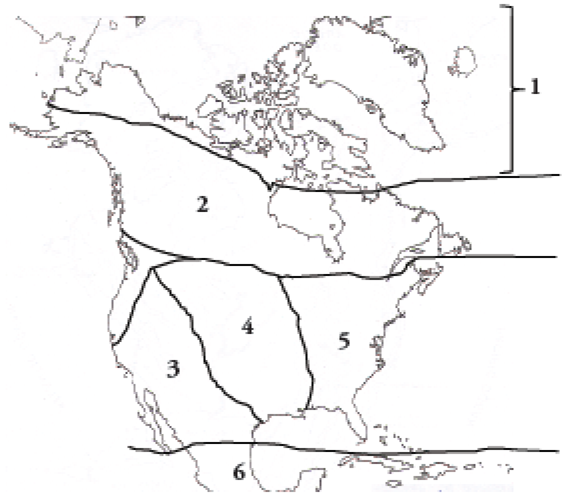
9. The six bars in Model 2 represent the six North American biomes introduced in Model 1, and include a list of some plants and animals typically found in each biome.

   a. What information is represented by the x-axis in Model 2?

   b. What information is represented by the y-axis in Model 2?

   c. How might the y-axis information in Model 2 be related to one of the data axes in Model 1?

10. Identify each of the six biomes found in North America on the map below. Average rainfall data is given to help you choose between biomes in the same latitudinal region.



Zone	Rainfall (cm)
1	25
2	75
3	25
4	60
5	150
6	>225

1. 3. 5.

2. 4. 6.

11. Use information from Model 1 and the map in Question 10 to label the six biomes in the chart in Model 2.

12. Refer to Model 2.

a. Which latitudinal region contains the fewest number of species?

b. List the biome(s) found in this latitudinal region.

c. Which latitudinal region contains the largest number of species?

d. List the biome(s) found in this latitudinal region.

13. **Biodiversity** is a term used to describe the variety of plant and animal species in a given biome. An ecosystem or biome that supports a large variety of species is very biodiverse.

    a. What biome in North America has the highest biodiversity?

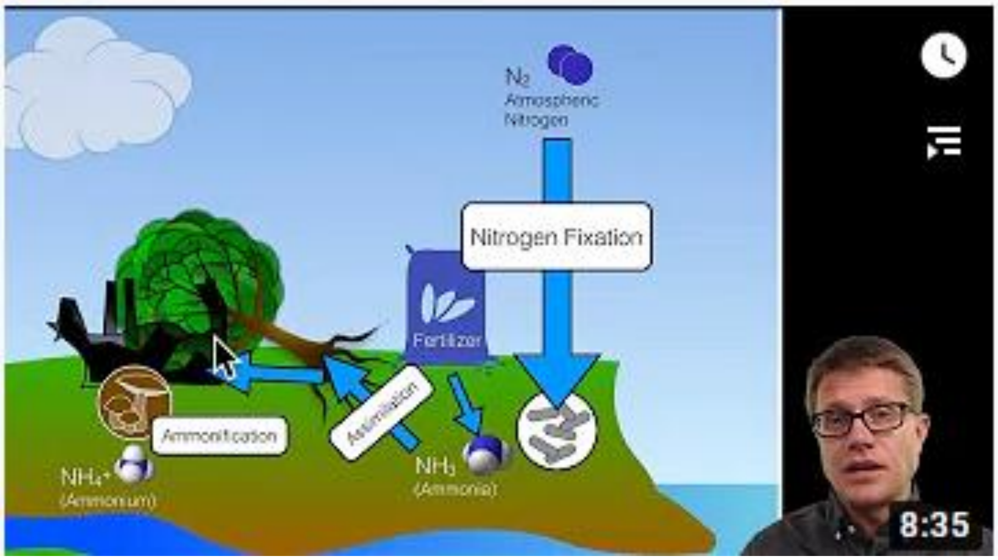
    b. What characteristics of this biome enable it to support such a high level of biodiversity?

    c. What biome in North America has the lowest biodiversity?

    d. What characteristics of this biome make it difficult for a high level of biodiversity to develop?

14. What is the general trend of the biodiversity in biomes as the latitude moves from the arctic region towards the equator?

Appendix R



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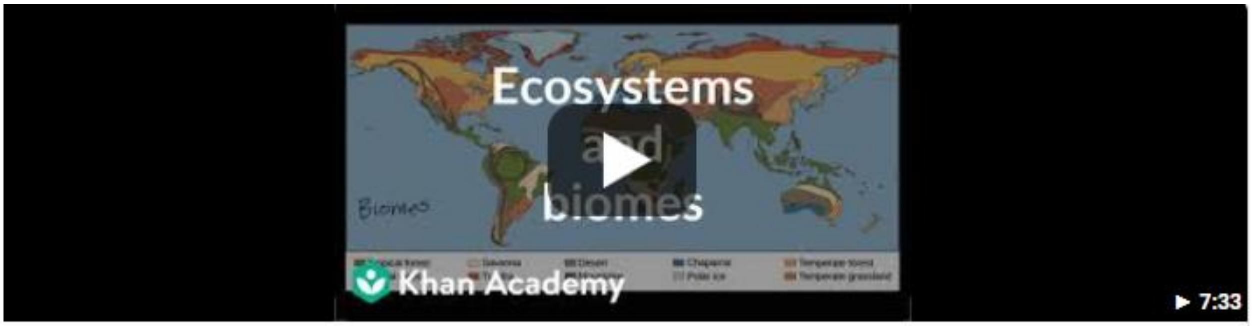
Appendix S



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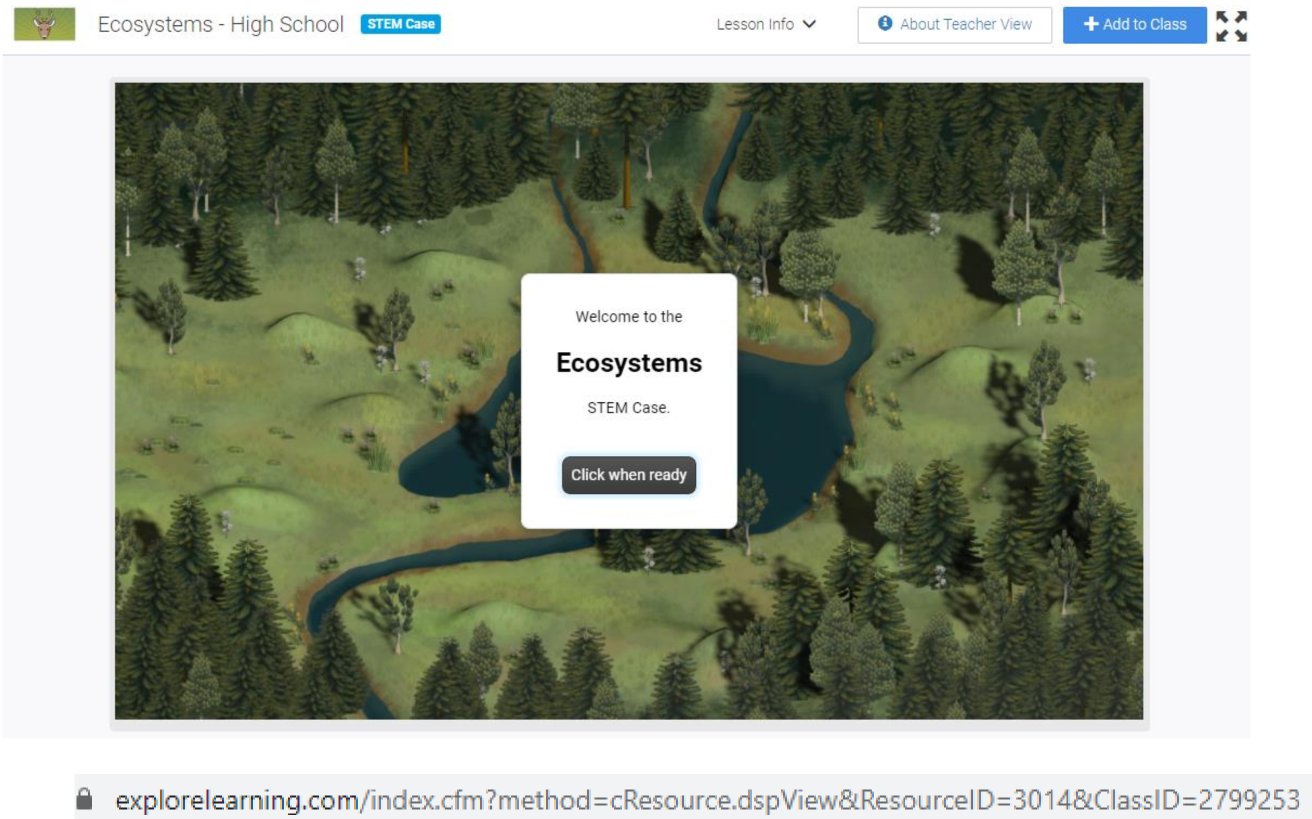
Appendix T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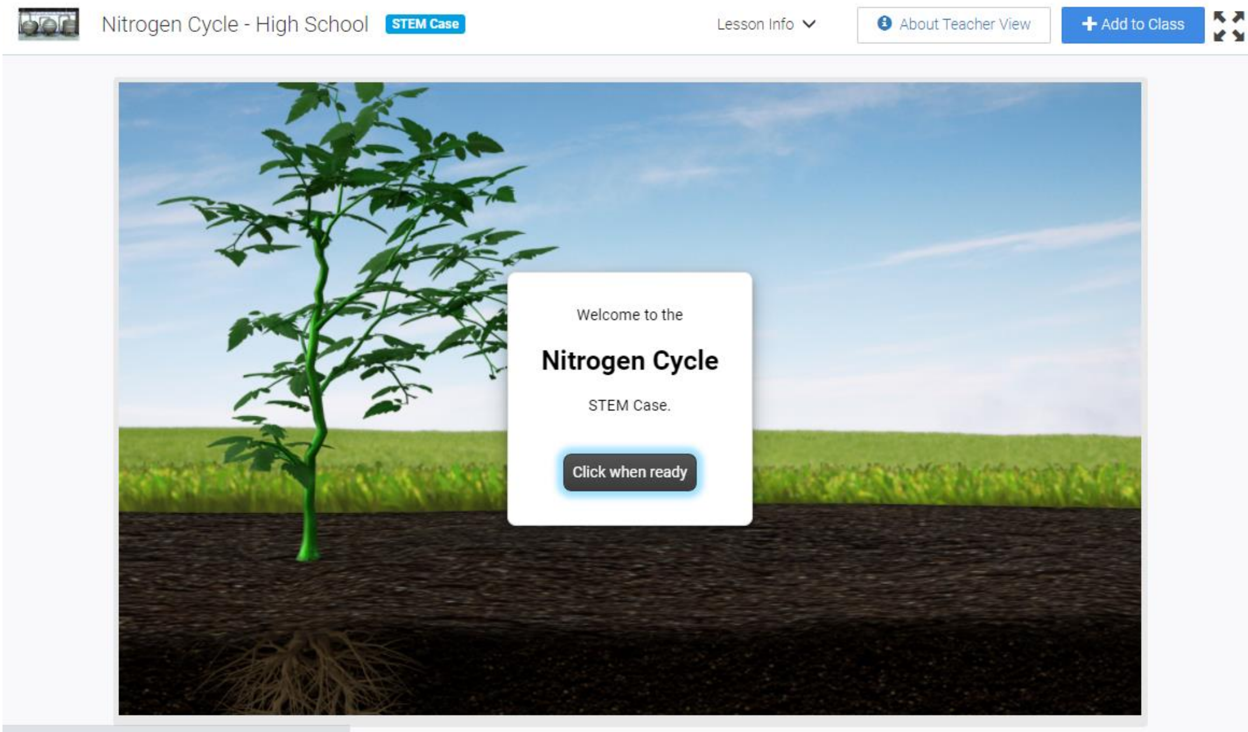
Appendix U



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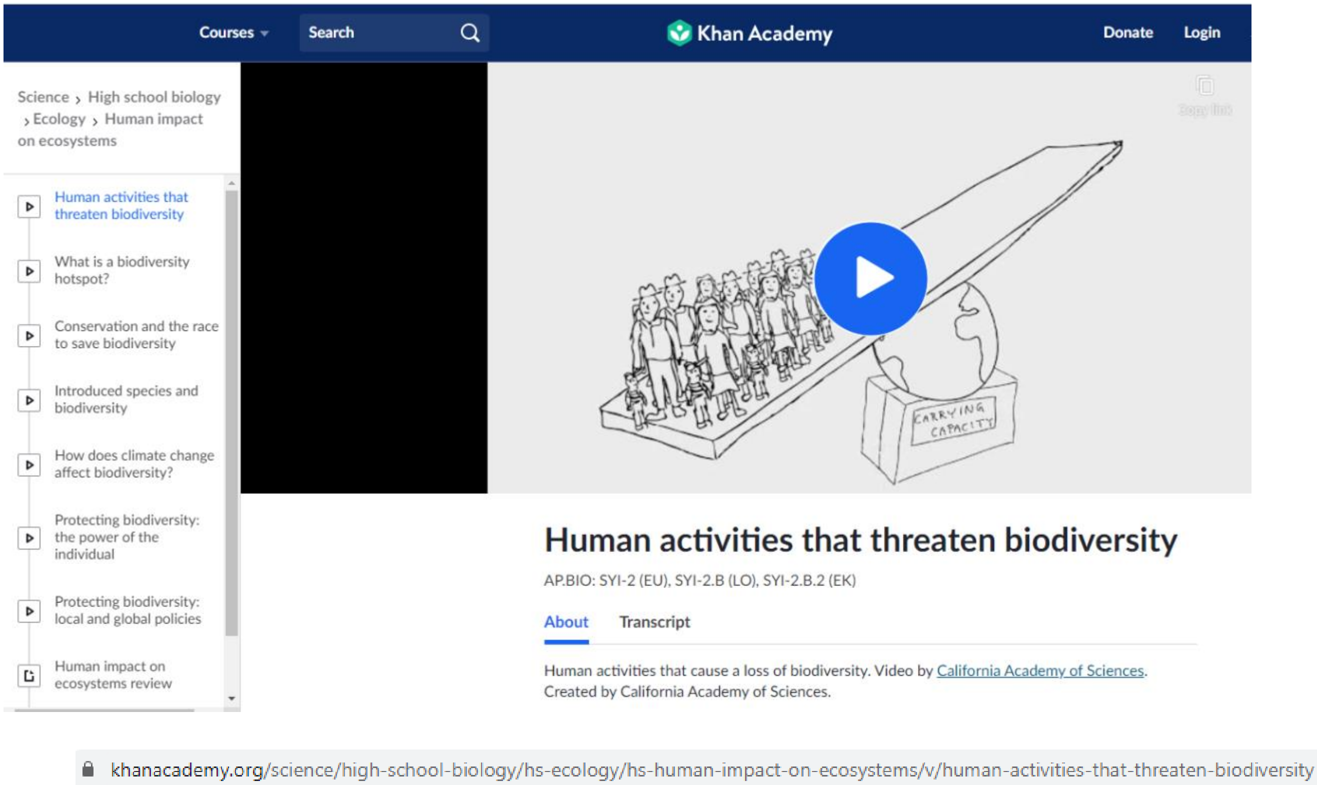
Appendix V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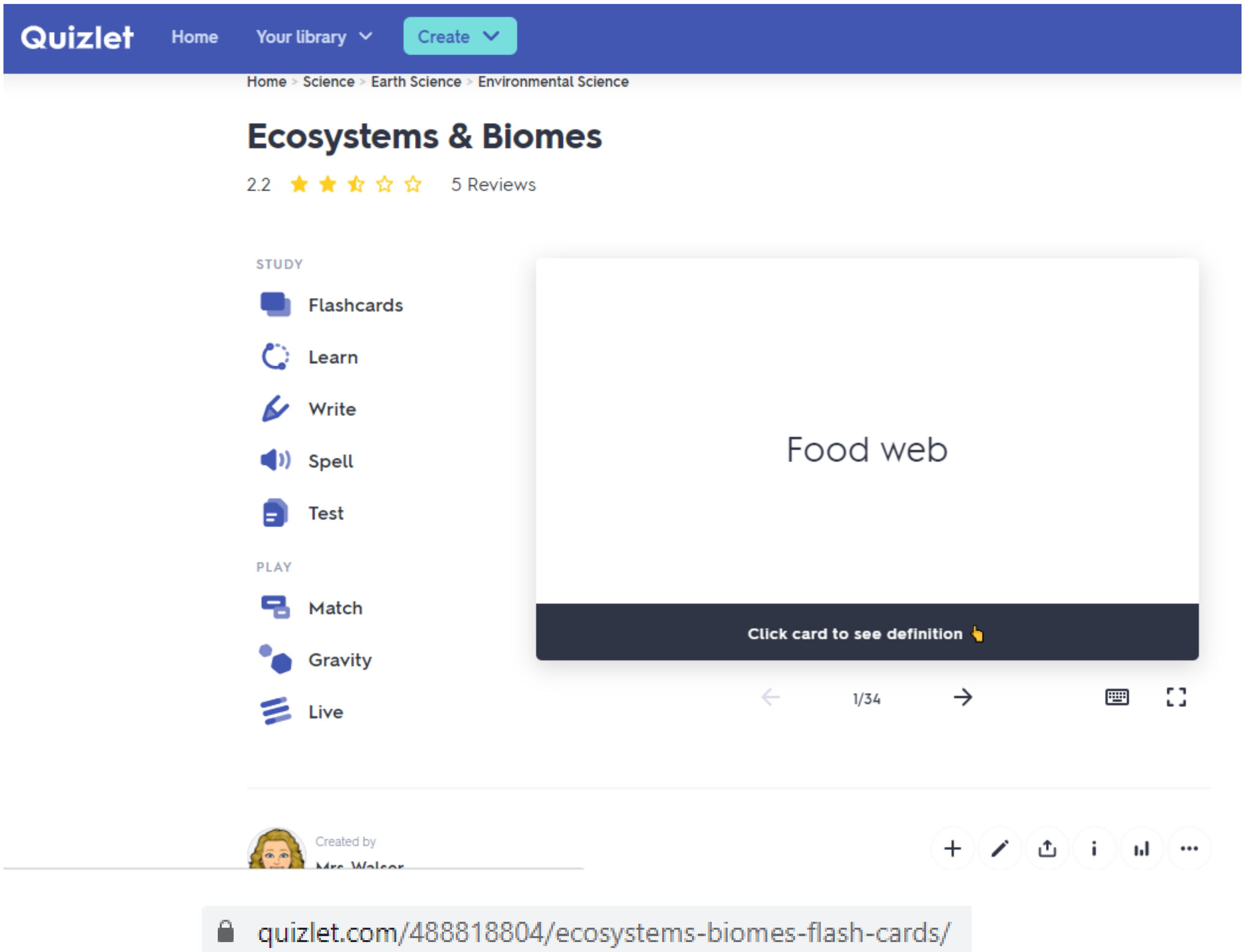
Appendix W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Appendix X

Ecosystems and Biomes Exam

Biology I

Name: ___________________________________

Date: ____________________________________

Class: ___________________________________

True or False: Write T (true) or F (false) legibly AND correct false statements to make them true.

1. _____ Heterotrophs that eat both plants and animals are referred to as carnivores.
2. _____ A food web links together all the food chains in an ecosystem.
3. _____ Ecology is the scientific study of interactions among organisms and between organisms and their environment.
4. _____ Autotrophs are also called consumers, while heterotrophs are called producers.
5. _____ Organisms that break down organic matter are called herbivores.
6. _____ Trees that produce seed-bearing cones and have leaves shaped like needles are called coniferous.
7. _____ The food an organism eats, how it obtains food, and what eats that organism are all part of its habitat.

Multiple Choice: Choose the one answer that best fits each question.

8. _____ A snake eats a frog that has eaten an insect that fed on a plant. The snake is a

   a. primary producer
   b. primary consumer
   c. secondary producer
   d. tertiary consumer

9. _____ Only 10% of the energy stored in an organism can be passed onto the next trophic level. Of the remaining energy, some is used for the organism's life processes, and the rest is

   a. Used in reproduction
   b. Stored as body tissue
   c. Stored as fat
   d. Eliminated as heat

10. _____ What is the process by which bacteria convert nitrogen gas in the air into ammonia?

   a. Nitrogen fixation
   b. Excretion
   c. Decomposition
   d. Denitrification

11. _____ The movements of energy and nutrients through living systems are different because

   a. Energy flows in one direction and nutrients recycle.
   b. Energy is limited in the biosphere and nutrients are always available.
   c. Nutrients flow in one direction and energy recycles.
   d. Energy forms chemical compounds and nutrients are lost as heat.

12. _____ Earth has three main climate zones because of differences in latitude and

   a. Amount of solar energy received
   b. Angle of heating
   c. Ocean currents
   d. Prevailing winds

13. _____ The unequal heating of Earth's surface

   a. Drives winds and ocean currents
   b. Causes winds that transport heat throughout the biosphere
   c. Has important effects on Earth's climate regions.
   d. Only a & b
   e. a, b, & c

14. _____ Which is a biotic factor that affects the size of a population in a specific ecosystem?

   a. Average temperature
   b. Type of soil
   c. Number and kind of predators
   d. Concentration on oxygen and carbon doxide

15. _____ Several species of warblers can live in the same spruce tree ONLY because they

   a. Have different habitats in the tree
   b. Eat different foods in the tree
   c. Occupy different niches in the tree
   d. Can find different microclimates in the tree

16. _____ Different species can share the same habitat, but competition among them is reduced if they

   a. Reproduce at different times
   b. Eat less
   c. Increase their populations
   d. Occupy different niches

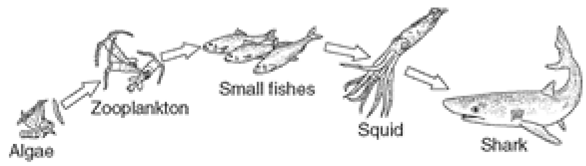
17. _____ Which two biomes have the least amount of precipitation?

   a. Tropical rain forest & grassland
   b. Tropical savannah & tropical dry forest
   c. Tundra & desert
   d. Boreal forest & temperate woodland

18. _____ Which biome is characterized by very low temperatures, little precipitation, and permafrost?

   a. Desert
   b. Tundra
   c. Temperate forest
   d. Temperate grassland

Completion: **Answer the questions that follow about the pictures or diagrams below.**



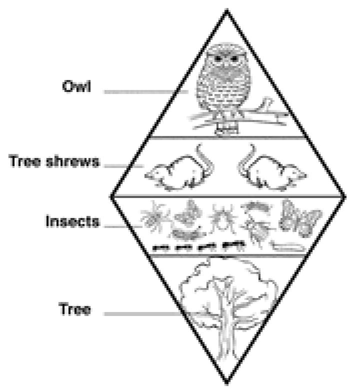
19. **Label the diagram** with the type of consumer/producer that each organism represents (trophic levels).

20. Name the producer(s) in the food chain: ______________________________

21. Name the consumer(s) in the food chain: ______________________________

22. Name the herbivore(s) in the food chain: ______________________________

23. Name the carnivore(s) in the food chain: ______________________________



24. Describe the **flow** of energy to the owl if the tree has *10,000 calories of energy*. Fill in each blank with the amount of energy (in calories) that is theoretically available at the given level if 90% of the energy consumed is either released as waste or heat, or used in cellular processes:

a. Insects' energy = ________

b. Shrews' energy = ________

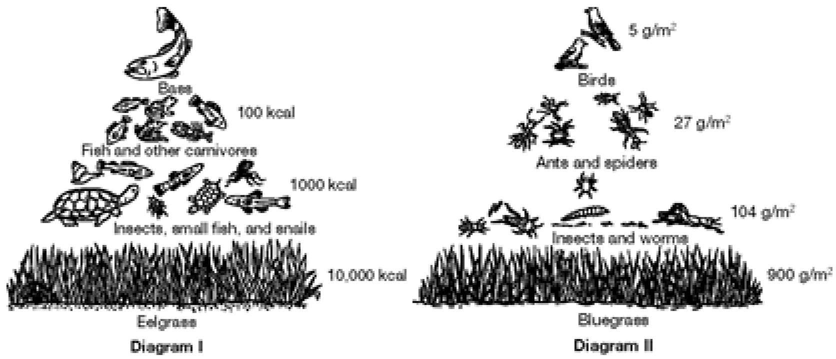
c. Owl's energy = ________

25. What makes this ecological pyramid different from what you would expect to see? ______________________

26. How could this pyramid have been drawn to show the base being the largest level? ____________

____

Ecological Pyramids: Use the diagrams below to answer the questions that follow.



27. **Label the diagram** with the type of consumer/producer that each organism represents (trophic levels).

28. Why does the amount of energy and mass decrease as you move up the pyramid? ____________________

____

____

29. If a limiting nutrient is supplied to the producers in Diagram II, what effect could it have on the birds?

____

____

30. How many kilocalories (kcal) can the top carnivore in Diagram I store? Explain. ____________________

____

____

31. Describe how chemosynthesis could contribute to the energy represented by Diagram I. _______________

____

____

Biomes: Use the table below to answer the questions that follow.

Average Rainfall and Temperature of Earth's Biomes

Biome	Average Yearly Rainfall	Average Temperature	Climate Zone
Tropical rain forest	400 cm	Daytime: 34°C Nighttime: 20°C	Tropical
Tropical dry forest	250–300 cm	Dry season: 32°C Wet season: 20°C	Tropical
Temperate forest	75–125 cm	Summer: 28°C Winter: 6°C	Mostly temperate
Taiga	35–75 cm	Summer: 14°C Winter: -10°C	Mostly temperate
Tropical savanna	150 cm	Dry season: 34°C Wet season: 16°C	Mostly tropical
Desert	Less than 25 cm	Summer: 38°C Winter: 7°C	Tropical and temperate
Temperate grassland	25–75 cm	Summer: 30°C Winter: 0°C	Temperate
Tropical woodland	Less than 50 cm	Summer: 20°C Winter: 10°C	Temperate
Tundra	30–50 cm	Summer: 12°C Winter: -26°C	Temperate and polar

32. Which climate zone includes the most biomes? ______________________________

33. Which biomes include areas with an average yearly rainfall of **less than** 75 cm? (Hint: NOT less than or equal to!)

____

34. Which biomes include areas that have an average yearly rainfall of more than 200 cm? ______________

____

35. Which two biomes shown have seasons determined by the amount of precipitation they receive at different times of the year? ______________________________

36. What is the highest average temperature shown? The lowest average temperature? How many degrees of temperature are there between the highest and the lowest temperatures? ______________

____

____

Matching: **Write the correct letter on the line next to its definition. Each choice may only be used once.**

37. _____ Group of organisms that breed to produce fertile offspring.
38. _____ All organisms and their environment in a particular place.
39. _____ Capture energy in order to produce their own food.
40. _____ Interactions among organisms and with their environment.
41. _____ Individuals of the same species living in the same area.
42. _____ Using light energy to power chemical reactions that convert CO_2 and water into O_2 and carbohydrates.
43. _____ Consumers that break down organic matter, like bacteria.
44. _____ A depiction of the complex feeding interactions in an ecosystem linking all food chains.
45. _____ Area that contains the combined portions of the planet in which all life exists: land, water, and air.
46. _____ Different populations that live together in a defined area.
47. _____ Organisms that rely on other organisms for their energy and food supply.
48. _____ Using chemical energy to produce carbohydrates.
49. _____ A series of steps where energy is transferred by eating
50. _____ A step in a food chain or web; a "feeding level."
51. _____ Total amount of living tissue within a trophic level
52. _____ Show relative amounts of energy/matter in each trophic level.
53. _____ A group of ecosystems that cover large areas and have similar soil, climate and ecological communities.
54. _____ Physical, nonliving factors that shape an ecosystem.
55. _____ A tree that sheds its leaves during a particular season yearly.
56. _____ Area where an organism lives, with biotic and abiotic factors.
57. _____ Range of physical/ biological conditions where an organism lives and the way it uses those conditions; occupation.
58. _____ Biological influences on organisms within an ecosystem.
59. _____ Any necessity of life such as light, water, or shelter.
60. _____ Trees that produce seed-bearing cones.

A. Autotroph
B. Biomass
C. Biome
D. Biosphere
E. Chemosynthesis
F. Community
G. Decomposer
H. Ecological Pyramid
I. Ecology
J. Ecosystem
K. Food Chain
L. Food Web
M. Heterotroph
N. Photosynthesis
O. Population
P. Species
Q. Trophic Level
R. Biotic factors
S. Abiotic factors
T. Habitat
U. Niche
V. Resource
W. Deciduous
X. Coniferous

__Essay:__ **Answer the following question to the best of your ability. Use full sentences and answer all parts of the question.**

61. Describe the flow of energy and matter among the following members of an ecosystem: decomposers, autotrophs, heterotrophs, and the sun. Be sure to explain the *amount* of energy and matter that are transferred and what happens to the energy and matter that are *not* transferred.

Appendix Y

Week	Intervention	Instruments/Data Collected	Notes
1	Present the introduction for the Population & Community Ecology Unit using the Khan Academy Introduction to Ecology and Population Size activity	Two EdPuzzle Videos: Populations & Exponential Growth Two guided inquiry activities: Population Distribution, Population Growth	School in remote learning
2	Present the introduction for the next unit using the Khan Academy Population Growth and Interactions activity	Two EdPuzzle Videos: Logistic Growth & r/K Selection Lab simulation: Gizmo: Rabbit Population	Return to in-person learning; Shortened week due to holiday weekend
3	Review Population & Community Ecology using Quizlet Review	Summative assessment: Population & Community Ecology Exam	No issues
4	Present the introduction for the Ecosystem & Biome Ecology Unit using the Khan Academy Trophic Levels and Biogeochemical Cycles activities	Two EdPuzzle Videos: Ecosystem Ecology & Energy Flow in Ecosystems Two guided inquiry activities: Energy Transfer in Living Organisms & Ecological Pyramids	Teacher Quarantined (teaching remotely)

5	Lead group work on a guided inquiry activity (Biomes of North America)	Two EdPuzzle Videos: Biogeochemical Cycles & Ecosystems and Biomes Two guided inquiry activities: Gizmo STEM Case: Ecosystems & Gizmo STEM Case: Nitrogen Cycle	Teacher Quarantined (teaching remotely)
6	Review Ecosystems & Biomes using Quizlet Review	Summative assessment: Ecosystem & Biome Ecology Exam	No issues

Appendix Z

17:30

Alyssa Walser
Sham'ah Md-Yunus
Curriculum and Instruction

Thank you for submitting the action research protocol titled, "Impact of Homework Completion Differences Between Genders on Biology Summative Assessment Scores" for review by the Eastern Illinois University Institutional Review Board (IRB). The protocol was reviewed on and has been certified that it meets the federal regulations exemption criteria for human subjects research. The protocol has been given the IRB number 21-005. You are approved to proceed with your project.

The classification of this protocol as exempt is valid only for the research activities and subjects described in the above named protocol. IRB policy requires that any proposed changes to this protocol must be reported to, and approved by, the IRB before being implemented. You are also required to inform the IRB immediately of any problems encountered that could adversely affect the health or welfare of the subjects in this study. Please contact me in the event of an emergency. All correspondence should be sent to:

Institutional Review Board
c/o Office of Research and Sponsored Programs
Telephone: 217-581-8576
Fax: 217-581-7181
Email: eiuirb@eiu.edu

Thank you for your cooperation, and the best of success with your research.

Jesse Funk
Compliance Coordinator
Office of Research and Sponsored Programs
Telephone: 581-8576
Email: eiuirb@eiu.edu